



Technical Publications

Vivid™ *iq*

Version 206.x.x



User Manual

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Rev. 10

Operating Documentation

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Regulatory requirement

This product complies with regulatory requirements of the following European Regulation 2017/745 concerning medical devices.



First CE marked in 2022.

This manual is a reference for the Vivid *iq* ultrasound systems, hereafter referred to as Vivid *iq*. It applies to all revisions of the 206.x.x software for the Vivid *iq* ultrasound system.



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Revision History

Reason for change

REV	DATE (YYYY-MM-DD)	REASON FOR CHANGE
Rev. 1	2021-10-25	Initial Release
Rev. 2	2021-11-09	Add CE mark statement
Rev. 3	2021-11-24	Update measurement accuracy
Rev. 4	2022-03-31	Add MR unsafe mark Update Probe Application Form and Probe Preset Indications for Use form Update footprint for L4-20t-RS Update probe support note Add CH-REP label Update dimensions in System Data Update Brazilian Importer address Update Conformance Standards Update to implement 510K changes Add DICOM Viewer
Rev. 5	2022-06-28	1. Update 510K comments: (1) Add contrast Low MI imaging information; (2) Add using contrast Low MI section; (3) Add Note on page 5-49; 2. Update Pre-Post Compare information and update the figure in using pre-post section: 3. Probe check: (1) Update the Introduction section; (2) Update Auto Trigger interval configuration section; 4. Measurement Uncertainties section in Measurement Accuracy: (1) Update information in 2D AutoEF when Adult TTE raw data with ECG(see 'accuracy w/o editing' for Easy Auto EF); (2) Update information in AFI/Triplane AFI when Adult TTE Raw data (see 'accuracy w/o editing' for Easy AFI LV); 5. Add Ukrainian Representative information 6. Update preset for L4-20t and 9L probe
Rev. 6	2023-05-12	1.Update measurement accuracy for AI-Auto Measure - 2D 2.Update AR address for Kazakh 3.Update 'advanced contrast' to 'Vascular/ AbdominalContrast' 4. Update IPX information 5. Update e-Delivery contents 6.Update UI graphics Fig. 4-4 and Fig.3-19 7.Update Table 14-16 'Peripherals and Accessories' 8.Update cleaning and disinfecting information 9.Update Brazil Importer Address

REV	DATE (YYYY-MM-DD)	REASON FOR CHANGE
Rev. 7	2023-07-17	Update contents about system cart Add A8000
Rev. 8	2024-03-29	Update Authorized Representative in Ukraine Remove probe chemical agent lists and update probe care card section
Rev. 9	2024-10-29	1. Add complaint inbox email address information 2. Add System malfunction section 3. Update battery information content 4. Add Standard cart/Premium cart Specifications 5. Add Transcend DVD Writer kit
Rev. 10	2025-05-29	1. Update Digital streaming information 2. Update graphic 4-21 for ECG

List of Effective Pages

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Revision History	Rev. 10	Chapter 9	Rev. 10
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Please verify that you are using the latest revision of this document. Information pertaining to this document is maintained on ePDM (GE electronic Product Data Management). If you need to know the latest revision, contact your distributor, local GE Sales Representative or in the USA call the GE Ultrasound Clinical Answer Center at 1 800 682 5327 or 1 262 524 5698.

Regulatory Requirements

Conformance Standards

- According to IEC/EN 60601-1,
 - Equipment is Class I, Type BF or CF Applied Part for probes, Type CF Applied Part for ECG.
 - Continuous Operation
- According to CISPR 11,
 - Equipment is Group 1, Class A ISM Equipment.
- According to IEC 60529,
 - The footswitch rate IPx8 is suitable for use in surgical rooms.
 - Probe head (immersible portion) and cable are IPX7.

ICE catheters are IPX 8.

Probe connector is not waterproof.

System is Ordinary Equipment (IPX0).

This product complies with emissions limits for a Group 1, Class A Medical Devices as stated in EN 60601-1-2.

This product complies with the regulatory requirement of the following:

- The Vivid *iq* is an Active Diagnostic Medical Product belonging to Class IIa according to the MDR-REGULATION (EU) 2017/745 for use on human patients.
- Regulation (EU) 2017/745 concerning medical devices: the CE label affixed to the product testifies compliance to the Regulation.

The location of the CE marking is shown in the Safety chapter of this manual.

Conformance Standards (continued)



Authorized EU Representative

GE Medical Systems SCS

283 rue de la Minière 78530 BUC, France



Authorized Switzerland Representative

GE Medical Systems (Schweiz) AG

Europa-Strasse 31, 8152 Glattbrugg, Switzerland

Conformance Standards (continued)

- International Electrotechnical Commission (IEC).
 - IEC/EN 60601-1 Medical Electrical Equipment – Part 1: General Requirements for Basic Safety and Essential Performance.
 - IEC/EN 60601-1-2 Medical electrical equipment – Part 1-2: General requirements for basic safety and essential performance–Collateral standard: Electromagnetic disturbances–Requirements and tests.
 - IEC/EN60601-1-6 Medical electrical equipment - Part 1-6 General requirements for safety - Collateral Standard: Usability.
 - IEC/EN60601-2-37 Medical electrical equipment Part 2-37: Particular requirements for the safety of ultrasonic medical diagnostic and monitoring equipment.
- International Organization of Standards (ISO)
 - ISO 10993-1 Biological evaluation of medical devices.
- ANSI/AAMI ES60601-1 Medical Electrical Equipment - Part 1 : General Requirements for Basic Safety and Essential Performance.
- Canadian Standards Association (CSA).
 - CAN/CSA- 22.2, NO. 60601-1 Medical Electrical Equipment - Part 1: General Requirements for Basic Safety and Essential Performance.
- CSA 22.2, NO. 601.1 Medical Electrical Equipment- Part 1: General Requirements for Basic Safety and Essential Performance.
- NEMA/NIUM Acoustic Output Display Standard (NEMA/NIUM UD3).
- Medical Device Good Manufacturing Practice Manual issued by the FDA (Food and Drug Administration, Department of Health, USA).

Certifications

- GE Medical Systems (China) Co., Ltd. is ISO 13485 Certified.

Original Documentation

The original document was written in English.

Country-Specific Approval

- Brazil
ANVISA N°: 80071260375

Importer Information

Table i-1: Importer

Turkey	<u>Türkiye İthalatçısı / Turkish Importer</u> GE Medical Systems Türkiye Ltd. Şti. Esentepe Mah. Harman Sok. No: 8 34394 Şişli İstanbul Türkiye
Brazil	INFORMAÇÕES DO DETENTOR DA NOTIFICAÇÃO NO BRASIL GE HEALTHCARE DO BRASIL COMÉRCIO E SERVIÇOS PARA EQUIPAMENTOS MEDICOS-HOSPITALARES LTDA. Av. Magalhães de Castro, 4800 – Andar 10 Conj. 101 e 102, Torre 3 - Cidade Jardim - CEP: 05676-120 - São Paulo/SP – Brasil CNPJ: 00.029.372/0001-40 TELEFONES: 3004 2525 (Capitais e Regiões Metropolitanas) 08000 165 799 (Demais Localidades)

Authorized Representative in Kazakhstan

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Russian	ОО «ДжиИ Хэлскеа Казахстан» Казахстан, город Алматы, Медеуский район, улица Зенкова, дом 26/41, почтовый индекс 050010 T +7 727 3560020

Authorized Representative in Ukraine

Ультразвукова діагностична система Vivid iq	
	Знак відповідності технічним регламентам
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Дата останнього перегляду посібника користувача є датою останньої редакції та вказана у посібнику користувача.	

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Chapter 1

Introduction

This chapter consists of information concerning indications for use/contraindications, contact information, and how this documentation is organized.

The Vivid iq ultrasound unit is a high performance digital ultrasound imaging system with total data management.

The system provides image generation in 4D, 2D (B) Mode, Color Doppler, Power Doppler (Angio), M-Mode, Color M-Mode, PW and CW Doppler spectral, Tissue Velocity imaging, advanced Strain and Contrast applications.

The fully digital architecture of the Vivid iq unit allows optimal usage of all scanning modes and probe types, throughout the full spectrum of operating frequencies.

Attention

This manual contains necessary and sufficient information to operate the ultrasound unit safely.

Read and understand all instructions in the User Manual before attempting to use the ultrasound unit.

Keep this manual with the equipment at all time. Periodically review the procedures for operation and safety precautions.

NOTE: *The Online Help offers a quick way for the user to access the manual. When there are differences between Online Help and User Manual, please refer to User Manual for the only right version.*

Disregarding information on safety is considered abnormal use.

Not all features, probes, peripherals or products described in this document may be available or cleared for sale in all markets. Please contact your local GE representative to get the latest information.

The system is CLASS A and GROUP 1 according to CISPR 11.

NOTE: *Please note that orders are based on the individually agreed upon specifications and may not contain all features listed in this manual.*

NOTE: *All references to standards / regulations and their revisions are valid at the time of publication of the user manual.*

Documentation



CAUTION

Safety instructions must be reviewed before operating the unit.

Vivid *iq* documentation consists of various manuals:

- The User Manual and Online Help (TRANSLATED) provides information needed by the user to operate the system safely. It describes the basic functions of the system, safety features, operating modes, measurements/calculations, probes, and user care and maintenance.
- The Advanced Reference Manual (ENGLISH ONLY) contains data tables, such as measurements and calculations, OB, and Acoustic Output.
- The Release Notes (TRANSLATED) identifies Notes and Workarounds for current Vivid *iq* system, providing information issues you may encounter while performing scans and offers workarounds for these issues. It also contains some updates to the User Manual.
- The Privacy and Security Manual (TRANSLATED) describes privacy and security considerations, privacy and security capabilities, and how they are configured and used appropriately.
- The Service Manual (ENGLISH ONLY) supplies block diagrams, lists of spare parts, descriptions, adjustment instructions, or similar information which helps qualified technical personnel in repairing those parts of the system which have been defined as repairable.
- Medical Ultrasound Safety publication from American Institute of Ultrasound in Medicine (AIUM) (ENGLISH ONLY). Provided as ALARA Educational Program, to comply with US FDA Track 3 - Not available in all countries.

Documentation (continued)

NOTE: *The eDocumentation kit provides instructions on how to read the user documentation via electronic media. All user manuals are provided in electronic format. The eDocumentation media includes English and all other translations.*

The Vivid iq manuals are written for users who are familiar with basic ultrasound principles and techniques. They do not include sonographic training or detailed clinical procedures.

NOTE: *The screen graphics in this manual are only for illustrational purposes. Actual screen output may differ.*

NOTE: *Probe information displayed on screen examples does not necessarily reflect the probes available on your ultrasound system. Please refer to the Probes chapter for a listing of available probes and features.*

Users can download latest version of manuals at below link:
<http://www.gehealthcare.com/DocumentationLibrary>

NOTE: *Users can also scan the QR code label near the on/off button to get the Vivid iq quick card and have a quick overview of the operation.*



Principles of operation

Medical ultrasound images are created by computer and digital memory from the transmission and reception of mechanical high-frequency waves applied through a probe. The mechanical ultrasound waves spread through the body, producing an echo where density changes occur. For example, in the case of human tissue, an echo is created where a signal passes from an adipose tissue (fat) region to a muscular tissue region. The echoes return to the probe where they are converted back into electrical signals.

These echo signals are highly amplified and processed by several analog and digital circuits that use filters with many frequency and time response options to transform the high-frequency electrical signals into a series of digital image signals which are stored in memory. Once in memory, the image can be displayed in real-time on the image monitor.

A probe is an accurate, solid-state device, providing multiple image formats. The digital design and use of solid-state components provides highly stable and consistent imaging performance with minimal required maintenance.

Intended use

The Vivid *iq* is a high-performance compact ultrasound system designed for cardiovascular and shared services applications.

Indications for use

The Vivid *iq* is high-performance compact diagnostic ultrasound system designed for Cardiovascular and Shared Services. It is intended for use by qualified and trained Healthcare professionals for Ultrasound imaging, measurement, display and analysis of the human body and fluid.

Vivid *iq* clinical applications include: Fetal/Obstetrics, Abdominal (includes GYN), Pediatric, Small Organ (includes breast, testes, thyroid), Neonatal Cephalic, Adult Cephalic, Cardiac (includes Adult and Pediatric), Peripheral Vascular, Musculoskeletal Conventional, Musculoskeletal Superficial, Urology (Including prostate), Transcranial, Transrectal, Transvaginal, Transesophageal, Interventional Guidance (including Biopsy), Thoracic/Pleural, Intraoperative(Vascular), Intracardiac and Intraluminal. Modes of operation include: B, M, PW Doppler, CW Doppler, Color Doppler, Color M, Power Doppler, Harmonic Imaging, Real-Time (RT) 3D Mode (4D), Coded Pulse and Combined modes: B/M, B/Color M, B/PWD, B/CWD, B/Color/PWD, B/Color/CWD, B/Power/PWD. The device is intended for use in an indoor hospital environment including echo lab, other hospital settings, operating room, Cath lab and EP lab, in private medical offices, and in limited settings outside of professional Healthcare facilities.

Frequency of use

Daily (Typically 8 hours)

Types of use

Multiple patient multiple use

Operator profile

- Qualified and trained physicians or sonographers with at least basic ultrasound knowledge.
- The operator must have read and understood the user manual.

NOTE: *Only qualified physicians or sonographers should perform ultrasound scanning on human subjects for medical diagnostic reasons. Request training, if needed.*

Clinical Applications

Specific intended applications and exam types include:

- Fetal/Obstetrics
- Abdominal
- Pediatric
- Small Organ
- Neonatal Cephalic
- Adult Cephalic
- Cardiac
- Peripheral Vascular
- Musculoskeletal Conventional
- Musculoskeletal Superficial
- Urology
- Transcranial
- Transrectal
- Transvaginal
- Transesophageal
- Interventional Guidance
- Thoracic/Pleural
- Intraoperative
- Intracardiac and Intraluminal

Contraindications

The Vivid *iq* ultrasound unit is not intended for ophthalmic use or any use causing the acoustic beam to pass through the eye.



CAUTION

Vivid *iq* should be used in compliance with law. Some jurisdictions restrict certain uses, such as gender determination.

Patient population (system and probes)

- Age: all ages (including embryos and fetuses)
- Location: worldwide
- Sex: male and female
- Weight: all weight categories, see note below
- Height: no limitations

NOTE: Extreme obesity may affect operation of the device.

Clinical Benefit (system and probes)

The clinical benefit of a diagnostic ultrasound device is to help healthcare professionals provide an accurate diagnostic information (visualize human tissue/internal structure) that enhances the diagnostic and treatment care pathways of the patient for a variety of diseases and conditions.

Prescription device



CAUTION: Federal law restricts this device to sale by or on the order of a physician.

Reporting of serious incidents

Any serious incident related to the use of this GE HealthCare device should be reported to both the Manufacturer and the health authority/competent authority where the device is installed.

To report to GE HealthCare:

Either contact your local service representative or report to:
in-box.complaints@gehealthcare.com.

Please provide the following information:

- The catalogue number or the model designation of the device as stated on its identification plate affixed on the device;
- The SystemID/serial number/lot number of the device;
- Date of incident;
- Description of incident, including any patient or user impact/injury;
- Your contact information(facility, address, contact name, title, and telephone number).

Safety

All information in Chapter 'Safety' on *page 2-1*, should be read and understood before operating the ultrasound unit.

CE mark statement

Product model with software version	Complies with European Medical Device Directive / Regulation	CE Mark and Notify Body No.
Vivid <i>iq</i> (software version v206)	European Medical Device Regulation 2017/745	CE0197
Vivid <i>iq</i> (software version v204)	Medical Device Directive 93/42/EEC	CE0197
Vivid <i>iq</i> v204 to v206 UPG	European Medical Device Regulation 2017/745	CE0197
Vivid <i>iq</i> v204 to v206 UPG SW only	European Medical Device Regulation 2017/745	CE0197

Contact Information

Contacting GE Ultrasound

For additional information or assistance, please contact your local distributor or the appropriate support resource listed on the following pages:

INTERNET

<http://www.gehealthcare.com>

http://www3.gehealthcare.com/en/Products/Categories/Ultrasound/Ultrasound_Probes

Clinical Questions

For information in the United States, Canada, Mexico, and parts of the Caribbean, call the Customer Answer Center.

TEL: (1) 800-682-5327 or (1) 262-524-5698

In other locations, contact your local Applications, Sales, or Service Representative.

Service Questions

For service in the United States, call GE CARES.

TEL: (1) 800-437-1171

In other locations, contact your local Service Representative.

Information Requests

To request technical product information in the United States, call GE.

TEL: (1) 800-643-6439

In other locations, contact your local Applications, Sales, or Service Representative.

Placing an Order

To order accessories, supplies, or service parts in the United States, call the GE Technologies Contact Center.

TEL: (1) 800-558-5102

In other locations, contact your local Applications, Sales, or Service Representative.

AMERICAS

ARGENTINA

GE Healthcare TEL: 11-5298-2400
Nicolas Vedia 3616, piso 5
Buenos Aires

BRAZIL

INFORMAÇÕES DO DETENTOR DA NOTIFICAÇÃO NO BRASIL

GE HEALTHCARE DO BRASIL COMÉRCIO E SERVIÇOS PARA
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Chapter 2

Safety

Describes the safety and regulatory information pertinent to operating this ultrasound system as well as procedures for simple care and maintenance of the unit.

‘Safety Precautions’ on page 2-2

‘Owner Responsibility’ on page 2-4

‘Acoustic Output’ on page 2-6

‘Important Safety Considerations’ on page 2-15

‘Device Labels’ on page 2-52.

Safety Precautions

Precaution Levels

Icon description

Various levels of safety precautions may be found on the equipment, and different levels of severity are identified by one of the following icons that precede precautionary statements in the text.



Indicates that a specific hazard is known to exist which through inappropriate conditions or actions will cause:

- Severe or fatal personal injury
- Substantial property damage



Indicates that a specific hazard is known to exist which through inappropriate conditions or actions may cause:

- Severe personal injury
- Substantial property damage



Indicates that a potential hazard may exist which through inappropriate conditions or actions will or can cause:

- Minor injury
- Property damage

Icon description (continued)

NOTE: Indicates precautions or recommendations that should be used in the operation of the ultrasound system, specifically:

- Maintaining an optimum system environment
- Using this Manual
- Notes to emphasize or clarify a point

Owner Responsibility

Introduction



CAUTION

For USA only:

CAUTION: Federal law restricts this device to sale by or on the order of a physician.

It is the responsibility of the owner to ensure that anyone operating the system reads and understands the safety information. However, there is no representation that the act of reading this manual renders the reader qualified to operate, inspect, test, align, calibrate, troubleshoot, repair, or modify the system. The owner should make certain that only properly trained, fully-qualified service personnel undertake the installation, maintenance, troubleshooting, calibration and repair of the equipment.

The owner of the ultrasound unit should ensure that only properly trained, fully qualified personnel are authorized to operate the system. Before authorizing anyone to operate the system, it should be verified that the person has read, and fully understands, the operating instructions contained in this manual. It is advisable to maintain a list of authorized operators.

Should the system fail to operate correctly, or the unit not respond to the commands described in this manual, the operator should contact GE Service.

For information about specific requirements and regulations applicable to the use of electronic medical equipment, consult local, state, and federal agencies.

Notice against user modification

Never modify this product, including system components, software, cables, etc. User modification may cause safety hazards and degradation in system performance. All modification must be done by a GE qualified person.

Regulatory information



CAUTION

Vivid *iq* systems are designed for compatibility with commercially available ICE catheters (AcuNav 8F, AcuNav 10F, SoundStar 3D 10F, SoundStar eco 10F and SoundStar eco 8F) and Carto systems.

Please verify clearance of these devices before using them with the Vivid *iq* systems.

Acoustic Output

Definition of the acoustic output parameters

Acoustic Output Display Specifications

The display consists of three parts: Thermal Index (TI), Mechanical Index (MI), and a relative Acoustic Output (AO) value. Although not part of the NEMA/AIUM standard, the AO value informs the user of where the system is operating within the range of available output.

The TI and MI are displayed at all times. The TI and MI display starts at a value of 0 and increments in steps of 0.2.

Always be aware of the acoustic output level by observing the Acoustic Output Display. In addition, become thoroughly familiar with the Acoustic Output Display and equipment controls affecting output.

Thermal Index

Depending on the examination and type of tissue involved, the TI parameter will be one of three types:

- **Soft Tissue Thermal Index (TIS)**. Used when imaging soft tissue only, it provides an estimate of potential temperature increase in soft tissue.
- **Bone Thermal Index (TIB)**. Used when bone is near the focus of the image as in the third trimester OB examination, it provides an estimate of potential temperature increase in the bone or adjacent soft tissue.
- **Cranial Bone Thermal Index (TIC)**. Used when bone is near the skin surface as in transcranial examination, it provides an estimate of potential temperature increase in the bone or adjacent soft tissue.

Mechanical Index

MI recognizes the importance of non-thermal processes, cavitation in particular, and the Index is an attempt to indicate the probability that they might occur within the tissue.

Changing the Thermal Index Type

You can select the displayed TI type by choosing **Thermal Index** in operation panel. This preset is application dependent so each application could specify a different TI type.

TI and MI Display Accuracy

When display $MI \geq 0.6$, $TI \geq 3.6$, the displayed values of MI and IT is not lower than 50% or higher than 150% of the measured value.

When display $MI < 0.6$, $TI < 3.6$, the absolute error of $MI \leq 0.3$, the absolute error of $TI \leq 1.8$.

Ispta

The Ispta is the Spatial Peak Temporal Average Intensity. The absolute maximum regulatory limit of Ispta is 720 mW/cm^2 as set by the FDA 510(k) guidance of September 9, 2008.

Acoustic output display on the Vivid iq

Located on the upper right section of the system display monitor, the acoustic output display provides the operator with real-time indication of acoustic levels being generated by the system, and the acoustic output level could be adjusted by user. (See Figure 2-1).



1. Title bar
2. MI
3. TI

Figure 2-1. The display of MI and TI on the screen

The Vivid *iq* chooses the correct category based on mode of operation and chosen application, and presents the relevant TI category to the operator. It is therefore important that the operator chooses the right application. The system also provides the ability to select the display of any of the TI categories regardless of the current application.

NOTE: *The Vivid iq does not monitor the duration of thermal exposure.*

References

- The British Medical Ultrasound Society. Guidelines for the safe use of diagnostic ultrasound equipment.
- American Institute of Ultrasound in Medicine Consensus Report on Potential Bioeffects of Diagnostic Ultrasound.

The maximum possible MI and Ispta on the Vivid *iq* is within the limits set in Track 3 in the FDA 510(k) guide of September 9, 2008, $MI < 1.9$ and $Ispta < 720 \text{ mW/cm}^2$.

ALARA



CAUTION

Ultrasound can produce harmful effects in tissue and potentially result in patient injury. Always minimize exposure time and keep ultrasound levels low when there is no medical benefit. Use the principle of ALARA (As Low As Reasonably Achievable), increasing output only when needed to obtain diagnostic image quality. Observe the acoustic output display and be familiar with all controls affecting the output level. See the *Bioeffects* section of the *Acoustic Output* chapter in the *Advanced Reference Manual* for more information.



CAUTION

The operator of the device must sufficiently understand the acoustic output and be able to obtain the related thermal index values. The probe with self-heating in the air cannot be used in transvaginal scanning. Always minimize exposure time to the irradiation and keep ultrasound acoustic output level low for embryos or fetuses.

Training

During each ultrasound examination the user is expected to weigh the medical benefit of the diagnostic information that would be obtained against the risk of potentially harmful effects. Once an optimal image is achieved, the need for increasing acoustic output or prolonging the exposure cannot be justified. It is recommended that all users receive proper training in applications before performing them in a clinical setting. Contact the GE sales representative for training assistance.

Safety statement

GE safety statement

Although no harmful biological effects have been demonstrated for ultrasound frequencies, intensities, or exposure times used in examination with the GE system, GE recommends using the lowest acoustic output settings which will produce diagnostically acceptable information.

System controls affecting acoustic output

The operator controls that directly affect the acoustic output are discussed in the Acoustic Output Data Tables in the Reference Manual. These tables show the highest possible acoustic intensity for a given mode, obtainable only when the maximum combination of control settings is selected. Most settings result in a much lower output. It is important to note the following:

- The duration of an ultrasound examination is as important as the acoustic output, since patient exposure to output is directly related to the exposure time.
- Better image quality yields faster clinical results, making it possible to complete the relevant ultrasound examination more rapidly. Therefore, any control that improves the quality of the examination can help to reduce patient exposure, even though it may not directly affect acoustic output.

Probe selection

As long as the appropriate application is available, any probe can be used with the knowledge that the intensities fall at, or below, those stated in the Acoustic Output Data Tables. The duration of patient exposure is most likely minimized with the use of a probe that is optimized to provide resolution and focal depth, appropriate to the examination.

Application selection

Selecting the probe and application preset appropriate to a particular ultrasound examination automatically provides acoustic output limits within FDA guidelines for that application. Other parameters which optimize performance for the selected application are also set automatically, and should assist in reducing the patient exposure time. See 'Activating the probe on *page 12-20* for information on selecting probes and application presets.

Changing imaging modes

Acoustic output depends on the imaging mode selected. The choice of mode (2D, M-Mode, Doppler or Color Flow) determines whether the ultrasound beam is stationary or in motion. This greatly affects the energy absorbed by the tissue.

See 'Scanning Modes' on *page 5-1*, for complete information on changing imaging modes.

When operating in a combined mode, such as 2D and M-Mode, the total acoustic output comprises contributions from each individual mode. Depending on the modes in use, either or both output indices may be affected.

The user can override the default settings, but care should be taken to observe the displayed MI and TI values.

Power

It is possible to change the power in all operating modes so that the operator can use the ALARA principle.

OB Exam

Exam Preparation

Prior to an ultrasound examination, the patient should be informed of the clinical indication, specific benefits, potential risks, and alternatives, if any. In addition, if the patient requests information about the exposure time and intensity, it should be provided. Patient access to educational materials regarding ultrasound is strongly encouraged to supplement the information communicated directly to the patient. Furthermore, these examinations should be conducted in a manner and take place in a setting which ensures patient dignity and privacy:

- Prior material knowledge and approval of the presence of nonessential personnel with the number of such personnel kept to a minimum.
- An intent to share with the parents per the physician's judgment, either during the examination or shortly hereafter, the information derived.
- An offer of choice about viewing the fetus.
- An offer of choice about learning the sex of the fetus, if such information becomes available.

Ultrasound examinations performed solely to satisfy the family's desire to know the fetal sex, to view the fetus, or to obtain a picture of the fetus should be discouraged.

Important Safety Considerations

Introduction

This section includes considerations for the following:

- Patient safety
- Personnel and equipment safety

The information contained in this section is intended to familiarize the user with the hazards associated with the use of the unit, and to alert them to the extent to which injury and damage may occur if the precautions are not observed.

Users are obligated to familiarize themselves with these safety considerations and to avoid conditions that could result in injury or damage.

Patient safety

Ensure that the hands of the patient are away from the system during the exam. The position of the operator and the patient vary by scan region. In most cases, the operator sits/stands straight in front of the operator console and the patient lies on the bed on the right (or left) side of the system.

Patient identification



WARNING

The concerns listed in this section can seriously affect the safety of the patient undergoing a diagnostic ultrasound examination.

Always include proper identification with all patient data and verify the accuracy of the patient's name and/or identity number when entering such data. Ensure that the correct patient ID is provided on all recorded data and hard copy prints. Identification errors could result in an incorrect diagnosis.

Diagnostic information

The images and calculations provided by the system are intended as a diagnostic tool for competent users. They are explicitly not to be regarded as the sole, irrefutable basis for clinical diagnosis. Users are encouraged to study the literature and reach their own professional conclusions regarding the clinical utility of the system.



CAUTION

The system provides calculations (e.g. estimated fetal weight) and charts based on published scientific literature. The selection of the appropriate chart and clinical interpretation of calculations and charts is the sole responsibility of the user. The user must consider contraindications for the use of a calculation or chart as described in the scientific literature. The diagnosis, decision for further examinations, and medical treatment must be performed by qualified personnel following good clinical practice.

The user should be aware of the product specifications and system accuracy and stability limitations. These limitations must be considered before making any decision based on quantitative values. If in doubt, consult the nearest GE Ultrasound Service Office.

Equipment malfunction or incorrect settings can result in measurement errors or failure to detect details in the image. The user must become thoroughly familiar with the operation of the unit in order to optimize its performance and to recognize possible malfunctions. Application training is available through the sales representative.



CAUTION

Be certain to ensure the privacy of patient information.

Mechanical hazards



WARNING

Damaged probes or improper use and manipulation of the transesophageal probe may result in injury or increased risk of infection. Inspect probes frequently for sharp, pointed, or rough surface damage that could cause injury or tear protective barriers (gloves and sheaths). Never use excessive force when manipulating intracavity probes. Become familiar with all instructions and precautions provided with special purpose probes.



WARNING

Observe probe immersion levels (see Figure 12-8).

Inspect probes for sharp edges or rough surfaces that could injure sensitive tissue.

DO NOT bend or pull the cable forcefully, to avoid mechanical shock or impact to the probe.



CAUTION

Ultrasound transducers are sensitive instruments which can easily be damaged by rough handling. Take extra care not to drop transducers and avoid contact with sharp or abrasive surfaces. A damaged housing, lens, or cable can result in patient injury or serious impairment of operation.

Transesophageal probe safety

Never use excessive force when manipulating the transesophageal probe. The detailed operator manual enclosed with the transesophageal probe must be read carefully.

Safe and efficient data storage is crucial when doing transesophageal examination. To ensure optimal image storage during a transesophageal examination the user should consider:

- Creating a new examination when using the TEE probe in order to limit the size of the examination.
- Storing the images on the local archive. Storage on a remote archive may be affected by network instability and traffic.

Electrical Hazard



WARNING

A damaged probe may increase the risk of electric shock if conductive solutions come in contact with internal live pads. Inspect probes often for cracks or openings in the housing and holes in and around the acoustic lens, or other damage that could allow moisture to enter. Become familiar with the probe's use and care precautions outlined in 'Probe' on *page 12-1*.

The scanner and Electrosurgical units



WARNING

This equipment provides no special means of protection from high frequency (HF) burns that may result from using an electrosurgical unit (ESU). To reduce the risk of HF burns, avoid contact between the patient and ultrasound transducer or ECG electrodes while operating the ESU. Where contact cannot be avoided, as in the case of TEE monitoring during surgery, make sure the transducer or ECG electrodes are not located between the ESU active and dispersive electrodes and keep the ESU cables away from the transducer or ECG cables.

Defibrillation



CAUTION

Remove any patient connections that belong to Vivid iq from the patient when defibrillators are used.



CAUTION

Disconnect any intracavitary probes remaining in the patient from the system before defibrillation.



WARNING

Make sure that nobody touches the connector of any probe remaining in the patient during defibrillation and that the connector is not in direct contact with any conductive material during defibrillation.



WARNING

Remove the ICE catheter from the patient, or disconnect the umbilical cord connector from the scanner when defibrillators are used.

System malfunction



WARNING

Any electronic device can fail without warning signs, therefore the user is advised to follow local clinical practice guidelines for having a backup imaging plan when performing time-critical image-guided examinations and interventions.

Personnel and equipment safety

The hazards listed below can seriously affect the safety of personnel and equipment during a diagnostic ultrasound examination.

General hazard



This equipment contains dangerous voltages that are capable of serious injury or death.

If any defects are observed or malfunctions occur, stop operating the equipment and perform the proper action for the patient. Inform a qualified service person and contact a Service Representative for information.

There are no user replaceable or serviceable components inside the console. Refer all servicing to GE qualified service personnel only.

Ensure that unauthorized personnel do not tamper with the unit.



Do not use this equipment if a safety problem is known to exist. Have the unit repaired and performance verified by qualified service personnel before returning to use.



Only GE approved and recommended peripherals and accessories should be used.

Explosion hazard



Never operate the equipment in the presence of flammable or explosive liquids, vapors, or gases. Malfunctions in the unit or sparks generated by fan motors can electrically ignite these substances. Operators should be aware of the following points to prevent such explosion hazards.

- If flammable substances are detected in the environment, do not plug in or turn on the system.
- If flammable substances are detected after the system has been turned on, do not attempt to turn off the unit, or to unplug it.
- If flammable substances are detected, evacuate and ventilate the area before turning off the unit.



Please cut off power supply immediately in case exposure to smoke.

Electrical hazard



The internal circuits of the unit use high voltages, capable of causing serious injury or death by electrical shock.



To avoid risk of electric shock, this equipment must only be connected to a supply mains with protective earth.

To avoid injury

- Do not remove the unit's protective covers. No user-serviceable parts are inside. If servicing is required, contact qualified technical personnel.
- Connect the attachment plug to a reliable (hospital grade) grounding outlet (having equalization conductor) to assure adequate grounding.
- Do not place liquids on or above the unit. Conductive fluids seeping into the active circuit components may cause short circuiting, which could result in an electrical fire.
- An electrical hazard may exist if any light, monitor, or visual indicator remains on after the unit is turned off.

Fuses blown within 36 hours of being replaced may indicate a malfunctioning electrical circuit within the system. In this event, the unit must be checked by GE Ultrasound service personnel. No attempt should be made to replace the fuses with others of a higher rating.



Servicing must be performed by GE qualified service personnel.



In case any serious incident occurred in relation to Vivid *iq* ultrasound products should be reported to GE Healthcare and the competent Authority.

Moving hazard



CAUTION

The ultrasound unit weighs approximately 5 Kg (11.02 lb.).

Special care must be used to avoid injury when moving or transporting the system.

- Always use the handle to move the system.
- Do not let the system strike walls or door frame.

Ensure that the unit is well prepared before transporting. Refer to 'Moving and Transporting the Unit' on *page 3-22* for more information.

Biological hazard



CAUTION

For patient and personnel safety, beware of biological hazards while performing transesophageal procedures. To avoid the risk of disease transmission:

- Use protective barriers (gloves and probe sheaths) whenever necessary. Follow sterile procedures as required.
- Thoroughly clean probes and reusable accessories after each patient examination and disinfect or sterilize as needed. Refer to 'Probe' on *page 12-1*, for probe use and care instructions.
- Follow all in-house infection control policies as they apply to personnel and equipment.

Pacemaker hazard

The possibility of the system interfering with pacemakers is minimal. However, as this system generates high frequency electrical signals, the operator should be aware of the potential hazard this could cause.

Hazard Symbols

Icon Description

Potential hazards are indicated by the following icons:

Table 2-1: Potential Hazards

Icon	Potential Hazard	Usage	Source
	Biological Hazard Describes precautions necessary to prevent the risk of disease transmission or infections. • Patient/user infection due to contaminated equipment.	• Cleaning and care instructions • Sheath and glove guidelines	ISO 7000 No. 0659
	Electrical Hazard Describes precautions necessary to prevent the risk of injury through electric hazards. • Electrical micro-shock to patient, e.g., ventricular	• Probes • ECG, if applicable • Connections to back panel	
	Moving Hazard Describes precautions necessary to prevent the risk of injury through moving or tipping hazard! • Console, accessories or optional storage devices that can fall on patient, user, or others. • Collision with persons or objects may result in injury while maneuvering or during system transport. • Injury to user from moving the console.	• Moving • Using brakes • Transporting	
	Acoustic Output Hazard • Patient injury or tissue damage from ultrasound radiation.	• ALARA, the use of Power Output following the 'as low as reasonably achievable' principle	
	Explosion Hazard Describes precautions necessary to prevent the risk of injury through explosion hazard! • Risk of explosion if used in the presence of flammable anesthetics.	• Flammable anesthetic	
	Fire and Smoke Hazard • Patient/user injury or adverse reaction from fire or smoke. • Patient/user injury from explosion and fire.	• Replacing fuses • Outlet guidelines	

Electrical safety

Device classifications

The ultrasound unit is a Class I device, type BF, type CF, according to IEC 60601-1.

Internally connected peripheral devices

The system, together with peripheral devices, such as video printer, meets IEC 60601-1 standards for electrical isolation and safety. These standards are applicable only when the specified peripheral devices are plugged into the AC outlets provided on the unit.

External Connection of other peripheral devices



CAUTION

External devices can be used only if CE marked and in compliance with related standards (EN 60601-1 or EN 60950). Conformance to EN 60601-1 must be verified.

Accessory equipment connected to the analog and digital interfaces must be certified according to the respective IEC standards (e.g. IEC 60950 for data processing equipment and IEC 60601-1 for medical equipment). Furthermore all complete configurations shall comply with the valid version of the system standard IEC 60601-1. Anybody connecting additional equipment to the signal input part or signal output part of the ultrasound unit configures a medical system, and is therefore responsible that the system complies with the requirements of the valid version of IEC 60601-1. If in doubt consult the technical service department or your local GE representative.

Other external devices, such as printers, and external monitors, usually exceed allowable leakage limits and, when plugged into separate AC outlets that are then connected to the unit, are in violation of patient safety standards. Suitable electrical isolation of such external AC outlets may be required in order to meet UL60601-1 and IEC 60601-1 standards for electrical leakage.

Allergic reactions to latex-containing medical devices



CAUTION

Contact with natural rubber latex may cause a severe anaphylactic reaction in persons sensitive to the natural latex protein. Sensitive users and patients must avoid contact with these items.

Due to reports of severe allergic reactions to medical devices containing latex (natural rubber), the FDA advises healthcare professionals to identify latex-sensitive patients, and be prepared to treat allergic reactions promptly. Latex is a component of many medical devices, including surgical and examination gloves, catheters, incubation tubes, anesthesia masks, and dental dams. Patient reaction to latex has ranged from contact urticaria to systemic anaphylaxis.

For more details regarding allergic reaction to latex, refer to *FDA Medical Alert MDA91-1*, March 29.

Use of ECG



CAUTION

Do not use the Vivid *iq* Ultrasound system ECG wave for diagnostic and monitoring.

Electromagnetic Compatibility (EMC)

NOTE: *This equipment generates, uses and can radiate radio frequency energy. The equipment may cause radio frequency interference to other medical and non-medical devices and radio communications. To provide reasonable protection against such interference, this unit carries the CE mark. It complies with regulatory requirements of the European Directive 93/42/EEC concerning medical devices. It also complies with emission limits for a Group 1, Class A Medical Device as stated in EN 60601-1-2 (IEC 60601-1-2).*

NOTE: *Proper installation following the service manual is required in order to achieve the full EMC performance of the product.*

NOTE: *Do not use devices which intentionally transmit RF Signals (cellular phones, transceivers, or radio controlled products) other than those supplied by GE (wireless microphone, broadband over power lines, for example) in the vicinity of the equipment as it may cause performance outside the published specifications. Keep the power to these type devices turned off when near this equipment.*

Electrical medical equipment needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in this manual.

All types of electronic equipment may characteristically cause electromagnetic interference with other equipment, transmitted either through air or connecting cables. The term Electromagnetic Compatibility (EMC), indicates the capability of the equipment to curb electromagnetic influence from other equipment, while at the same time not affecting other equipment with similar electromagnetic radiation.

Radiated or conducted electromagnetic signals can cause distortion, degradation, or artifacts in the ultrasound image which may impair the ultrasound unit's essential performance (see page 2-45).

Electromagnetic Compatibility (EMC) (continued)

There is no guarantee that interference will not occur in a particular installation. If this equipment is found to cause or respond to interference, attempt to correct the problem by one or more of the following measures:

- Re-orient or re-locate the affected device.
- Increase the separation between the unit and the affected device.
- Power the equipment from a source other than that of the affected device.
- Consult the service representative for further suggestions.

The manufacturer is not responsible for any interference or responses caused by the use of interconnecting cables other than those recommended, or by unauthorized changes or modifications to this unit. Unauthorized changes or modifications could void the user's authority to operate the equipment.

To comply with the regulations on electromagnetic interference, all interconnecting cables to peripheral devices must be shielded and properly grounded. Use of cables not properly shielded and grounded may result in the equipment causing or responding to radio frequency interference, in violation of the European Union Medical Device Directive and FCC regulations.

Electromagnetic Compatibility (EMC) (continued)

Devices which intrinsically transmit radio waves such as cellular phones, radio transceivers, mobile radio transmitters, radio-controlled toys, and so on, should preferably not be operated near the unit. See 'Minimum distances' on *page 2-45* about the recommended minimum separation distances between portable and mobile RF communications equipment and the ultrasound unit.

Any electrical device can unintentionally emit electromagnetic waves. However, minimum device separation distances cannot be calculated for such unspecified radiation. When the ultrasound unit is used adjacent to or in close proximity to other equipment the user should be attentive to unexpected device behavior which may be caused by such radiation.

The ultrasound unit is intended for use in the electromagnetic environment specified in the tables below.

The user of ultrasound unit should assure that the device is used in such an environment.

Notice upon Installation of Product

Separation distance and effect from fixed radio communications equipment: field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast, and TV broadcast transmitter cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the ultrasound system is used exceeds the applicable RF compliance level as stated in the immunity declaration, the ultrasound system should be observed to verify normal operation. If abnormal operation is observed, additional measures may be necessary, such as re-orienting or relocating the ultrasound system or using an RF shielded examination room may be necessary.

1. Use either power supply cords provided by GE or ones designated by GE. Products equipped with a power source plug should be plugged into the fixed power socket which has the protective grounding conductor. Never use any adaptor or converter to connect with a power source plug (e.g. three-prong-to-two-prong converter).
2. Locate the equipment as far away as possible from other electronic equipment.
3. Be sure to use only the cables provided by or designated by GE. Connect these cables following the installation procedures (e.g. wire power cables separately from signal cables).
4. Lay out the main equipment and other peripherals following the installation procedures described in the service manuals and peripherals manufacture's manuals.

General Notice

1. Designation of peripheral equipment connectable to this product.

The equipment indicated in peripheral chapter can be hooked up to the product without compromising its EMC performance.

Avoid using equipment not designated in the list. Failure to comply with this instruction may result in poor EMC performance of the product.

2. Notice against user modification

The operator should never modify this product. User modifications may cause degradation in EMC performance.

Modification of the product includes changes in:

- a. Cables (length, material, wiring, etc.)
- b. System installation/layout
- c. System configuration/components
- d. Securing system parts (cover open/close, cover screwing)

3. Operate the system with all covers closed. If a cover is opened for some reason, be sure to shut it before starting/resuming operation.
4. Operating the system with any cover open may affect EMC performance.

Residual risks disclosure

- The user manual discloses "Bioeffect" information as follows:

"During a screening and diagnostic ultrasound examination, high frequency sound penetrates and interacts with tissue in and around the area of anatomy to be imaged. Only a small portion of this sound energy is reflected back to the transducer for use in constructing the image while the remainder is dissipated within the tissue. The interaction of sound energy with tissue at sufficiently high levels can produce biological effects (aka bioeffects) of either a mechanical or thermal nature. Although the generation of bioeffect is intentional with therapeutic ultrasound, it is generally undesired in screening and diagnostic applications and may be harmful in some conditions."
- The user manual discloses safety information as follows:

"Mechanical Index (MI) recognizes the importance of non-thermal processes, cavitation in particular, and the Index is an attempt to indicate the probability that they might occur within the tissue. Display precision is ± 0.1 and accuracy is $\pm 50\%$. Always observe the Acoustic Output display for possible effects."

Peripheral Update for EC countries

The following is intended to provide the users in EC countries with updated information concerning the connection of the Vivid *iq* to image recording and other devices or communication networks.⁷



Use of this equipment adjacent to or stacked with other equipment should be avoided because it could result in improper operation. If such use is necessary, this equipment and the other equipment should be observed to verify that they are operating normally.



Use of accessories, transducers and cables other than those specified or provided by the manufacturer of this equipment could result in increased electromagnetic emissions or decreased electromagnetic immunity of this equipment and result in improper operation.



Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer than 30 cm (12 inches) to any part of the Vivid *iq*, including cables specified by the manufacturer. Otherwise, degradation of the performance of this equipment could result.

Peripherals used in the patient environment

The Vivid *iq* has been verified for overall safety, compatibility and compliance with the image recording devices listed in Supplies/Accessories section.

The Vivid *iq* has also been verified for compatibility, and compliance for connection to a local area network (LAN) via the rear panel Ethernet connection, provided the LAN components are IEC/EN 60950 compliant.

Connection may also be made to a CE Marked and IEC/EN 60950 compliant modem using one of the serial or USB ports on the system.

The Vivid *iq* may also be used safely while connected to devices other than those recommended above if the devices and their specifications, installation, and interconnection with the system conform to the requirements of IEC/EN 60601-1.

Accessory equipment connected to the analog and digital interfaces must be certified according to the respective IEC standards (i.e., IEC60950 for data processing equipment and IEC60601-1 for medical equipment). Furthermore, all complete configurations shall comply with the valid version of the system standard IEC60601-1. Everyone who connects additional equipment to the signal input part or signal output part of the Vivid *iq* system configures a medical system, and is therefore responsible to ensure that the system complies with the requirement of the valid version of IEC60601-1. If in doubt, consult the technical service department or your local GE representative.

Peripherals used in the patient environment (continued)

General precautions for installing an alternate on-board device would include:

1. The added device must have appropriate safety standard conformance and CE Marking.
2. The total power consumption of the added devices, which connect to the Vivid *iq* and are used simultaneously, must be less than or equal to the rated supply of the Vivid *iq*.
3. There must be adequate heat dissipation and ventilation to prevent overheating of the device.
4. There must be adequate mechanical mounting of the device and stability of the combination.
5. Risk and leakage current of the combination must comply with IEC/EN 60601-1.
6. Electromagnetic emissions and immunity of the combination must conform to IEC/EN 60601-1-2.

General precautions for installing an alternate off-board, remote device or a network would include:

1. The added device(s) must have appropriate safety standard conformance and CE Marking.
2. The added device(s) must be used for their intended purpose having a compatible interface.
3. Signal or mains isolation devices and additional protective earth may be needed to assure compliance with IEC/EN 60601-1.

Peripherals used in the patient environment (continued)



CAUTION

The connection of equipment or transmission networks other than as specified in the user instructions can result in an electric shock hazard or equipment malfunction. Substitute or alternate equipment and connections requires verification of compatibility and conformity to IEC/EN 60601-1 by the installer. Equipment modifications and possible resulting malfunctions and electromagnetic interference are the responsibility of the owner.

Peripheral used in the non-patient environment

The Vivid *iq* has also been verified for compatibility, and compliance for connection to a USB HDD/USB memory via the system USB port, provided the USB HDD/USB memory are IEC/EN 60950 compliant.

Interference caution

Intended healthcare environment: Professional healthcare facility environment.



CAUTION

Use of devices that transmit radio waves near the unit could cause it to malfunction.

Devices which intrinsically transmit radio waves, such as cellular phones, radio transceivers, mobile radio transmitters, radio-controlled toys, etc., should preferably not be operated near the unit. See page 2-45 about the recommended minimum separation distances between portable and mobile RF communications equipment and the ultrasound unit.

Medical staff in charge of the unit are required to instruct technicians, patients, and other people who may be around the unit to fully comply with the above recommendations.

Any electrical device can unintentionally emit electromagnetic waves. However, minimum device separation distances cannot be calculated for such unspecified radiation. When the ultrasound unit is used adjacent to or in close proximity to other equipment the user should be attentive to unexpected device behavior which may be caused by such radiation.

The Medical Electrical System is suitable for use in professional healthcare facility environment.

The ultrasound unit is intended for use in the electromagnetic environment specified in the tables below.

The user of the ultrasound unit should ensure that the device is used in such an environment.

Declaration of Emissions

This system is suitable for use in the following environment. The user must assure that it is used only in the electromagnetic environment as specified.

Guidance and manufacturer's declaration – electromagnetic emissions.		
Emissions type	Compliance	Electromagnetic environment - guidance
RF emission CISPR 11 EN55011	Group 1	The ultrasound unit uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emission CISPR 11 EN55011	Class A	This system is suitable for use in all establishments, other than domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes, provided the following is heeded: This system is intended for use by healthcare professionals only. This system may cause radio interference or may disrupt the operation of nearby equipment. It may be necessary to take mitigating measures, such as re-orienting or relocating the system or shielding the location.
Harmonic emission IEC 61000-3-2	Class A	
Voltage fluctuations/flicker emissions IEC 61000-3-3	Complies	

NOTE: *The EMISSIONS characteristics of this equipment make it suitable for use in industrial areas and hospitals (CISPR 11 class A). If it is used in a residential environment (for which CISPR 11 class B is normally required) this equipment might not offer adequate protection to radio-frequency communication services. The user might need to take mitigation measures, such as relocating or re-orienting the equipment.*

Declaration of Immunity

The system is suitable for use in the specified electromagnetic environment and it meets the following immunity test levels. Higher immunity levels may cause the system's essential performance lost or degraded.



CAUTION

Please DO NOT use this system near the active HF Surgical Equipment in the hospital.

Table 2-2: Electromagnetic Immunity

Phenomenon	Basic EMC Standard or Test Method	Regulatory Acceptable Level	EMC Environment and Guidance
Electrostatic discharge	IEC 61000-4-2	± 8 kV contact ± 2 kV, ± 4 kV, ± 8 kV, ± 15 kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%. Mains power quality should be that of a typical commercial and/or hospital environment. If the user requires continued operation during power mains interruptions, it is recommended that the system be powered from a UPS or a battery. NOTE: U_T is the a.c. mains voltage prior to application of the test level. Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial and/or hospital environment. Separation distance to radio communication equipment must be maintained according to the method below. Interference may occur in the vicinity of equipment marked with the symbol:  Image degradation or interference may occur due to conducted RF noise on the equipment mains power supply or other signal cable. Such interference is easily recognized and distinguishable from patient anatomy and physiological waveforms. Interference of this type may delay the examination without affecting diagnostic accuracy. Additional mains/signal RF isolation or filtering may be needed if this type interference occurs frequently.
Radiated RF EM fields	IEC 61000-4-3	3 V/m 80 MH - 2.7GHz 80%AM at 1kHz	
Proximity fields from RF wireless communications equipment	IEC 61000-4-3	See the RF wireless communication equipment table in “Recommended minimum separation distances”.	
Rated power frequency magnetic fields	IEC 61000-4-8	30 A/m 50 Hz or 60 Hz	
Electric fast transients bursts	IEC 61000-4-4	Power supply port: ±2 kV, 100 kHz repetition frequency; Signal input/output parts port: ±1 kV, 100 kHz repetition frequency.	
Surges	IEC 61000-4-5	Line to line: ±0.5 kV, ±1 kV Line to earth: ±0.5 kV, ±1 kV, ±2 kV	
Conducted disturbances induced by RF fields	IEC 61000-4-6	3 V in 0.15 MHz - 80 MHz 6 V in ISM and/or amateur radio bands between 0.15 MHz and 80 MHz 80 % AM at 1kHz	
Voltage dips	IEC 61000-4-11	0% U_T : 0.5 cycle at 0°, 45°, 90°, 135°, 180°, 225°, 270°, and 315° 0% U_T : 1 cycle and 70% U_T : 25/30 cycles sine phase at 0°	
Voltage interruptions	IEC 61000-4-11	0% U_T : 250/300 cycle	
NOTE: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people. If noise generated from other electronic equipment is near the probe’s center frequency, noise may appear on the image. Good power line isolation is required.			

Minimum distances

Recommended separation distances between portable and mobile RF communications equipment and the ultrasound unit						
The ultrasound unit is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the ultrasound unit can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the ultrasound unit as recommended below, according to the maximum output power of the communications equipment. Portable and mobile radio communications equipment (e.g. two-way radio, cellular/ cordless telephones and similar equipment) should be used no closer to any part of this system, including cables, than determined according to the following method:						
Test frequency (MHz)	Band (MHz)	Service	Modulation	Maximum power (W)	Distance (m)	Immunity test level (V/m)
385	380 - 390	TETRA 400	Pulse modulation 18Hz	1.8	0.3	27
450	430 -470	GMRS 460 FRS 460	FM ± 5 kHz deviation 1 kHz sine	2	0.3	28
710	704 - 787	LTE Band 13, 17	Pulse modulation 217 Hz	0.2	0.3	9
745						
780						
810	800 - 960	GSM 800/900, tetra 800, iDEN 820, CDMA 850, LTE Band 5	Pulse modulation 18 Hz	2	0.3	28
870						
930						
1720	1700 - 1990	GSM 1800, CDMA 1900, GSM 1900, DECT, LTE Band 1, 3, 4, 25, UMTS	Pulse modulation 217 Hz	2	0.3	28
1845						
1970						
2450	2400 - 2570	Bluetooth, WLAN, 802.11 b/g/n, RFID 2450, LTE Band 7	Pulse modulation 217 Hz	2	0.3	28
5240	5100 - 5800	WLAN, 802.11 a/n,	Pulse modulation 217 Hz	0.2	0.3	9
5500						
5785						

Recommended separation distances between portable and mobile RF communications equipment and the ultrasound unit

For transmitters rated at a maximum output power not listed above the recommended separation distance d in metres (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

Essential performance

The essential performance of the ultrasound unit is:

- The ability to display physiological images as input for diagnosis by trained physician.
- The ability to display physiological traces as aid for diagnosis by trained physician.
- The ability to display quantified data as input for diagnosis by trained physician.
- The display of ultrasound indexes as aid for safe use of the unit.
- The display of probe surface temperature as aid for safe use of the unit (Probe dependent).

Cable Specifications

Table 2-3: Cable specification list

Port No.	Name	Cable Length	Cable Shielded
1	Mains	< 3m	Unshielded
2	Probe	< 3m	Shielded
3	ECG	> 3m	Unshielded
4	USB	< 3m	Shielded
5	HDMI	< 3m	Shielded
6	LAN	> 3m	Unshielded
7	DC Power	> 3m	Unshielded
8	USB Port for Printer	> 3m	Shielded
9	Footswitch	> 3m	Unshielded

Wireless Adapter specification

Table 2-4: Wireless Adapter specification

Received frequency (GHz)	Emission frequency (GHz)	Modulation Type	Effective radiation frequency
2.412	2.412	OFDM	<=100mW
2.417	2.417		
2.422	2.422		
2.427	2.427		
2.432	2.432		
2.437	2.437		
2.442	2.442		
2.447	2.447		
2.452	2.452		
2.457	2.457		
2.462	2.462		

Patient Environmental Devices



Figure 2-2. Vivid *iq* system (opened view)



Figure 2-3. Peripheral/accessory connector panel

1. 2 USB ports (3.0), Max 5.0 Gbps	6. Port for DC In (for AC Adapter and connecting to cart)
2. 1 ECG connector port	7. Network port (LAN port)
3. 4D probe connector port (for connecting 4D probe cable from cart)	8. HDMI port (Video output)
4. 1 probe connector port	9. Security lock
5. USB port (2.0) (for USB connection and connecting to cart), Max 480 Mbps	10. 2 USB ports (2.0), Max 480 Mbps

Acceptable Devices

The Patient Environmental devices shown on the previous page are specified to be suitable for use within the PATIENT ENVIRONMENT.



CAUTION

DO NOT connect any probes or accessories without approval by GE within the PATIENT ENVIRONMENT.

Unapproved Devices



CAUTION

DO NOT use unapproved devices.

If devices are connected without the approval of GE, the warranty will be INVALID.

Any device connected to the Vivid *iq* must conform to the requirements for IEC or equivalent standards appropriate to devices.

Accessories, Options, Supplies



CAUTION

Unsafe operation or malfunction may result. Use only the accessories, options and supplies approved or recommended in these instructions for use.

Environmental protection

Disposal

Table 2-5: WEEE symbol

	Bottom of the system and Probe connector

This symbol indicates that waste electrical and electronic equipment must not be disposed of as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.

For accessing the WEEE passport of the GE Healthcare products please:

- Go to GE Healthcare Support Documentation Library:
<https://customer-doc.cloud.gehealthcare.com>
- Select Modality: Ultrasound (UL)
- Enter Document Name or keyword: WEEE
- Click: Search
- Select the desired WEEE passport

NOTE: *Probes must be cleaned and disinfected before they are replaced or disposed.*

Device Labels

The following table describes the purpose and location of safety labels and other important information provided on the equipment.

Label Icon Description

The following table describes the purpose and location of safety labels and other important information provided on the equipment.

Table 2-6: Label Icons

Label/Icon	Purpose/Meaning	Location	Reference
	GE Logo	Various	N/A - by GE Healthcare
Identification and Rating Plate 	Manufacturer's name and address	Rating plate Probes	EN ISO 15223-1:2021
	Date of manufacture: The date could be a year, year and month, or year, month and day, as appropriate. See ISO 8601 for date formats.	Bottom Probes	EN ISO 15223-1:2021
	Catalog or model number	Bottom Probes	EN ISO 15223-1:2021
	Serial number	Bottom Probes	EN ISO 15223-1:2021

Table 2-6: Label Icons (Continued)

Label/Icon	Purpose/Meaning	Location	Reference
	Direct Current: For products to be powered from a DC supply	Bottom	IEC417-5031
For use with adapter model	For use with adapter model	Bottom	GE Created
Made in China	Made in China	Various	GE Created
Type/Class Label	Used to indicate the degree of safety or protection.		EN 60601-1:2006/ A1:2013 (IEC60601-1:2005 /A1:2012)
IP Code (IPX8) IPX8: MKF 2-MED GP26	Indicates the degree of protection provided by the enclosure per IEC60 529. IPX8 can be used in an operating room environment.	Bottom of Footswitch	EN 60601-1:2006/ A1:2013 (IEC60601-1:2005 /A1:2012)
IP Code (IPX7) IPX7: Probe head	Indicates the degree of protection provided by the enclosure per IEC60 529. IPX7 can be used in an operating room environment.	Probe Connector	EN 60601-1:2006/ A1:2013 (IEC60601-1:2005 /A1:2012)
	Authorized European Representative address.	beginning of the manual	EN ISO 15223-1:2021
	This symbol indicates the authorised representative in Switzerland.	Rating plate Probes	Swiss Medical Devices Ordinance 812.213
	United States only Prescription Requirement label.	Bottom panel	United States regulatory requirement.
	Type BF Applied Part (man in the box) symbol is in accordance with IEC 878-02-03.	Beside the probe connector	EN 60601-1:2006/ A1:2013 (IEC60601-1:2005 /A1:2012)

Table 2-6: Label Icons (Continued)

Label/Icon	Purpose/Meaning	Location	Reference
	"follow instruction for use" mark "Consult accompanying documents" is intended to alert the user to refer to the operator manual or other instructions when complete information cannot be provided on the label.	Safety label Probes	EN 60601-1:2006/ A1:2013 (IEC60601-1:2005 /A1:2012)
	Exclamatory Mark	Various	EN 60601-1:2006/ A1:2013 (IEC60601-1:2005 /A1:2012)
	General .	Probe	IEC348
	"CAUTION" - Dangerous voltage" (the lightning flash with arrowhead) is used to indicate electric shock hazards.	Various	EN 60601-1:2006/ A1:2013 (IEC60601-1:2005 /A1:2012)
	Do not use the following devices near this equipment: cellular phone, radio receiver, mobile radio transmitter, radio controlled toy, etc. Use of these devices near this equipment could cause this equipment to perform outside the published specifications. Keep power to these devices turned off when near this equipment.	Various	ISO7010
	Keep the system dry.	Package label	EN ISO15223:2021
	The CE marking indicates the equipment comply with Medical Device Regulation (MDR) 2017/745.	Rating plate Probes	Medical Device Regulation (MDR) 2017/745

Table 2-6: Label Icons (Continued)

Label/Icon	Purpose/Meaning	Location	Reference
CISPR 11 / EN 55011 CLASS : A GROUP : 1 CLASSE : A GROUPE : 1	EMC class level label: CISPR CAUTION: The Vivid iq conforms to the CISPR11, Group 1, Class A of the international standard for Electromagnetic disturbance characteristics.	Bottom	CISPR 11/EN 55011
 CAUTION 주의 注意 This machine should be used in compliance with law. Some jurisdictions restrict certain uses, such as gender determination. 본 기계는 법규를 준수하여 사용되어야 합니다. 특정면 사용 제한 등 법적 규정까지 꼭 지켜 사용해야 합니다. 应符合使用规定，某些国家法规禁止使用其做胎儿性别鉴定等。	CAUTION: This machine should be used in compliance with law. Some Jurisdictions restrict certain uses, such as gender determination.	Bottom Note: For China, Korea and India only.	GE Created
	“ON” indicates the power on position of the power switch. CAUTION: This Power Switch DOES NOT ISOLATE Mains Supply.	Control Panel.	EN 60601-1:2006/ A1:2013 (IEC60601-1:2005 /A1:2012)
	“Protective Earth” indicates the protective earth (grounding) terminal.	Inside of AC adapter	EN 60601-1:2006/ A1:2013 (IEC60601-1:2005 /A1:2012)
	NRTL Listing and Certification Mark is used to designate conformance to nationally recognized product safety standards. The Mark bears the name and/or logo of the testing laboratory, product category, safety standard to which conformity is assessed and a control number.	Bottom	NRTL Listing and Certification Mark.
	Equipment Type CF indicates equipment containing a floating applied part with a degree of protection suitable ofr direct cardiac contact.	ECG Module	EN 60601-1:2006/ A1:2013 (IEC60601-1:2005 /A1:2012)

Table 2-6: Label Icons (Continued)

Label/Icon	Purpose/Meaning	Location	Reference
	This symbol indicates that waste electrical and electronic equipment must not be disposed of as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.	• Bottom • Probe	WEEE Recast Directive 2012/19/ EU
	This symbol indicates that waste electrical and electronic equipment must not be disposed of as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.	Probe	WEEE Recast Directive 2012/19/ EU

Table 2-6: Label Icons (Continued)

Label/Icon	Purpose/Meaning	Location	Reference
	The separate collection symbol is affixed to a battery, or its packaging, to advise you that the battery must be recycled or disposed of in accordance with local or country laws. The letters below the separate collection symbol indicate whether certain elements (Pb=Lead, Cd=Cadmium, Hg=Mercury) are contained in the battery. To minimize potential effects on the environment and human health, it is important that all marked batteries that you remove from the product are properly recycled or disposed. For information on how the battery may be safely removed from the device, please consult the service manual or equipment instructions. Information on the potential effects on the environment and human health of the substances used in batteries is available at this url: http://www.gehealthcare.com/euen/weee-recycling/index.html	Battery Pack if contains Pb/Cd/Hg	WEEE Recast Directive 2012/19/EU

Table 2-6: Label Icons (Continued)

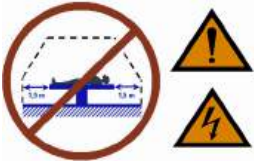
Label/Icon	Purpose/Meaning	Location	Reference
	This symbol indicates the product contains hazardous materials in excess of the limits established by the Chinese standard GB/T 26572 Requirements of concentration limits for certain restricted substances in electrical and electronic products. The number in the symbol is the Environment-friendly Use Period (EFUP), which indicates the period during which the hazardous substances contained in electrical and electronic products will not leak or mutate under normal operating conditions so that the use of such electrical and electronic products will not result in any severe environmental pollution, any bodily injury or damage to any assets. The unit of the period is "Year".	- Probe - China Rating Plate	SJ/T11364-2014
	When closing the LCD cover, use caution to avoid injuring hands or fingers as there is a closing mechanism which allows the LCD cover to automatically close.	Bottom	GE created
	Do not put the battery in fire.	Battery Pack	GE created
	Do not disassemble or mistreat the battery.	Battery Pack	GE created
	Do not connect the DVD-RW to the system while scanning. The DVD-RW can be used when connecting to the Cart.	DVD-RW	EN 60601-1:2006/ A1:2013 (IEC60601-1:2005 /A1:2012)

Table 2-6: Label Icons (Continued)

Label/Icon	Purpose/Meaning	Location	Reference
	GOST symbol: Russia Regulatory Country Clearance.	Bottom Note: Only after Russian regulatory registration is complete, this label will be located on the console.	Russia regulatory requirements.
	“Eurasian Conformity” mark; the single conformity mark for circulation of products on the markets of member-states of Customs Union. This product passed all conformity assessment (approval) procedures that correspond to the requirements of applicable technical regulations of the Customs Union.	Bottom. Note: Only after Russian regulatory registration is complete, this label will be located on the console.	Eurasian Conformity requirements.
	Mark of conformity with the Technical Regulations.	This product meets the requirements of the Technical Regulations on medical devices, approved by Resolution No.753 of the Cabinet of Ministers of Ukraine of 2 October 2013. Note: Only after Ukrainian regulatory registration is complete, this label will be located on the console.	Ukraine regulatory requirements.
	INMETRO Certification: SGS	Body back cover Note: Only after Brazilian regulatory registration is complete, this label will be located on the console.	Brazil regulatory requirement.

Table 2-6: Label Icons (Continued)

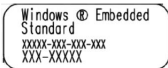
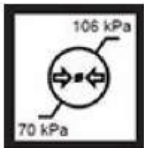
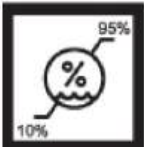
Label/Icon	Purpose/Meaning	Location	Reference
	Every system has a unique marking for identification, the Unique Device Identification (UDI) Label. The UDI label consists of a series of alpha-numeric characters and barcode which uniquely identify the Vivid <i>iq</i> system as a medical device manufactured by General Electric. Scan or enter the UDI information into the patient health record as required by country-specific laws.	Rating Plate Probes	EN ISO 15223-1:2021 (only for UDI symbol)
	Windows sticker	Bottom	GE created
	: crushing of hands.	Flexible Arm cover	GE created
	Symbol indicating that the Instructions for Use are supplied in electronic form	Rear Panel	ISO 7000-3500
	This is the QR code label which users can scan to download the Vivid <i>iq</i> Quick Card.	Near ON/OFF button	GE created
	This symbol indicates that the device is a Medical Device.	Rating plate Probes	EN ISO 15223-1:2021

Table 2-6: Label Icons (Continued)

Label/Icon	Purpose/Meaning	Location	Reference
	This symbol indicates the system is MR Unsafe and should remain outside the MRI scanner room.	Bottom	ASTM F2503-20
	To indicate the acceptable upper and lower limits of atmospheric pressure for transport and storage.	Package labeling	ISO 7000-2621
	To identify the temperature limits, for example on transport packaging to indicate limits within which the package has to be kept and handled. The temperature values may be shown adjacent to the symbol.	Package labeling	ISO 7000-0632
	To indicate the acceptable upper and lower limits of relative humidity for transport and storage.	Package labeling	ISO 7000-2620
	On transport packaging. To indicate that the content of the package is fragile and that the package must be handled with care.	Package labeling	ISO 7000-0621
	To indicate that the marked item or its material is part of a recovery or recycling process.	Probe packaging boxes and probe box labels.	ISO 7000-1135

Label Locations

NOTE: The labels are on the bottom of the system. The label content may be different for different regions. Please refer to the labels on the system for the actual content.

NOTE: For labels on the cart, please refer to Vivid iq Mobile Cart User Instruction for details.

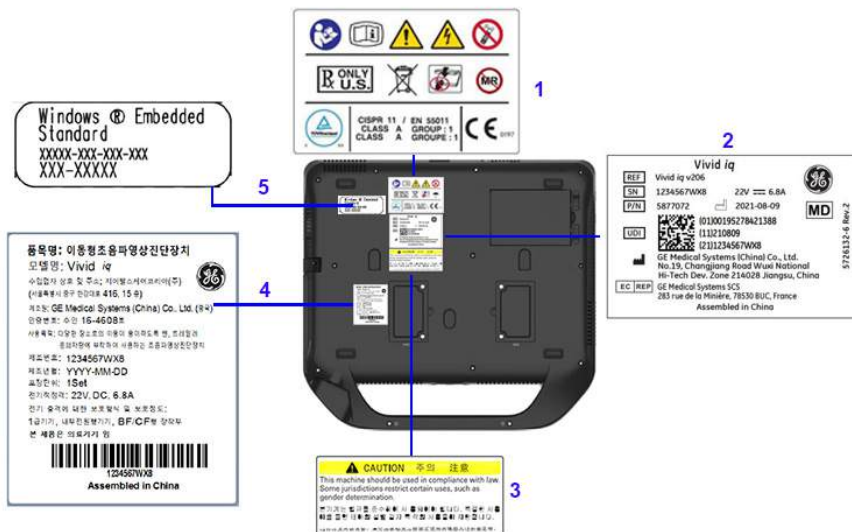


Figure 2-4. Vivid iq label location

1. Safety label
2. Rating plate
3. Gender label (for China, Korea, and India only)
4. Rating plate for Korea (for Korea only)
5. Windows sticker

Label Locations (continued)



Figure 2-5. AC Adapter label location



Figure 2-6. Battery Label



Do not disassemble or mistreat the battery. Do not put the battery in fire. Replace the battery with the same battery type only. Failure to follow these instructions may present risk of explosion fire or high temperature. See page 3-35 the battery section for additional safety instructions.

Probe Label Explanation

The following information appears on all probe labels, regardless of the connector type, except for “IPX7”, “CE Mark”, “MD symbol” and “XDclear™” which only appears on applicable probes.

NOTE: *The probe label displayed in this manual is only for illustrational purposes. Refer to the actual probe label for the specific information.*

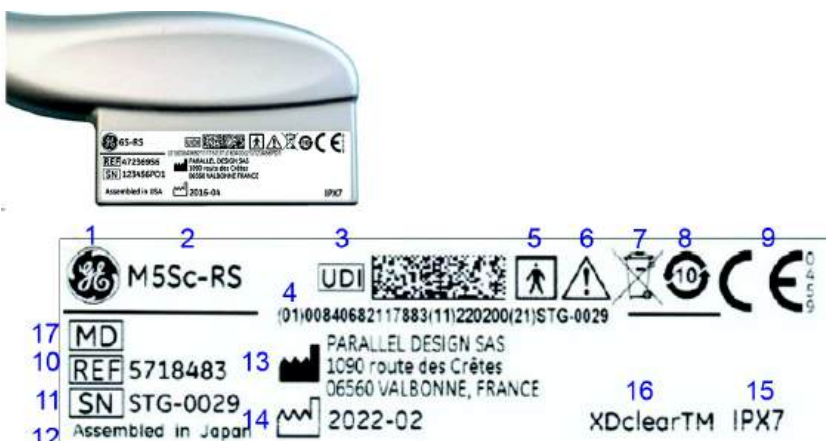


Figure 2-7. Probe label

1. GE Logo	8. Chinese RoHS Hazardous Substance Symbol
2. Probe Model (Name)	9. CE Mark and Notified Body Number
3. UDI Symbol and Data Matrix	10. REF: Catalog/model number
4. UDI Human Readable Label Text: Global Trade Item Number, GTIN, (01), Manufacturing Date (11), Serial Number (21)	11. Serial Number
5. Type BF/CF Applied Part	12. Manufacturer's site country of origin
6. Caution: Consult the Manual	13. Legal Manufacturer's Name and Address
7. WEEE Waste Symbol	14. Date of Manufacture, as YYYY-MM
	15. IP Classification
	16. Product Marketing indicator information
	17. Symbol indicates the item is a medical device

NOTE: *Non-GE probes will also have a UDI symbol and equivalent information.*

Probe Box Label

NOTE: The probe box label displayed in this manual is only for illustrational purposes. Refer to the actual probe box label for the specific information.



Figure 2-8. Probe box label

UDI Global Trade Item Number (GTIN) Label and Probe Box Barcode Locations

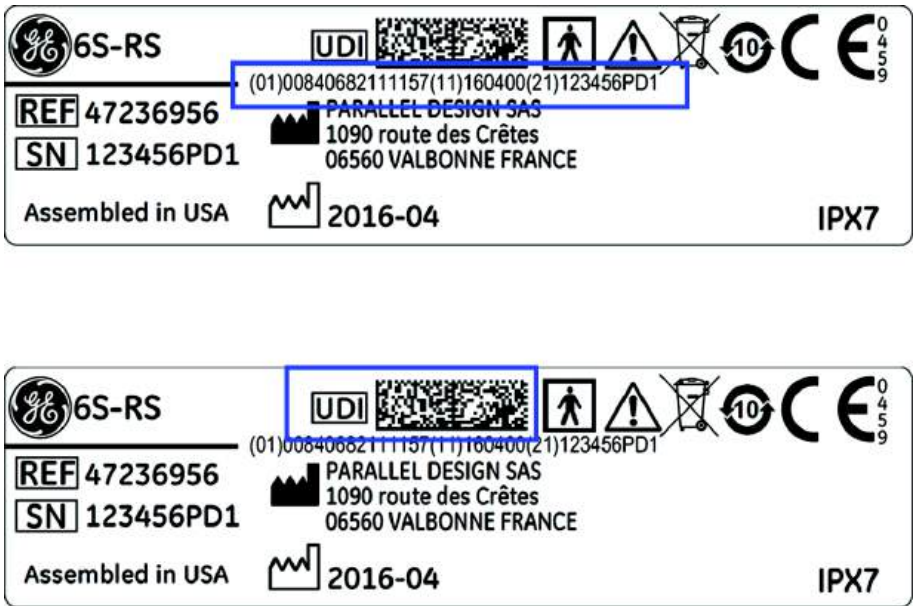


Figure 2-9. Probe Label UDI GTIN and Barcode Locations

UDI Global Trade Item Number (GTIN) Label and Probe Box Barcode Locations (continued)

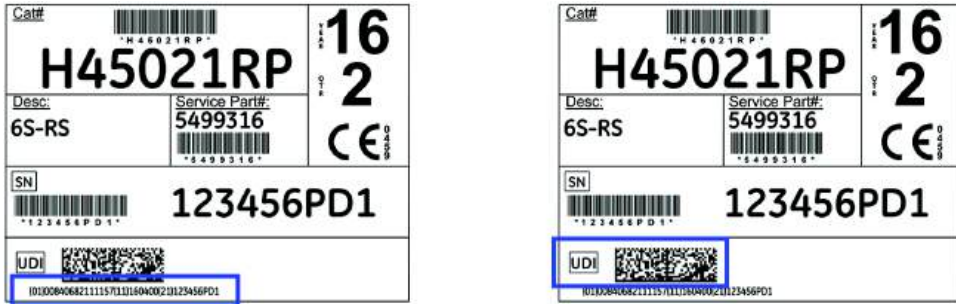


Figure 2-10. Probe Box Label UDI GTIN and Barcode Locations

RoHS Vivid *iq* Hazardous Substances



The following product pollution control information is provided according to SJ/T11364-2014 Marking for Control of Pollution caused by Electronic Information Products.

This symbol indicates the product contains hazardous materials in excess of the limits established by the Chinese standard GB/T 26572 Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products. The number in the symbol is the Environment-friendly Use Period (EFUP), which indicates the period during which the toxic or hazardous substances or elements contained in electronic information products will not leak or mutate under normal operating conditions so that the use of such electronic information products will not result in any severe environmental pollution, any bodily injury or damage to any assets. The unit of the period is "Year".

In order to maintain the declared EFUP, the product shall be operated normally according to the instructions and environmental conditions as defined in the product manual, and periodic maintenance schedules specified in Product Maintenance Procedures shall be followed strictly.

Consumables or certain parts may have their own label with an EFUP value less than the product. Periodic replacement of those consumables or parts to maintain the declared EFUP shall be done in accordance with the Product Maintenance Procedures. This product must not be disposed of as unsorted municipal waste, and must be collected separately and handled properly after decommissioning.

Name and Concentration of Hazardous Substances

Table 2-7: Table of hazardous substances' name and concentration for Vivid iq

Component Name	Hazardous substances' name					
	Pb	Hg	Cd	Cr (VI)	PBB	PBDE
LCD Panel	X	O	O	O	O	O
Printed Circuit Board Assemblies	X	O	O	O	O	O
Keyboard Assemblies	X	O	O	O	O	O
Power Assemblies	X	O	O	O	O	O
Battery	X	O	O	O	O	O
Ultrasound Probes	X	O	O	O	O	O
This table is prepared according to SJ/T 11364. O: Indicates that hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in GB/T 26572. X: Indicates that hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in GB/T 26572. • Data listed in the table represents best information available at the time of publication. • Applications of hazardous substances in this medical device are required to achieve its intended clinical uses, and/or to provide better protection to human beings and/or to environment, due to lack of reasonably (economically or technically) available substitutes. For example: Lead is could be used in Printed circuit solder.						

NOTE: Please refer to 'Name and Concentration of Hazardous Substances - Cart' in Vivid iq Mobile Cart User Instruction for detailed hazardous substances name and concentration of cart.

WEEE Passport

The WEEE (Waste Electrical and Electronic Equipment) Passport describes product recycling information. To access the WEEE passport for GE Healthcare products:

1. Go to the GE Healthcare Support Documentation Library at: <https://customer-doc.cloud.gehealthcare.com/#/cdp/dashboard>
2. Select the modality "Ultrasound (UL)."
3. Enter the document name or the keyword "WEEE."
4. Press "Search."
5. Select the desired WEEE passport.

Safe Product and Packaging Disposal

This product and package should be disposed of according to hospital disposal practices, and local environmental and waste disposal regulations. Components and accessories of the Vivid *iq* which have come into direct or indirect contact with the patient may be biohazardous, and should be disposed of according to facility guidelines for biohazardous material. The waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the disposal/decommissioning of equipment.

Chapter 3

Getting started

This chapter describes:

‘Preparing the Unit for Use’ on page 3-3

‘Moving and Transporting the Unit’ on page 3-22

‘System Description’ on page 3-26

‘Perform exams without logging in’ on page 3-64.

‘Starting an Examination after logging in’ on page 3-67.

Introduction

Only qualified physicians or ultrasound sonographers should perform scans of patients for medical diagnostic reasons. Request training, if needed. Ensure that unauthorized personnel do not tamper with the unit.



All the warnings in Chapter '**Safety**' on **page 2-1**, should be read and understood before operating the unit.

In order to avoid spillage into the unit, never place liquids on the unit or the Control Panel. Maintain a clean environment. Turn off the system before cleaning the unit. Refer to '*System Care and Maintenance*' on *page 14-24* for cleaning instructions.

To carry out regular preventative maintenance refer to Chapter14 on page 14-1.

Preparing the Unit for Use

Before the system arrives

NOTICE

This medical equipment is approved, in terms of the prevention of radio wave interference, to be used in hospitals, clinics and other institutions which are environmentally qualified. The use of this equipment in an inappropriate environment may cause some electronic interference to radios and televisions around the equipment.

Ensure that the following is provided for the new system:

- Power Requirements
 - A separate power outlet with a 10 amp circuit breaker.
 - Frequency: 50 Hz/60 Hz (+/-3Hz)
 - 100V - 240V (+/- 10%)
- Take precautions to ensure that the console is protected from electromagnetic interference.

Precautions include:

- Operate the console at least 5 meters (15 feet) away from motors, typewriters, elevators, and other sources of strong electromagnetic radiation (non-medical grade UPS must be at least 2 meters (6 feet) away from console).
- Operation in an enclosed area (wood, plaster or concrete walls, floors and ceilings) helps prevent electromagnetic interference.
- Special shielding may be required if the console is to be operated in the vicinity of radio broadcast equipment.

F



CAUTION

Do not operate the system in the vicinity of a heat source, of strong electric or magnetic fields (close to a transformer), or near instruments generating high-frequency signals, such as HF surgery. These can adversely affect the ultrasound images.

Site requirements

The ultrasound unit must operate within the proper environment and in accordance with the requirements described in this section. Before using the system, ensure that the requirements are met.

Optimal operation of the unit can be obtained by implementing the following requirements:

Power requirements

The ultrasound unit uses a separate power outlet for 100–240 V (+/-10%), 50/60 Hz (+/-3Hz).



WARNING

Operating the unit with the wrong voltage range causes damages, voiding the factory warranty.

Operating Environment

Ensure that there is sufficient air flow around the ultrasound unit when installed in a fixed location.

Environmental requirements

The system should be operated, stored, or transported within the parameters outlined below. Either its operational environment must be constantly maintained or the unit must be turned off.

Requirement	Temperature	Humidity	Air Pressure
Operational	3–40 °C (system without battery) 3–30 °C (system with battery)	30–80% non-condensing	700–1060 hPa
Storage	-5–50 °C	10–90% non-condensing	700–1060 hPa
Transport	-5–50 °C	10–90% non-condensing	700–1060 hPa

Environmental requirements (continued)



CAUTION

The Vivid *iq* system and probe connector are not waterproof. Do not expose the device to water or any kind of liquid.



CAUTION

The cart is not waterproof. Do not expose the cart to water or any kind of liquid.

Never set liquids on the cart to ensure that liquid does not drip into the unit.



CAUTION

Be sure that the system is fixed correctly on the mobile cart to avoid falling down.



CAUTION

Do not operate the system in the vicinity of a heat source, of strong electric or magnetic fields (close to a transformer), or near instruments generating high-frequency signals, such as HF surgery. These can affect the ultrasound images adversely.

Electromagnetic interferences

The ultrasound unit is approved for use in hospitals, clinics, and other environmentally qualified facilities, in terms of the prevention of radio wave interference. The use of this equipment in an inappropriate environment may cause some electronic interference to radios and televisions around the equipment.

Ensure that the unit is protected from electromagnetic interferences as follows:

- Operate the unit at least 4.5 meters (15 feet) away from equipment that emits strong electromagnetic radiation.
- Shield the unit when operating it in the vicinity of radio broadcasting equipment, if necessary.

Connecting the unit

Connecting the ultrasound unit involves preliminary checks of the power cord, voltage level, and compliance with electrical safety requirements.

Use only power supply cords, cables, and plugs provided by or designated by GE Systems.

Ensure that the power cord and plug are intact and that the power plug is the proper hospital-grade type (where required).

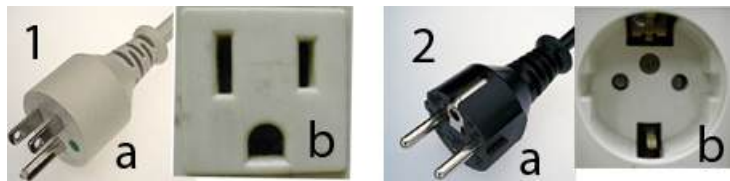


Figure 3-1. Example Plug and Outlet Configurations

- 1. 100-120 VAC, 1200 VA
Plug and Outlet Configuration
- 2. 220-240 VAC, 1200 VA
Plug and Outlet Configuration

NOTE: Country-specific power cords are currently available for the United States, Japan, the United Kingdom, Europe, Denmark, Switzerland, Israel, India/South Africa, China, Brazil, Australia/ New Zealand, and Argentina.

Table 3-1: Power Parameters

Part	Parameters
Vivid iq system	Input: 22Vd.c., 6.8A
Cart	Input: 100-240Va.c.~, 50/60Hz, 300VA <i>Note: Please refer to Vivid iq Mobile Cart User Instruction for Vivid iq cart detailed power parameters.</i>
Fuse	250V~, Rated Current:10A



Only connect cart to our Vivid iq system because inappropriate connection may lead to the risk of electric shock.

Connecting the unit (continued)



WARNING

The unit should be connected to a fixed power socket which has the protective grounding connector. Never use an extension cord or adapter plug.



WARNING

Failure to provide an adequate earth circuit can cause electrical shock, resulting in serious injury.



WARNING

Connection of additional protective earth conductors or potential equalization conductors is not necessary in most cases and is only recommended for situations involving multiple equipment in a high-risk patient environment to provide assurance that all equipment is at the same potential and operates within acceptable leakage current limits. An example of a high-risk patient would be a special procedure during which the patient has an accessible conductive path to the heart such as exposed cardiac pacing leads.

Voltage level check

Check the rating label at the bottom of the system for the voltage range indicated on the label.



Figure 3-2. The Rating label

NOTE: Please refer to Vivid iq Mobile Cart User Instruction for detailed Voltage Level Check of cart.



If the mains supply is not within the specified range, do not connect the unit to the power source. Contact your local distributor or the appropriate support resource.

Connecting to the electrical outlet



WARNING

POWER OUTAGE MAY OCCUR. The ultrasound unit requires a dedicated single branch circuit. To avoid circuit overload and possible loss of critical care equipment, make sure you **DO NOT** have other equipment operating on the same circuit.

The unit's power must be supplied from a separate, properly rated outlet to avoid risk of fire. Refer to 'Power requirements' on *page 3-4* for rating information.

The power cord should not, under any circumstances, be altered to a configuration rated less than that specified for the current.

Only connect Vivid *iq* and mains-operated accessories to the appropriate wall outlet. **DO NOT** connect them to a single or multiple socket outlets, an extension cord, power strip or an adapter plug.

1. Ensure that the wall outlet is of appropriate type, and that the power switch is turned off. The system and cart can draw power from standard wall outlets in the country of use.
2. Uncoil the power cable, allowing sufficient slack so that the unit can be moved slightly.
3. Attach the power plug to the system and secure it in place by using the retaining clamp.
4. Secure the power plug to the wall outlet.
5. If powered by AC/DC adapter, the power plug is an isolation means which used to isolate its circuits electrically from the **SUPPLY MAINS**.
6. If powered by cart, the main switch is an isolation means which used to isolate its circuits electrically from the **SUPPLY MAINS**.

The console can be powered by cart or battery.

Connecting to the electrical outlet (continued)



Use caution to ensure that the power cable does not disconnect during system use.

If the system is accidentally unplugged, data may be lost.



Do not position the system to make it difficult to operate the mains plug.

Power On/Off

To power on the unit

Press the On/Off switch on the Control Panel to power on the system. The Power On/Off switch illumination turns to white.

After initialization the default scanning screen is displayed.



Figure 3-3. The On/Off button

Log In

During the boot-up process the system may require the user to enter a password to operate it. Personal IDs and associated passwords can be configured in the Vivid *iq* ('Configuration – System and Users' on *page 4-44*)

If IDs and passwords have been entered and "Use Auto Logon" is Off ('Auto logon' on *page 4-64*), the Operator Login window appears, requesting for an ID and password when Power up sequence is completed, or when it is required.

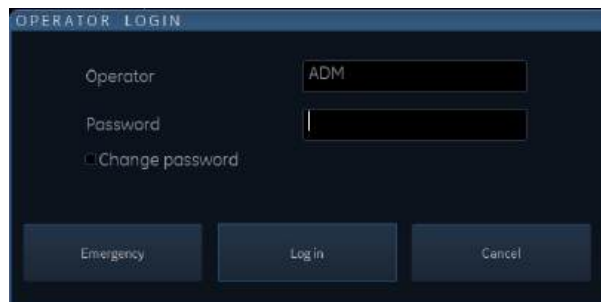


Figure 3-4. Operator Login Window

1. **Operator:** Enter the Operator ID.
2. **Password:** Enter Operator's password (optional).
3. **Log in or Cancel.**
 - **Log in:** Proceed with the logon
 - **Emergency:** Data stored only for the duration of the current exam (EUSR)
4. **Change Password:** Change password, as specified by the Password Policy.

Emergency access to the system

The Vivid *iq* Ultrasound System has an Emergency mode for using the system with minimal user authentication.

LED

Press the On/Off switch to turn power on. The power On/Off switch illumination turns to white.



Figure 3-5. The LED light

1. Indicates power status. After pressing the power On/Off switch, the system power is on and this LED is lit.
Color: White
2. Indicates the battery status. When the battery is charging, the LED is white. When battery is fully charged, the LED is off. When battery capacity is low, the LED is orange.
Color: White and Orange
3. Indicates hard disk working status. When the LED is flashing, the system is writing or reading from the hard disk.
Color: White

The system also has interactive 3-state backlight to indicate operator panel status:

1. White: active
2. Blue: available
3. Dim: off

To power off the unit

When the ultrasound unit is powered off, the system performs an automatic shutdown sequence. It is recommended to perform a full shutdown at least once per week.

Shutdown

1. Press the on/off button on the Control Panel.

The *Shutdown dialogue* window is displayed.

NOTE: *In case of total lockup of the system, hold the on/off button down a few seconds to turn the system off.*

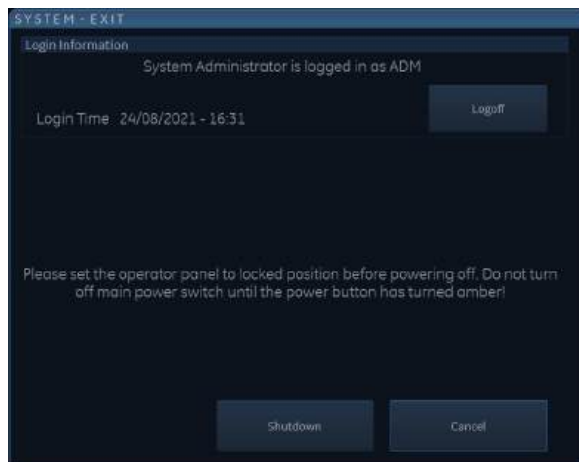


Figure 3-6. The Exit window

2. Select **Shutdown**.

The shutdown process takes a few seconds and is completed when the on/off button turns off.

NOTE: *After switching off the system, wait at least ten seconds before turning it on again.*

When switching the unit off to move it, follow the additional steps below:

1. Wait until the on/off button has turned off.
2. Remove the plug from the mains power socket.

Standby Mode

When the LCD monitor is locked when the system is working, it will enter the Standby mode automatically.



CAUTION

Patient data should be saved before entering standby mode.

Locking/unlocking the LCD monitor

The LCD monitor will be locked automatically when the system is closed with a little force.

Press the button under the Vivid logo to unlock the LCD and the LCD monitor can be opened.



Figure 3-7. Unlock the LCD



CAUTION

There is a pinch point on the LCD monitor. Take care to avoid injuring hands or fingers when flipping down the LCD monitor.



Figure 3-8. The pinch point

LCD monitor position adjustment

The LCD monitor position can be adjusted for easy viewing.

- The monitor can be moved forward/backward for the optimum viewing position.



Figure 3-9. LCD adjustment forward/backward

LCD monitor position adjustment (continued)

- The monitor can be rotated up/down around its central pivot point for viewing as a pad.



Figure 3-10. LCD adjustment up/down



CAUTION

The maximum angle for the monitor opening up is 90 degree, do not push the LCD panel with force, otherwise it will damage the hinge.

LCD Monitor Brightness adjustment

The Monitor brightness can be adjusted to the normal viewing of a good gray scale image. The operator may press the right corner of the LCD screen to display the tray menu, and press + or - to adjust the brightness.

Cart Adjustment

Please refer to Vivid *iq* Mobile Cart User Instruction for details of Cart Adjustment.

Moving and Transporting the Unit

Moving the unit

To prepare the unit to be moved

1. Turn the system off, and remove the plug from the wall.
2. Disconnect all cables linking the unit to any off-board peripheral devices and network.

NOTE: *To prevent damage to the power cord, DO NOT pull excessively on the cord or make sharp bends while wrapping.*

3. Store all probes in their original cases or in soft cloth or foam to prevent damage.
4. Ensure that no loose items are left on the unit.
5. Store sufficient gel and other essential accessories in the special storage case.



WARNING

Be sure to shut down the system completely before any transportation to avoid system overheating.



CAUTION

Avoid the pinch during moving the system.

To ensure safety while moving the unit

1. DO NOT attempt to move the unit using cables or probe connectors.
2. Always use the handle to move the system.
3. Ensure that the unit does not strike the walls or door frames.

Transporting the unit

Take extra care when transporting the unit by vehicle. In addition to the moving precautions listed under 'Moving the unit' on *page 3-22*, follow the procedure described below.

1. Disconnect all probes and secure them in their boxes.
2. Ensure that the unit is secured inside the vehicle.

Pack the system into the rolling bag

The user can pack the system into the rolling bag to transfer the unit.



Figure 3-11. The rolling bag

1. Put the system into the liner package.
2. Connect the belts.
3. Zip up the rolling bag.



Figure 3-12. Pack the system

Reinstalling at a new location

Acclimation Time

After being transported or stored, the system requires one hour for each 2.5 degree increment when its storage or transport temperature is below 10 °C or above 40 °C.

Table 3-2: System Acclimation Time Chart

Degree C	50	45	40	35	30	25	20	15	10	5	0	-5
Degree F	122	113	104	95	86	77	68	59	50	41	32	23
hours	4	2	0	0	0	0	0	0	0	2	4	6

System Description

System overview



Figure 3-13. Vivid iq system opened view

Control Panel

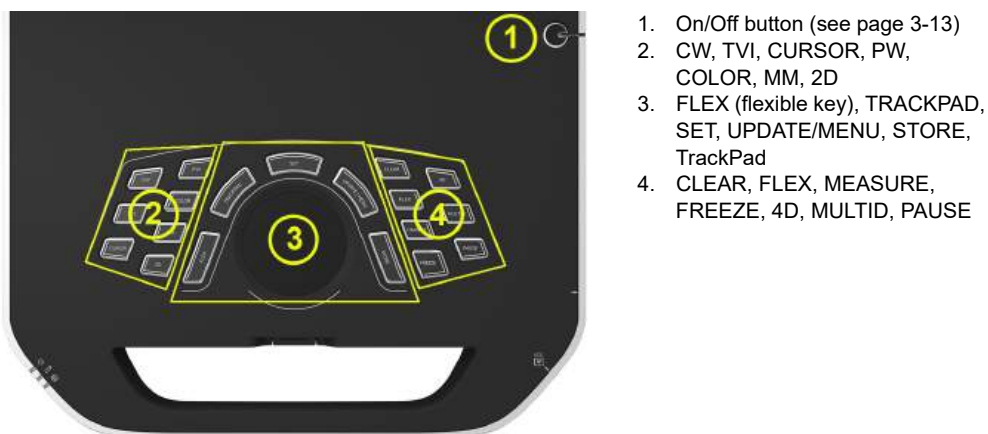


Figure 3-14. The Control Panel

Control Panel (continued)

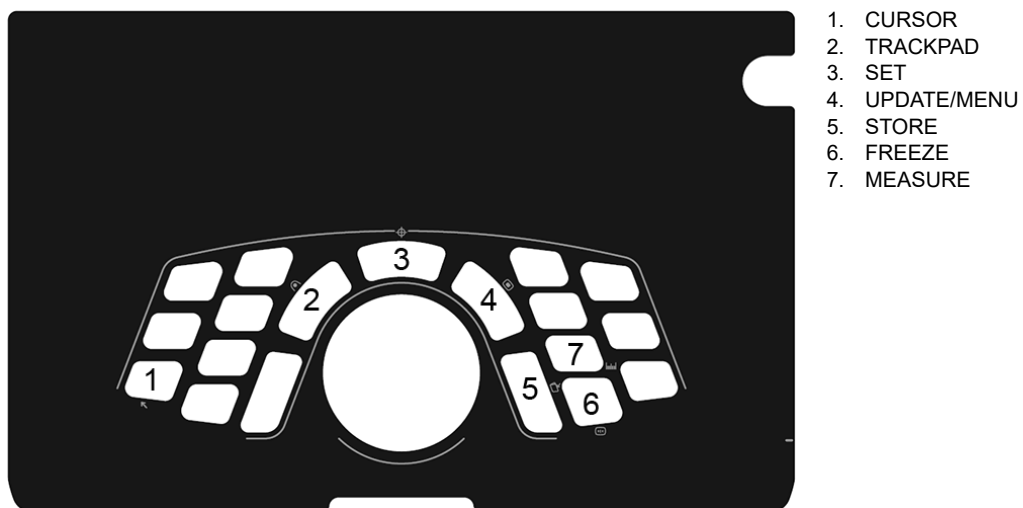


Figure 3-15. The Control Panel Film (Option)

Key illumination

The keys on the Control Panel are illuminated with white light in dimly environment.

Tray Menu

The Tray Menu is situated on the right top of the touch screen and contains some general functions of the system. When you click on the right top of the touch screen, the Tray Menu will display.

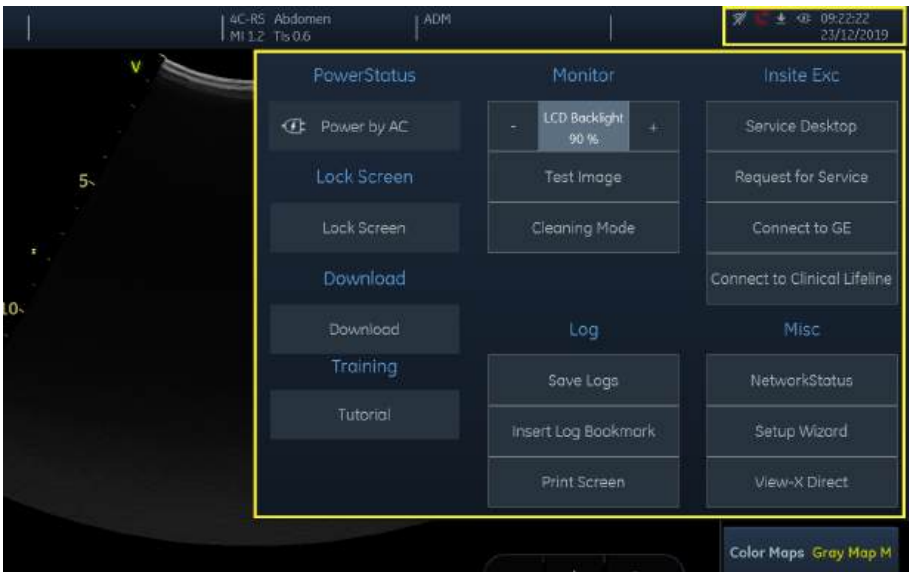


Figure 3-16. Tray Menu

Side Bar

The Side Bar is situated on the right side of the touch screen and contains the specific controls of mode/function.



Figure 3-17. Side Bar

Operation Panel

The Operation Panel is situated at the bottom part of the touch screen. The Operation Panel contains specific controls of each scanning mode.

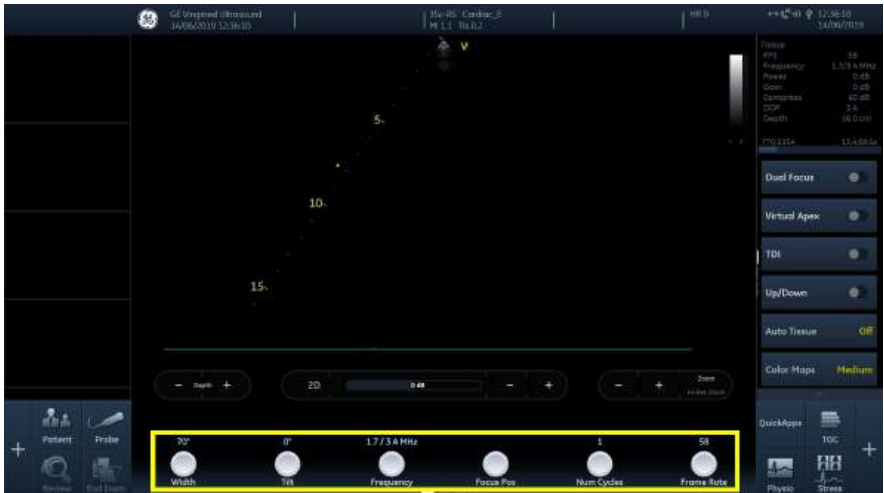


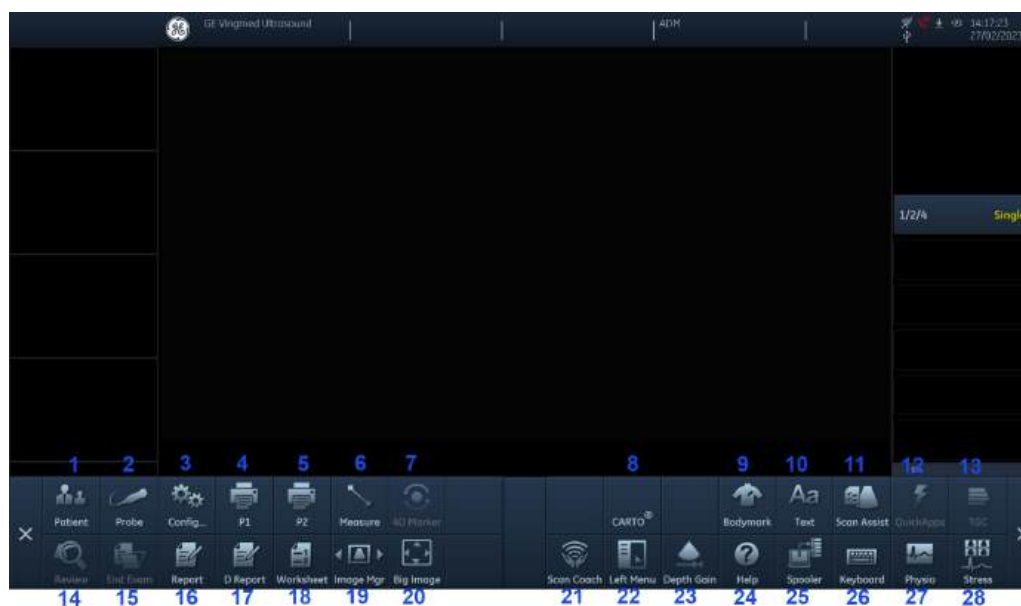
Figure 3-18. Operation Panel

Shortcut Bar

The Shortcut Bar is situated at the bottom part of the touch screen. The Shortcut Bar contains specific controls of exam functions.

Select either of the  icons on the left/right side of the Shortcut Bar at the bottom to expand the Shortcut Bar.

The expanded Shortcut Bar contains all the exam functions. The layout of the controls is configurable.



1. Patient	11. Scan Assist Pro	21. Scan Coach
2. Probe	12. QuickApps	22. Left Menu
3. Config...	13. TGC	23. Depth/Gain
4. P1	14. Review	24. Help
5. P2	15. End Exam	25. Spooler
6. Measure	16. Report	26. Keyboard
7. 4D Marker	17. Direct Report	27. Physio
8. Carto	18. Worksheet	28. Stress
9. Bodymark	19. Image Manager	
10. Text	20. Big Image	

Figure 3-19. Shortcut Bar

The alphanumeric keyboard

The alphanumeric keyboard is situated on the touch screen.

- 1. Select either of the  icons on the left/right side of the Shortcut Bar at the bottom.



Figure 3-20. The button to expand the Shortcut Bar

- 2. Select Keyboard button to unhide the alphanumeric keyboard.



Figure 3-21. Keyboard button

- 3. Alphanumeric keyboard is displayed. Select  at the right bottom of keyboard to hide the keyboard.



Lang: Switch between the English and the set language keyboard.

Figure 3-22. Alphanumeric keyboard

Cart (option)

For detailed cart configuration, please refer to Vivid *iq* Mobile Cart User Instruction.

The Vivid *iq* cart is able to mount a paper tray to place paper tissue and a cable tray to place cables. Please refer to Vivid *iq* Mobile Cart User Instruction for details.

Install Vivid *iq* system to cart

The Vivid *iq* system can be mounted to cart and please refer to 'Install Vivid *iq* System to Cart' in Vivid *iq* Mobile Cart User Instruction for details.

Locking the Wheels

To lock the wheels, please refer to 'Lock/Unlock Wheels' in Vivid *iq* Mobile Cart User Instruction for details.

Charge Box (option)

The system supports a Charge Box as an option. Please refer to 'Charge Box (Option)' in Vivid *iq* Mobile Cart User Instruction for details.

Installing/Uninstalling the Charge Box

Charge Box can be removed from the cart system, please refer to 'Installing/Uninstalling the Charge Box' in Vivid *iq* Mobile Cart User Instruction for details.

Charge Box Care and Maintenance

For detailed care and maintenance of the Charge Box, please refer to 'Charge Box Care and Maintenance' in Vivid *iq* Mobile Cart User Instruction.

Batteries in Charge Box

Batteries in Charge Box can be removed and replaced, please refer to 'Batteries in Charge Box' in Vivid *iq* Mobile Cart User Instruction for details.

LED Indicators Information

LED indicators show different status of the Charge Box and please refer to 'LED Indicators Information' in Vivid *iq* Mobile Cart User Instruction for details.

View Cart Battery Status

When the Cart Battery is being charged through the console, the cart battery status can be viewed from the screen. Please refer to 'View Cart Battery Status' in Vivid *iq* Mobile Cart User Instruction for details.

Battery

The lithium ion battery provides power when an AC power source is not available. A battery in the battery bay is standard with the Vivid *iq*. Lithium ion batteries last longer than conventional batteries and do not require replacement as often. You can expect approximately 1 scanning hour with the fully charged battery in use to supply power to the system, depending on operation modes used and battery status.

The expected battery lifetime is at least 2 years.

NOTE: *Where the integrity of external protective conductor in the installation or its arrangement is in doubt, EQUIPMENT shall be operated from its battery.*

NOTE: *While scanning with the battery supplying power only, the battery life may be shorter. Always archive the data and keep your attention on the battery status. When the battery power is low, charge the battery immediately in case that scanning will be interrupted and the data will be lost due to the automatic shutdown of the system.*

The lithium ion technology used in your system's battery is significantly less hazardous to the environment than the lithium metal technology used in some other batteries (such as watch batteries). Used batteries should not be placed with common household waste products. Contact local authorities for the location of a chemical waste collection program nearest you.

NOTE: *The battery is designed to work with Vivid *iq* systems only. Only use the batteries authorized by GE.*

Temperature Requirements

The battery should be charged, discharged and stored within the parameters outlined below:

- Operating temperature:
 - Charge: 3 - 30°C (50 - 86°F).
 - Discharge: 3 - 30°C (50 - 86°F)



Do not expose the battery to temperatures over 60°C (140°F). Keep it away from fire and other heat sources.



- The battery has a safety device. Do not disassemble or alter the battery.
- Do not short-circuit the battery by directly connecting the negative terminals with metal objects.
- Do not heat the battery or discard it in a fire.
- Do not charge the battery near a heat source, such as a fire or heater.
- Do not leave the battery in direct sunlight.
- Do not pierce the battery with a sharp object, hit it, or step on it.
- Do not use a damaged battery.
- Do not solder a battery.
- Do not connect the battery to an electrical power outlet.



If the Vivid *iq* is not being used on a monthly basis, the battery needs to be removed during the lengthy non-use period.

Battery (continued)



CAUTION

To avoid the battery bursting, igniting, or fumes from the battery causing equipment damage, observe the following precautions:

- Do not immerse the battery in water or allow it to get wet.
- Do not put the battery into a microwave oven or pressurized container.
- If the battery leaks or emits an odor, remove it from all possible flammable sources.
- If the battery emits an odor or heat, is deformed or discolored, or in a way appears abnormal during use, recharging or storage, immediately remove it and stop using it. If you have any questions about the battery, consult GE or your local representative.

Discharge/Charge Cycle

When the battery is stored for three months or more, the customer should perform one full discharge/charge cycle.

NOTE: *A full discharge/charge cycle means the system is turned on using battery power until the battery loses its charge completely and the system shuts down. Plug the Vivid iq in until the battery is fully charged as indicated by a green LCD light.*

Upon receipt of the Vivid iq and before first time usage, it is highly recommended that the customer perform one full discharge/charge cycle.

If the battery has not been used for >2 months, the customer is recommended to perform one full discharge/charge cycle. It is also recommended to store the battery in a shady and cool area with FCC (full current capacity).

One Full Discharge/Charge Cycle Process:

1. Full discharge of battery to let the Vivid iq automatically shut down.
2. Charge the Vivid iq to 100% FCC (full current capacity).
3. Discharge of Vivid iq for complete shut down (takes one hour for discharge).

When storing packs for more than 6 months, charge the pack at least once during the 6 month timeframe to prevent leakage and deterioration in performance.



CAUTION

Use only GE recognized batteries.

View current battery status

Users can check the battery icons to know the battery type, battery capacity, battery working status, battery charging status and battery health on the title bar of the right upper corner.

Battery type

Vivid *iq* can be powered by two different batteries. One is internal battery called scanner battery. The other one is installed inside charge box on cart, called cart battery. We use the following icons representing the battery type (Figure 3-23).



Figure 3-23. Scanner battery icon(left) and cart battery icon (right)

Battery capacity

We use the following icons to indicate the level of battery capacity. Take scanner battery icon as an example to explain.



Figure 3-24. Battery capacity levels

Table 3-3: Battery capacity icons

	This icon means the battery capacity is below 5%.
	This icon means the battery capacity is exceeding 5% and less than 15%.
	This icon means the battery capacity is exceeding 15% and less than 25%.
	This icon means the battery capacity is exceeding 25% and less than 50%.
	This icon means the battery capacity is exceeding 50% and less than 80%.
	This icon means the battery capacity is exceeding 80% and less than 100%.

Battery working status

We use the following icons to indicate the battery working status. Take scanner battery icon as an example to explain.



Figure 3-25. Battery working status icon

Table 3-4: Battery working status icons

	This icon means the battery is absent.
	This icon means the battery is working normally.
	This icon means there is an unknown error on battery.
	This icon means there is a permanent error on battery.

NOTE: *If there is an unknown error detected on your battery, please restart the ultrasound system or contact GE HealthCare service representative.*

NOTE: *If there is a permanent error detected on your battery, it means your battery has reached its end of life or is damaged. Please replace with a new one.*

Battery charging status

We use the following icons to indicate the battery charging status. Take scanner battery icon as an example to explain.



Figure 3-26. Battery charging status icon

Table 3-5: Battery charging status icons

	This icon means the battery is discharging.
	This icon means the battery is charging.

Battery health status

If the battery health is below 60%, a yellow exclamation mark will appear on battery icon. Take scanner battery icon as an example to explain.



Figure 3-27. Battery health status icon

NOTE: *If battery health below 60%, it's recommended to replace a new one.*

View current battery status from title bar

When the system is running on cart battery, there is a battery icon in the system title bar.



Figure 3-28. Running on cart battery

When the system is running on scanner battery, there is a battery icon in the system title bar.



Figure 3-29. Running on scanner battery

When the system is running by AC adapter without any battery installed, the AC adapter icon appears in the system title bar.



Figure 3-30. Charged by AC adapter

Battery Information Check

To view detailed information for scanner battery and cart battery, please select the tray menu from the right upper corner and press either of the battery buttons.

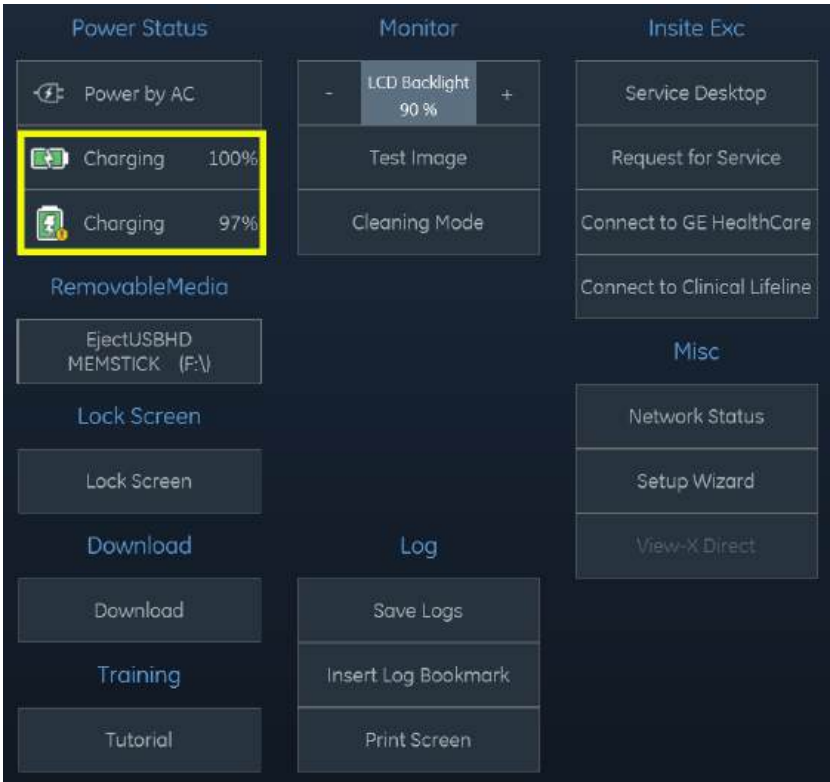


Figure 3-31. Battery Charging Icon

Battery Information Check (continued)

The pop-up window will show detailed battery information, including battery status, battery capacity and battery health for both scanner and cart.

Battery capacity is shown in percentage and battery health is shown by symbols. For cart battery, except the total capacity and total health, user can also check the battery status and battery health for each battery.

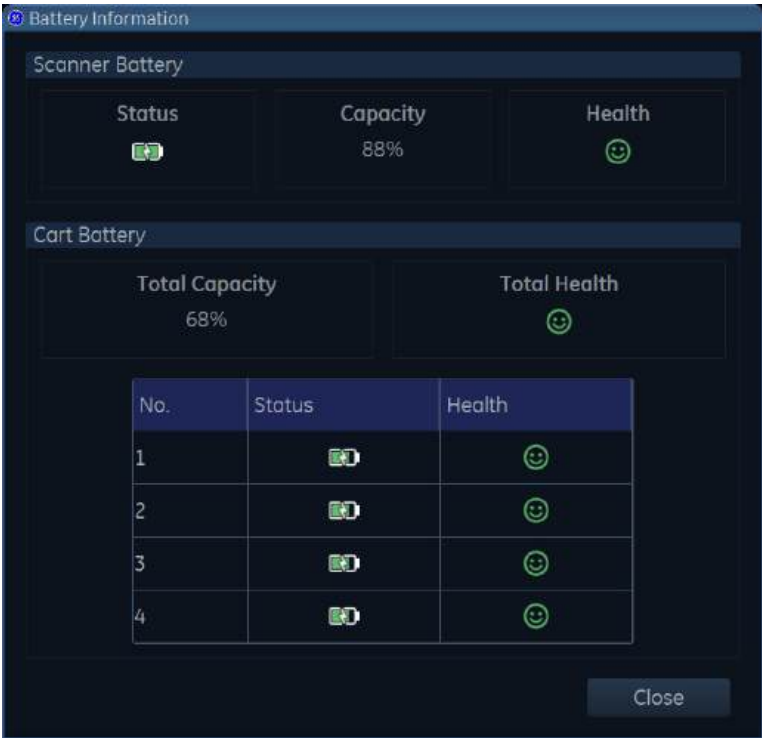


Figure 3-32. Battery Information Window

Battery Information Check (continued)

The following table will explain battery health icons.

Table 3-6: Battery Health Icons

	Green smile icon indicates the battery is in good health.
	Yellow icon indicates the battery health is below 60% and close to end of its life. Recommend to replace a new battery.
	Red sad icon indicates the battery has reached end of its life and can't be used for scanning. Replacement of a new battery is needed.
	This icon indicate state of health is not supported by current battery.

Battery Information Check (continued)

If the battery health is below 60%, there will be a warning message displayed on the lower part of battery information window to remind the user to replace a new battery.

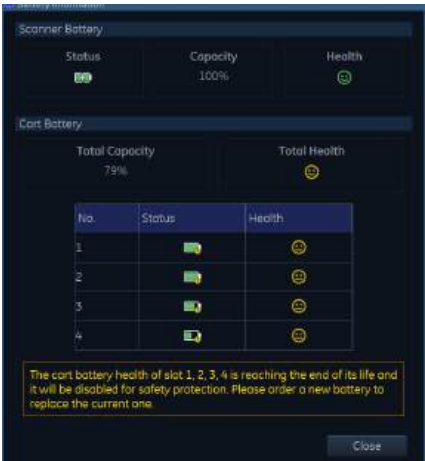


Figure 3-33. Battery Replacement Reminder (1)

If the battery has reached the end of its life and disabled for any further use, a warning message will be displayed on the lower part of battery information window to request the user to organize the replacement.



Figure 3-34. Battery Replacement Reminder (2)

Battery power low

If the battery is in use and the battery power capacity is below 15%, a message appears to warn the user that the battery power is low and it needs to be charged.

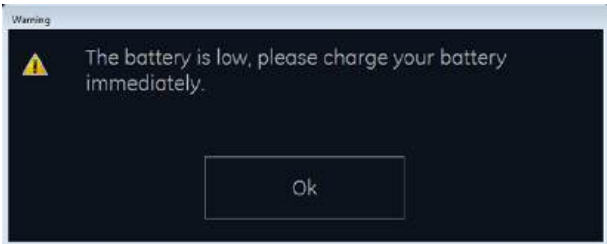


Figure 3-35. Battery power low (1)

If the battery is in use and the battery power capacity is below 5%, a message appears to warn the user to charge the battery immediately or the system will be shut down.

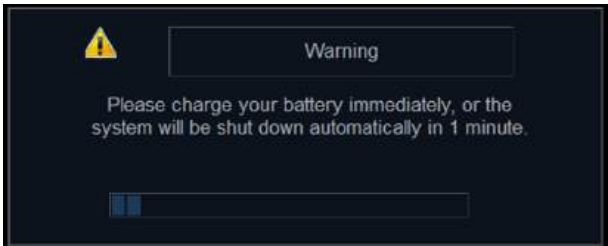


Figure 3-36. Battery power low (2)

Battery Removal

To remove the battery from the bottom cover of the system:

1. Shut down the system and disconnect the AC/DC power cord.
2. Push up the battery lock to both ends of the slot with both thumbs.



Figure 3-37. Unlock the battery

3. The battery is released. Put the finger in the breach of the battery box to dig up the battery and remove it from the battery box.



Figure 3-38. Remove the battery

Battery Installation

To install the battery to the bottom cover of the system:

1. Shut down the system and disconnect the AC/DC power cord.
2. Put the back end of the battery into the battery box.



Figure 3-39. Place the battery in the battery box

3. Press the battery until the battery is locked.

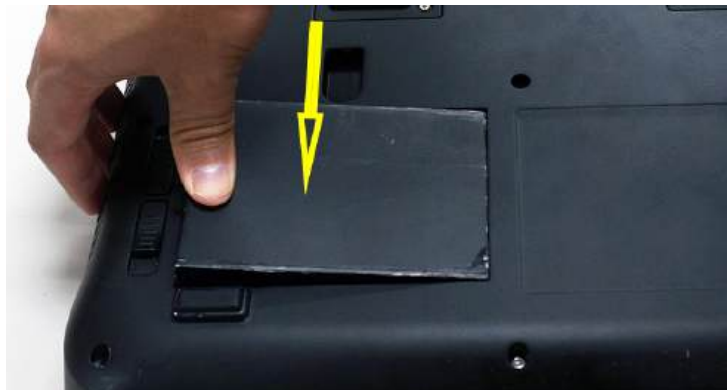


Figure 3-40. Install the battery

AC Adapter



CAUTION

Do not use an AC adapter without approval by GE.

Be sure that nothing rests on the AC adapter's power cable and that the cable is not located where it can be tripped over or stepped on.

Place the AC adapter in a ventilated area, such as a desk, when you use it to run Vivid *iq*. Do not cover the AC adapter with paper or other items that will reduce cooling; do not use the AC adapter inside a carrying case.

To prevent damage to the power cable of the AC adapter, DO NOT pull excessively on the cable; DO NOT make any sharp bends; DO NOT bend the power cable frequently.

Peripheral/accessory connector panel

The Peripheral/accessory connector panel is located at the side and rear of the unit (see Figure 3-41).



Figure 3-41. Peripheral/accessory connector panel

1. 2 USB ports (3.0), Max 5.0Gbps	6. Port for DC In (for AC Adapter and connecting to cart)
2. ECG connector port	7. Ethernet Network port (LAN port)
3. 4D probe connector port (for connecting 4D probe cable from cart)	8. HDMI port (Video output)
4. 1 probe connector port	9. Security lock
5. USB port (2.0) (for USB connection and connecting to cart), Max 480 Mbps	10. 2 USB ports (2.0), Max 480 Mbps

Peripheral/accessory connector panel (continued)



WARNING

Accessory equipment connected to the analog and digital interfaces must be certified according to the respective IEC standards (e.g. IEC 60950 for data processing equipment and IEC 60601-1 for medical equipment). Any person connecting additional equipment to the signal input part or output part of the ultrasound unit configures the medical system and is therefore responsible that the system complies with the requirements of the system standard IEC 60601-1. If in doubt, consult the technical service department or your local representative.

Do not touch the conducting parts of the USB or Ethernet cables when connecting equipment to the unit.



WARNING

Any devices or cables, other than those sold with the ultrasound unit, connected to the Peripheral /accessory connector panel, or to a USB port on the unit may result in an increase in the electromagnetic emission from the unit, or a decrease in the electromagnetic immunity of the unit.

Wired Footswitch (Option)

You can attach this Footswitch to the system by connecting it to one of the USB ports at the side of the system.



CAUTION

Disconnect the Footswitch before moving the system.



Figure 3-42. Footswitch and USB Cable

This is a 3-pedal Footswitch. You can configure its functionality from the **Config/Imaging/Application**. See 'Application Preset' on *page 5-90 for more information*.



CAUTION

When using the Footswitch, DO NOT hold down the footswitch pedal. Press and release the Footswitch pedal. Pushing and holding down the pedal behaves the same way as pushing and holding down a key on the keyboard.

Sony UP-D25MD (option)

1. Place the device in a suitable place.
2. Connect the USB Cable on the Printer.
3. Connect the power cord with the AC output in the wall outlet, then turn on the printer.
4. Connect USB cable to Vivid iq USB port.



Figure 3-43. Color Printer connection

UP-D898 MD Printer (option)

1. Place the device in a suitable place.
2. Connect the USB Cable on the Printer.
3. Connect the power cord with the AC output in the wall outlet, then turn on the printer.
4. Connect USB cable to Vivid iq USB port.



Figure 3-44. UP-D898 MD connection

Note regarding USB ports

Depending on the system configuration, USB mass storage may be disabled on the system (see 'USB External Media disabled' on *Page 4-14*). Enabling/disabling of USB mass storage can only be done by users with administrator rights: Sys Admin or GE Admin users (see 'System Users' on *page 4-61*).

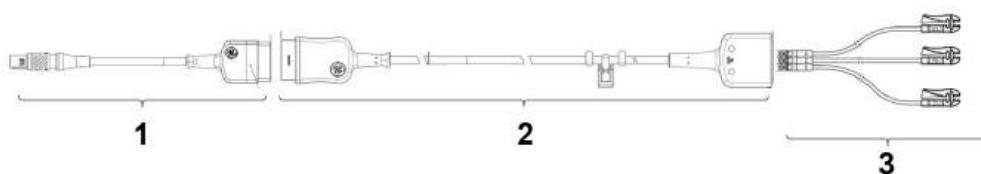
ECG

Installation procedure

Follow the below steps to connect the ECG Adapter Cable:

1. Connect the round connector of the ECG Adapter Cable to Vivid iq.
2. Connect the rectangular connector of the ECG Adapter Cable to Multi-Link 3-lead ECG Trunk cable.
3. Connect the leadwire set to the electrodes. Verify that the ECG signal appears on the ultrasound screen.

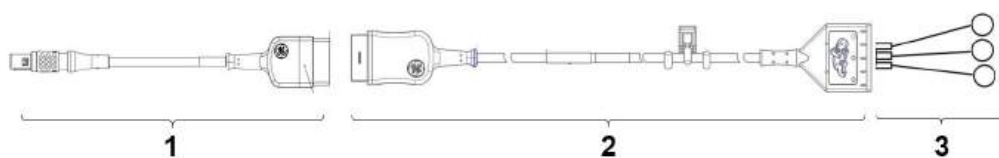
Adult configuration



1. ECG Adapter Cable
2. ECG cable, adult
3. ECG lead set, adult

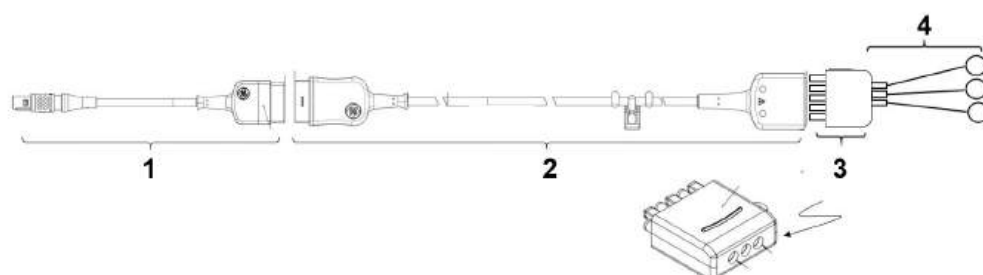
Figure 3-45. Adult Configuration

Neonatal configuration



1. ECG Adapter Cable
2. ECG cable, neo
3. Lead electr, neo

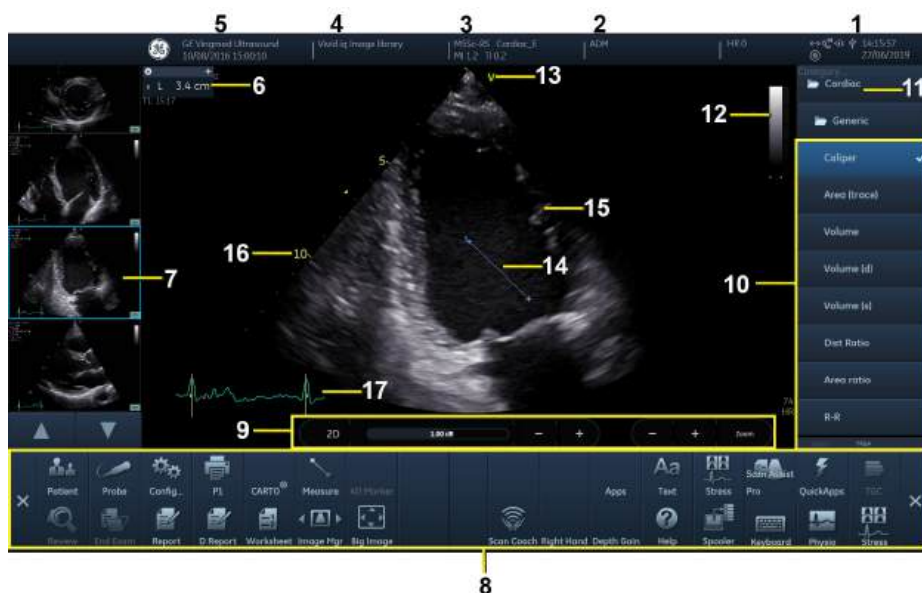
Figure 3-46. Neonatal Configuration 1



1. ECG Adapter Cable
2. ECG cable, adult
3. Adapter, ECG 3-lead
4. Lead electr, neo

Figure 3-47. Neonatal Configuration 2

The Scanning screen



1. -- Date
-- Time
-- Extended Life Battery icon
-- System battery icon
-- InSite ExC icon
-- USB device icon
-- Network icon
-- CD icon
2. Operator ID
3. -- Probe
-- Application
-- Mechanical & Thermal Index
4. Patient information
5. Institution/Hospital Name, Date, Time, System status (real-time of frozen)
6. Measurement result table
7. Clipboard
8. Shortcut Bar, Operation Panel
9. Gain Bar
10. Side Bar
11. Measurement category
12. Grayscale/Color bar
13. Probe orientation marker
14. Measurement
15. Image
16. Depth scale
17. Physiological traces, ECG, Resp

Figure 3-48. The scanning screen

Setup Wizard

Setup Wizard (Installation wizard) is a function to enable the operator to configure some common system settings when turning on the system for the first time after the software installation.

For Vivid iq, you can also enter Setup Wizard by clicking the **Setup Wizard** button on the tray menu.

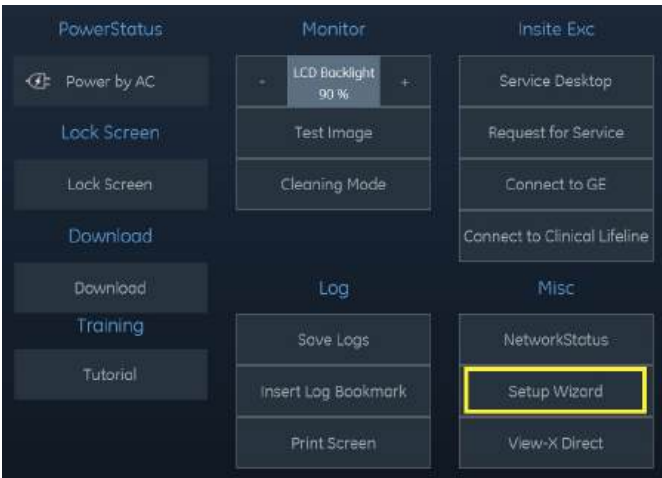


Figure 3-49. Enter Setup Wizard

Setup Wizard (continued)

1. Select the appropriate language for system language, manual language and input language from the drop-down list.



Figure 3-50. Language settings (1)

- If you do not change the language, press **Next** to continue.
- If you change the language setting, press **OK** to restart the system.

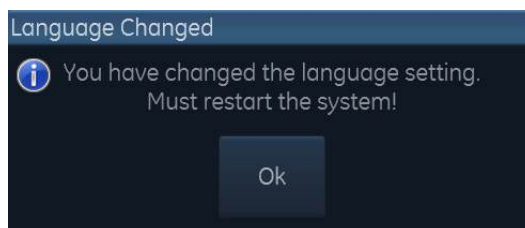


Figure 3-51. Language settings (2)

Setup Wizard (continued)

NOTE: If you press **Previous**, you will go to the previous page.

2. This screen shows the hospital and time information, and you can set the system date and time here.

SETUP WIZARD

Language Setting
General Information
Network Information
Insite Information
Summary Information

Hospital Information

Hospital: GE Vingmed Ultrasound

Department:

Echelon:

Time Information

System Date: 11/06/2019

System Time: 00:21:47

Time Format: 24

Date Format: EU

Default Century: 1900

Sync Time

Other Information

Units: Metric

Exit Restore Previous Next

Figure 3-52. General Information

3. Press **Next** to continue.
4. The **Network Information** screen shows the configuration of wireless and local network:

Setup Wizard (continued)

Language Setting TCP/IP

General Information

Network Information Choose the connection: Intel(R) Ethernet Connection (2) I219-LM Enable DHCP ☒

Insite Information MAC Address 00:30:64:56:58:AD

Summary Information IP Address 3.35.256.16

Subnet Mask 255.255.255.0

Default Gateway 3.35.256.254

DNS 10.220.220.220 Apply Refresh

Exit Restore Previous Next

Figure 3-53. Network Information (1)

Language Setting TCP/IP

General Information

Network Information Choose the connection: NETGEAR A6210 WiFi USB3.0 Adapter Enable DHCP ☒

Insite Information MAC Address A0:63:91:7E:D4:50

Summary Information IP Address 3.35.158.78

Subnet Mask 255.255.255.0

Default Gateway 3.35.158.254

DNS 10.220.220.220 Apply Refresh

Wireless

Scan Connect SSID

Authentication

Encryption

Password

Exit Restore Previous Next

Figure 3-54. Network Information (2)

Setup Wizard (continued)

Table 3-7: Network settings

Preset Parameter	Description
Enable DHCP	Select to enable DHCP.

- 5. Press **Next** to continue.
- 6. This screen shows the Agent Configuration. Check the Proxy box to configure the Proxy information and press **Submit**.

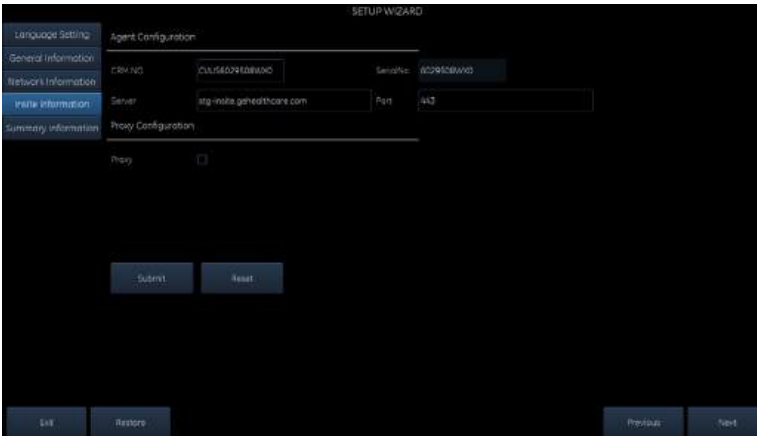


Figure 3-55. Agent Configuration

- 7. Press **Next** to continue.

Setup Wizard (continued)

- This screen shows the report of the previous settings. You can export it to the file.

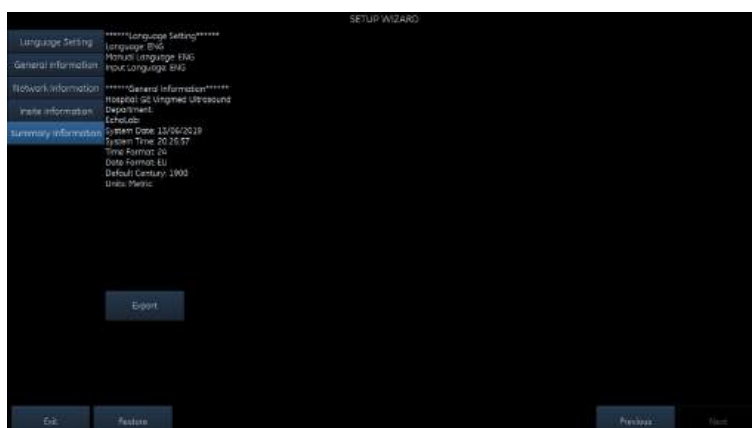


Figure 3-56. Summary Information

Press **Export** to store the report.

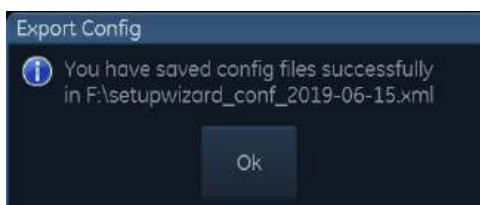


Figure 3-57. Export Summary

- Press **Exit** to exit Setup Wizard.

Perform exams without logging in

Overview

The Vivid *iq* gives the user full access to scanning and diagnostic functionality without having to log in. The user can switch on the system, start scanning and do diagnostics immediately as soon the system is powered up.

In this mode, the user will not have access to images and data stored on the system. The user will not be able to do any configuration changes to the system.

If pressing **Patient** to enter the Patient screen, the Operator Login dialog will be shown.

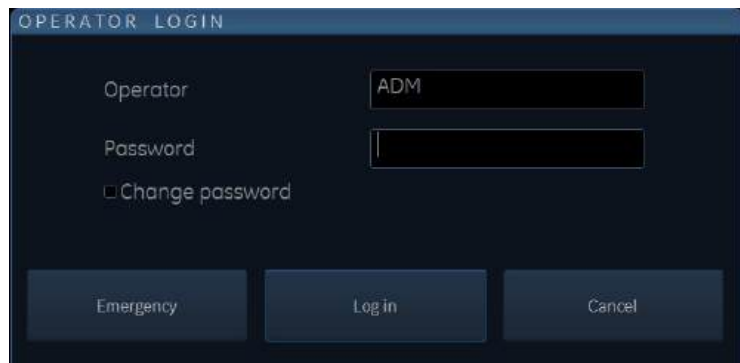


Figure 3-58. Operator Login dialog

The user can continue without logging in. Click **Emergency** button to start in Emergency mode or **Cancel** to return to scanning screen.

In Emergency mode, the user can create one patient record and enter patient demographics for one patient.

Unsaved images from previous session

When having completed a session without logging in to the system (by use of Emergency mode or operating the system without logging in) there might be images and data stored in the temporary storage. If so, the Operator Login dialog will be shown at next startup of the system.

The user can still choose between logging in, use Emergency mode or cancel the log in to enter the scanning screen.

Storing data to a dataflow

When data are stored without a patient record the images are not assigned to an exam or a patient.

When logging in to the scanner the user is asked to keep or discard the unsaved images, see Figure 3-59

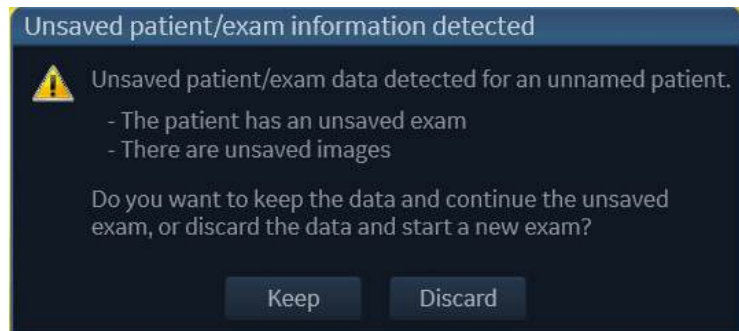


Figure 3-59. Unsaved patient/exam information

Next, when creating a new patient or opening an existing patient, the user will be asked to add the unsaved images to the patient record.

Storing data to a dataflow (continued)

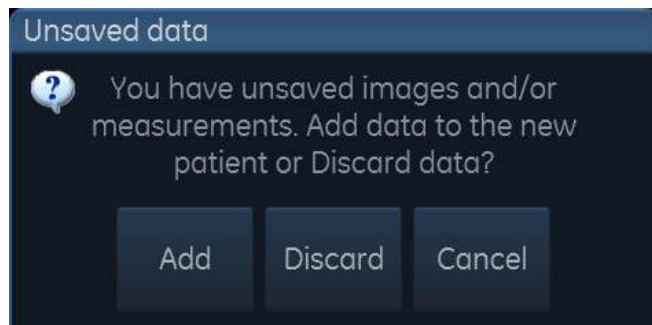


Figure 3-60. Unsaved data window

Patient record created in Emergency mode

When a patient record is created in Emergency mode, it is temporarily stored to the "NoArchive" dataflow. When there are unsaved patient record(s) in NoArchive when a user logs in, the user is asked if he/she want to transfer the patient record from "NoArchive" to another dataflow for permanent storage.

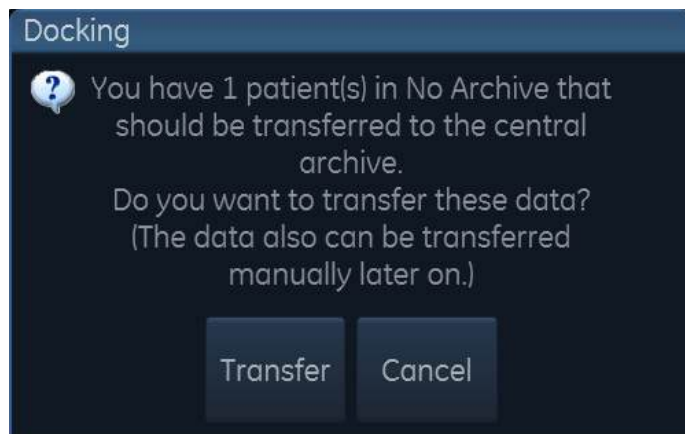


Figure 3-61. Docking dialog

Select **Transfer** to enter *Transfer* screen and to copy the patient record from NoArchive to another dataflow.

Starting an Examination after logging in

Creating a new patient record

1. Select **Patient** on the Shortcut Bar.
If required, log on by typing the user ID and password.
The *Archive* screen is displayed (Figure 3-62 on page 3-71).
2. In the *Archive* screen select the desired dataflow.
3. Type the **Patient Name**, and/or **ID**.

NOTE: *The unit can be configured to automatically generate a patient ID.*

With the default configuration, the system automatically checks whether the patient is already in the archive. The result of this search is displayed in the *Patient* list.

Verify that the patient to be created is not already in the *Patient* list.

4. To create a new patient record, select **New Patient**.
The *Create new patient record* window is displayed.
5. Enter additional patient information if required and press **Create**.

The unit is ready for scanning or the *Patient info and exam* screen is displayed (Figure 3-63 on page 3-72), depending on the system configuration.

If the unit is configured to display the *Patient info and exam* screen, follow the steps below:

1. Fill in the additional information in the *Patient info and exam* screen if required.

NOTE: *The information displayed on screen can be adjusted from the list of available information on lower part of the screen (see Figure 3-63 on page 3-72).*

2. Select **Back to scan** on the screen to start the examination.

NOTE: *The patient ID MUST be unique. The system does not support patient ID repetition.*

Selecting an existing patient record

1. Select **Patient** on the Shortcut Bar.
If required, log on by typing the user ID and password.
The *Archive* screen is displayed (Figure 3-62 on page 3-71).
2. In the *Archive* screen select the desired dataflow.
3. Type the **Patient Name**, and/or **ID** or another query that identifies the patient.
When default configured, the system automatically searches to see if the patient is already in the archive. The result of this search is displayed in the *Patient* list.
4. To start a new examination, press **Add Exam**.

NOTE: *If an examination with the current date already exists you will be asked whether to continue the existing examination or create a new examination.*

Scanning a New Patient



WARNING

Imaging functions may be lost without warning. Develop emergency procedures to prepare for such an occurrence.



WARNING

Always use the minimum power required to obtain acceptable images in accordance with applicable guidelines and policies.



WARNING

Always use the system on a flat surface in the patient environment.



WARNING

Ensure that the hands of the patient are away from the system during the exam.

The position of the operator and the patient vary by scan region.

In most cases, the operator sits/stands straight in front of the operator console and the patient lies on the bed on the right (or left) side of the system.



CAUTION

To avoid patient identification errors, always verify the identification with the patient. Make sure the correct patient identification appears on all screens and hard copy prints.



CAUTION

Check the probe cable and lens to confirm they are not broken before scanning.

Scanning a New Patient (continued)

When starting a new patient's exam, ensure you do the following:

1. Press **Patient**.
2. Press **New Patient** on the Patient menu.
If there are images on the clipboard, a pop-up menu appears. Specify whether you want to add data to the new patient or Discard data.
3. Select **Add** to add the images to the new patient.
The *Create new patient record* window is displayed.
4. Fill in patient information in the pop-up window and press **Create** button to get back to the scan window.
5. Press **Patient** to fill in additional patient information or choose the exam category.
6. When you have completed the study, press **End Exam**.



After completing the measurement, verify that the measurement result window is updated before you send or save the image.

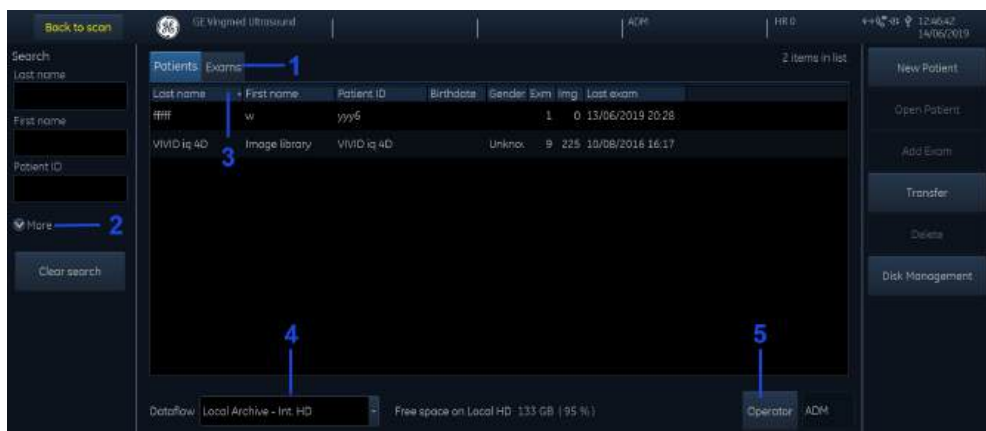
Ending an examination

There are 2 different options to end an exam. Perform one of the following actions:

- Select **End Exam** on the Shortcut Bar on touch screen.
- Select **Patient** on the Shortcut Bar, and select one of the following on the touch screen.

Archive: The examination is finished and the Archive screen is displayed. Any search criteria previously entered are remembered.

End Exam: The examination is finished and the *Archive* screen is displayed ready for a new search.



1. Display either patient or examination list.
2. Advanced search filters
3. Press one of the headings to sort the list accordingly (ascending/descending).
4. Select archive and other pre-defined services.
5. Change user.

The *Archive* screen may be slightly different depending on the Dataflow selected

Figure 3-62. The Archive screen

Ending an examination (continued)



- 1. List of examinations
- 2. Patient information
- 3. Examination information
- 4. Clipboard with images for the selected examination

Figure 3-63. The Patient info and exam screen

Chapter 4

Basic operations

This chapter describes:

‘Control Panel’ on page 4-2

‘Operation on Touch Screen’ on page 4-4

‘Removable Media’ on page 4-13

‘Physiological ECG Traces’ on page 4-20

‘Cineloop’ on page 4-28

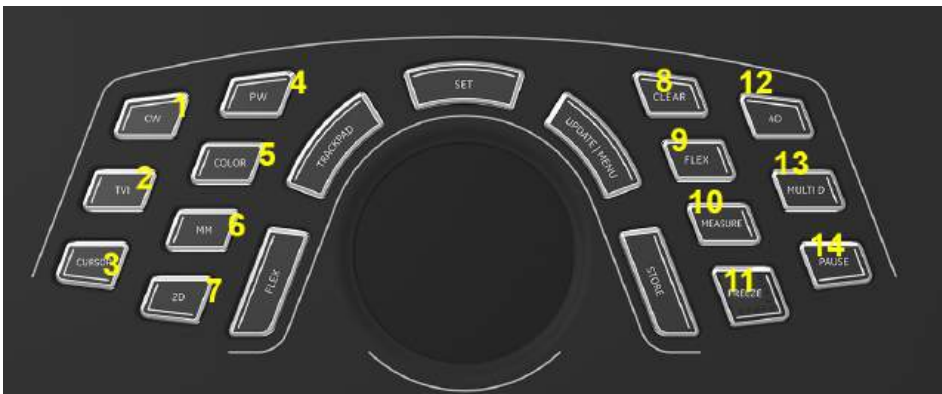
‘Zoom’ on page 4-31

‘Annotations’ on page 4-33

‘Configuration – System and Users’ on page 4-44.

Control Panel

Mode/Measurement/Feature keys



1. CW: Activate CW mode.
2. TVI: Activate TVI mode.
3. Cursor: Activate sample volume adjustment to adjust the sample volume location, length and angle.
4. PW: Activate PW mode.
5. Color: Activate Color Flow mode.
6. MM: Activate M mode.
7. 2D: Activate 2D mode.
8. Clear: Erase function.
9. Flex: Configurable with specific functions
10. Measure: Activate measurement function.
11. Freeze: Activate freeze mode.
12. 4D: Activate 4D mode.
13. Multid: Activate Multi-plane 4D.
14. Pause: Stop or restart a function, start/restart LOGIQ View.

Figure 4-1. Mode/Measurement/Feature keys (1)

Mode/Measurement/Feature keys (continued)



1. Trackpad:
 - Adjusts the selected control.
 - Moves the pointer.
 - Performs the selected control or highlighted menu item.
2. Flex key: Configurable with specific functions
3. Trackpad key:
 - Toggles between trackpad functional groups.
4. Set key:
 - A select key which functions like the mouse left key.
 - When Pos/Size is selected, press the Set key to switch between Pos and Size.
5. Update/Menu key:
 - In Live duplex mode (Doppler or M-mode): Toggles Live/Freeze between the 2D image and the spectrum image.
 - A select key which functions like the mouse right key.
6. Store key: Store Cine loop or images

Figure 4-2. Mode/Measurement/Feature keys (2)

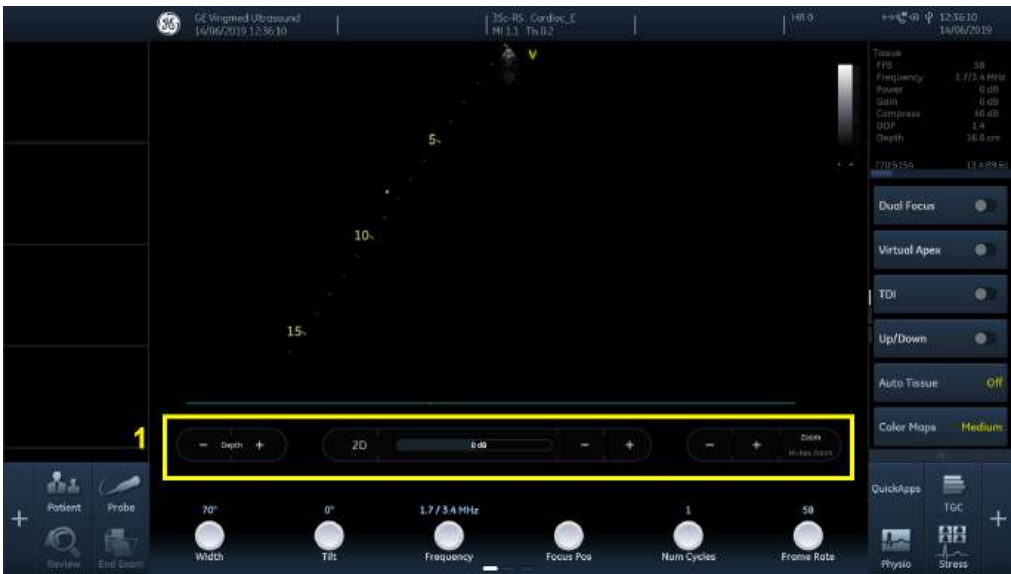
NOTE: The trackpad and LCD touch panel are able to operate by finger with medical gloves, the thickness of which is less than 0.5mm.

Operation on Touch Screen

Monitor Display

Gain Bar

The Gain Bar enables adjustment of depth, gain and zoom.



1. Depth/2D Gain/Zoom

Figure 4-3. Gain Bar

Shortcut Bar

The Shortcut Bar enables access to exam functions. You can press **+** on both sides to expand the menu to show all shortcut options. The layout of the shortcuts on the Shortcut Bar can be configured by moving the shortcut to the desired position. When you press the icon again, all the options are hidden except for the 4 options on each side.

The display of Shortcut Bar in the graphic is only an example. See 'Shortcut Bar configuration' on [page 4-49](#) for more information.



1. Patient	11. Scan Assist Pro	21. Scan Coach
2. Probe	12. QuickApps	22. Left Menu
3. Config...	13. TGC	23. Depth/Gain
4. P1	14. Review	24. Help
5. P2	15. End Exam	25. Spooler
6. Measure	16. Report	26. Keyboard
7. 4D Marker	17. Direct Report	27. Physio
8. Carto	18. Worksheet	28. Stress
9. Bodymark	19. Image Manager	
10. Text	20. Big Image	

Figure 4-4. Shortcut Bar

Shortcut Bar (continued)

Table 4-1: Shortcut Bar and Gain Bar

shortcut	Description
2D Gain	Adjust 2D Gain.
Depth	Adjust depth.
Zoom	Magnify the image display of a selected area.
Patient	Access the Archive screen.
Probe	Select probe and preset
Config...	Displays the configuration dialog box, allowing user configuration of various settings on the scanner. Some settings are configured for each application, press Application to access to application-specific settings.
P1	The function of the P1 can be customized by the user.
Carto	Set CartoSound Mode
Measure	Start the Measurement package
4D Marker	Enable the 4D marker function
Apps	Enable the Running Apps function
Bodymark	Access bodymarks.
Text	Access the annotation function.
Scan Assist Pro	Start Scan Assist Pro.
QuickApps	Enter QuickApps
TGC	Open TGC adjustment panel
Review	Review images in selected examination.
End Exam	End the current exam.
Report	Access report.
D Report	Access Direct Report
Worksheet	Display the measurement worksheet.
Image Manager	Review images in selected examination.
Big Image	Make the Image bigger
Scan Coach	Enable the Scan Coach function
Left Menu	Switch the side bar menu to the right or left
Depth/Gain	Enable the Depth/Gain adjustment bar
Help	Display the on-line version of the user manual.
Spooler	Display the current DICOM output jobs.

Table 4-1: Shortcut Bar and Gain Bar

shortcut	Description
Keyboard	Open alphanumeric keyboard
Physio	Access physiological traces.
Stress	Access to the Stress echo window.

Operation Panel

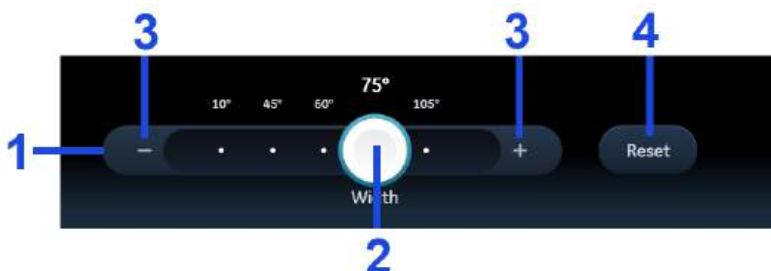
The Operation Panel are organized in tab pages on the Operation Panel. Move the Operation Panel left/right by touch to display the tab pages. The displayed controls may be different based on the active mode/function.

There are 1~3 short bars at the bottom of the Operation Panel. The highlighted short bar shows the current tab page among the left/middle/right pages.



Figure 4-5. Operation Panel

Select the control tab on the Operation Panel, the parameter values display for adjustment.



1. Gauge of parameter values.
2. The name below the tab indicates the current selected control/parameter. Location of the tab on the gauge indicates the current parameter value. Move the tab to left/right by touch to adjust the parameter value.
3. Parameter value adjustment tabs. Select "+" or "-" to adjust the parameter value.
4. Reset. Select this tab to reset the parameter value.

Figure 4-6. Mode/Measurement/Feature keys

Side Bar

The function controls are organized on the Side Bar. The active mode can be changed by selecting the corresponding tab.



Figure 4-7. Side Bar

There are different types of control buttons.

Button	Description
	Push button: Toggles the control between on and off states. - Highlighted color represents “On”. - Gray color represents “Off”.
	Menu push button: Opens a menu on screen. The selection in the menu is done by touch. The current selection from the menu is displayed inside the button.
	Push button: Toggles the control between different sates. The current state is displayed inside the button.
	When you see this icon on the right of the shortcut bar, it means the subsequent pages are available. You can swipe up and down for additional controls, and these controls are on off areas.

Trackpad with Gesture

Overview

Instead of pressing buttons on the operation panel, users can also adjust gain and depth with two fingers horizontally or vertically swiping on the trackpad.

Tutorial

For users feel strange about this feature, the system provides a tutorial instruction iconically showing how to do the adjustment on trackpad.

1. Press the **Tutorial** button on the drop-down tray menu on the right upper corner.

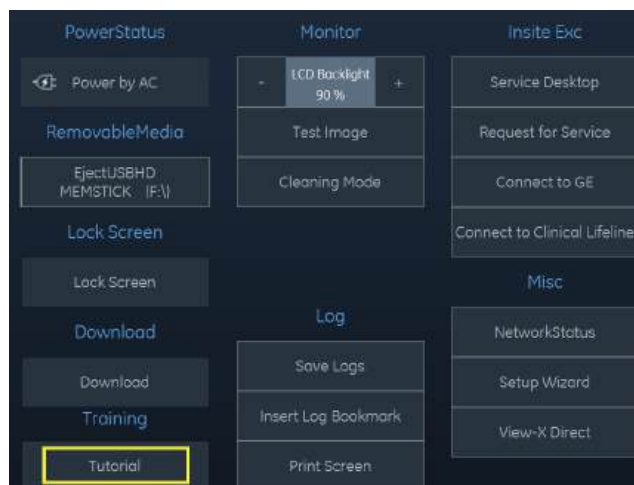


Figure 4-8. Tutorial Button

NOTE: There is a highlighted bar on the top of the scanning screen every time/week/month you start the system to inform users the trackpad gesture function. Press **Learn More** to learn more about the tutorial instruction. To hide the bar, you can go to the **Config(shortcut bar) -> System(tab) -> Trackpad(tab)** page and config the **"Show Tutorial"** section.



Figure 4-9. Highlighted Bar

Tutorial (continued)

2. Follow the indication on the display to adjust the Gain.



Figure 4-10. Gain Adjustment with Gesture

3. If you operate correctly, there will be a reminder to tell you will go to the next step.

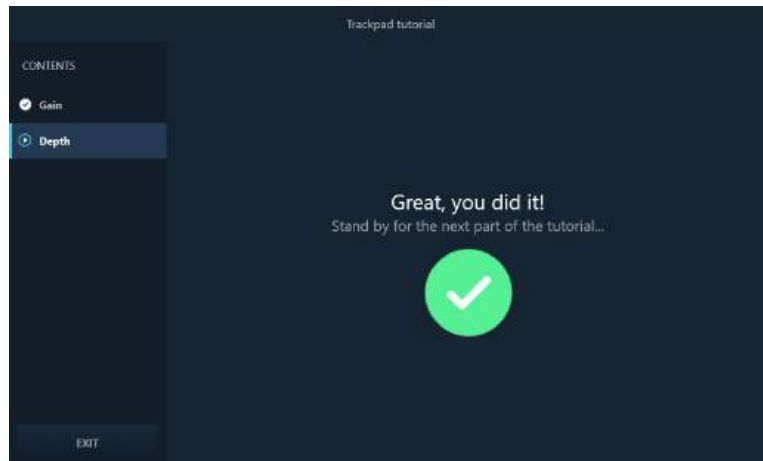


Figure 4-11. Stand by for the Next Step

Tutorial (continued)

4. Then, you will be prompted to adjust the **Depth**.



Figure 4-12. Depth Adjustment with Gesture

5. After the training is over, the system will inform you. Click the **Exit** button to start scanning.

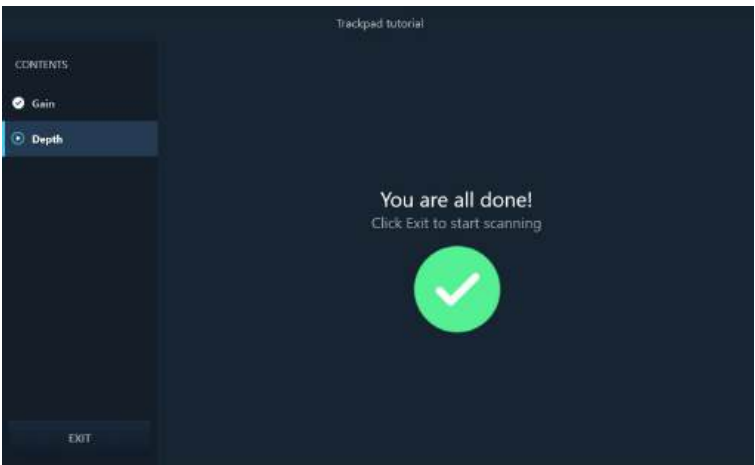


Figure 4-13. Finish Training

NOTE: *You can stop the tutorial training anytime you want by clicking the **Exit** button.*

Removable Media

Intended use

Removable media can be used for the following purposes:

- Long-term image storage: The final destination of the images, after they are moved out of the system harddisk by using the Disk Management feature (see page 10-85).
- Backup of patient database and system configuration presets (see page 10-95)
- Patient archive sneakernet: Copy a set of patient records between a scanner and EchoPAC Software Only using the Transfer feature (see page 10-77) with removable media.
- DICOM transfer to copy a set of patient records to/from a third party DICOM review station.
- XML export: Exports demographics, measurements, and reporting data from the unit to a third party reporting application using removable media (see page 10-77).
- Copy of system configuration presets between two units using the Backup/Restore feature (see page 10-95).
- Save images as JPEG, MP4, DICOM, or RawDICOM for review on a regular computer.

Supported removable media

The following removable media are supported:

- CD-R (option)
- DVD-R/W (option)
- USB Flash card
- USB memory stick
- USB HDD



CAUTION

USB Flash card:

- Use only shielded USB Flash cards that are verified for EMC performance according to EN55011/EN55022. The use of other USB Flash cards may cause interference on the system itself or on other electronic devices.

USB External Media disabled

By checking the USB External Media disabled box via **Config->Service**, you will disconnect all external USB Mass Storage devices connecting to the Vivid *iq* (requires reboot). Enabling/disabling of USB mass storage can only be done by users with administrator rights: Sys Admin or GE Admin users (see 'System Users' on *page 4-61*).

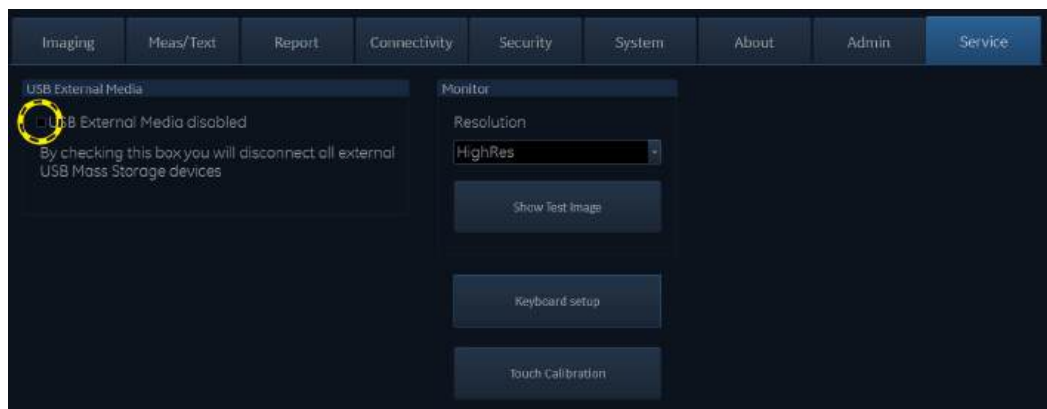


Figure 4-14. USB External Media disabled

About removable media and long-term image storage

We recommend to run the Disk management feature with Mobile USB HDD for long-term image storage, because of the longevity and reliability of this media. It is not recommended to use CD or DVD for long-term storage, because of weaker performance in general when it comes to longevity and reliability. However, Disk management does not prevent the use of CD/DVD for long-term image storage. If CD/DVD is used it is recommended to use Archival Grade or Medical Grade CD/DVD.

No matter which media is used, it is always highly recommended to take a backup of the media, which is the responsibility of the customer. The unit does not offer functionality for taking backup of images saved on long-term storage media.

Recommendation concerning CD and DVD handling

To avoid data loss, never touch the recordable surface of a disk. Handle the disk only by the outer edge. Do not place it face down on a hard surface. Fingerprints or scratches will make the disk unusable. Before usage, verify that the disk surface has no visible scratches. If there are any scratches, do NOT use the disk.

Formatting removable media



CAUTION

The formatting process will erase any data present on the media.

To format removable media:

- 1. Insert the USB drive in the USB port.
- 2. Select **Config** on the Shortcut Bar.
- 3. If required, log on to the system.
- 4. Select the category **Connectivity** and select the tab **Tools** (Figure 4-15).
- 5. Select the removable media from the *Media* drop-down menu (CD-R, DVD-R or USB device).

NOTE: Select **Refresh** if the media does not appear on the list.

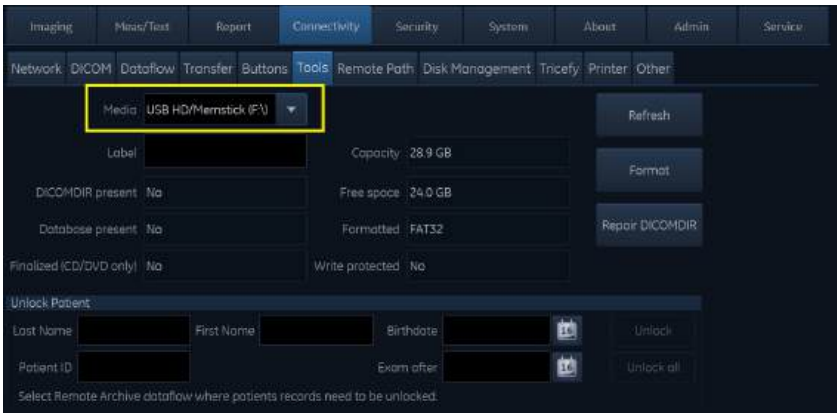


Figure 4-15. The Tools tab

Formatting removable media (continued)

6. Enter a name for the removable media in the *Label* field.

NOTE: *Only the following characters and signs can be used when labelling a media: A - Z, a - z, 0 - 9, “_” and “-”. Do not use more than 11 characters or signs. Do not use space.*

7. Press **Format**.

A confirmation window is displayed.



Figure 4-16. Formatting process

8. Select **YES** to continue.
9. Waiting for the display of the information window indicating that the formatting process is completed.

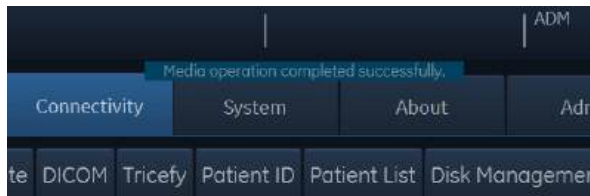


Figure 4-17. Formatting is completed

10. Eject the media as described below.

NOTE: *Removable media used during Disk space management, Backup, Export, or Save as do not need to be formatted in advance as the formatting process is part of these procedures if required.*

Ejecting removable media

1. Press the right top of the touch screen to show the tray menu.

NOTE: Do not eject CD/DVD using the button on the CD/DVD drive.

The *Eject device* menu is displayed.

2. Select to eject the relevant media.

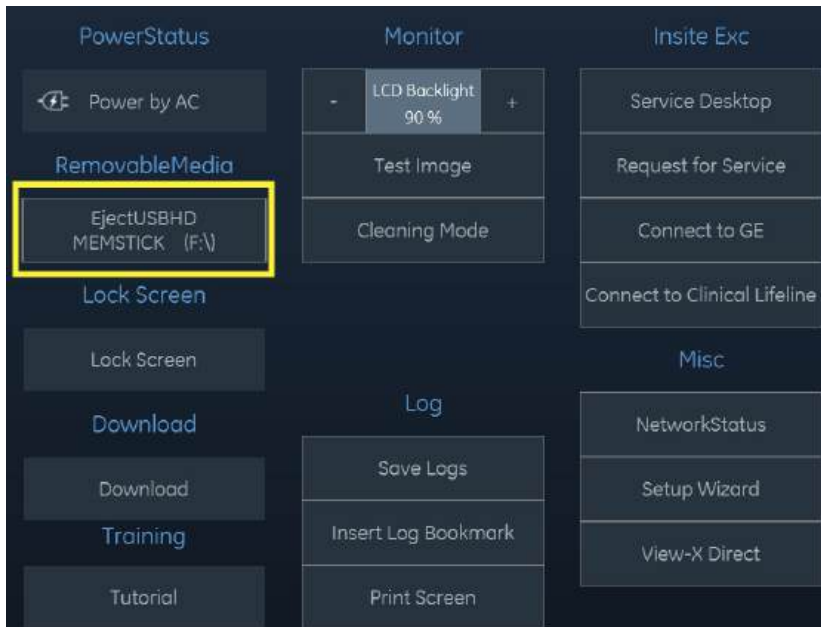


Figure 4-18. Ejecting removable media

Ejecting removable media (continued)

3. Wait for the display of the Information window indicating that the device was ejected successfully before removing the media.

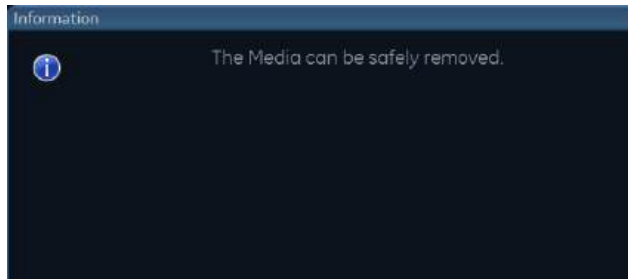


Figure 4-19. Ejecting complete

Physiological ECG Traces

Introduction

The system contains a physiological module capable of displaying the patient's ECG trace. The ECG module assists the ultrasound image function to identify the duration of systole and diastole in the image reading.



CAUTION

Use only GE accessories.

Conductive parts of electrodes and associated connectors for applied parts, including neutral electrodes should not contact other conductive parts, including earth.

Simultaneous use of two or more applied parts will cause summation of patient leakage currents.



CAUTION

Heart rate may be adversely affected by cardiac arrhythmias or the operation of cardiac pacemaker pulses.

Introduction (continued)



Figure 4-20. The patient (I/O) connection panel

NOTE: The ECG bpm (beats per minute) error is $\pm 5\%$.

NOTE: The external ECG input range the system can support is 70~700mv, -700~-70mv.

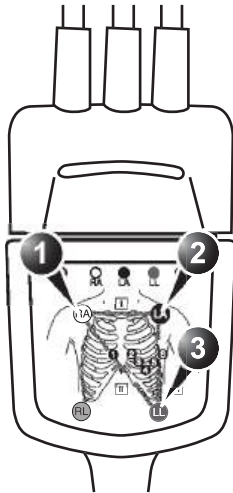
ECG

The ECG cable is a modular cable consisting of two distinct parts:

- **The Trunk:** A single cable connecting to the system at one end, providing a cable splitter device at the other end (see Figure 4-21).
- **The triple color-coded electrode cable:** To be inserted in the splitter device. Each electrode cable hooks up to the appropriate stick-on electrode by a color-coded clip type connector.

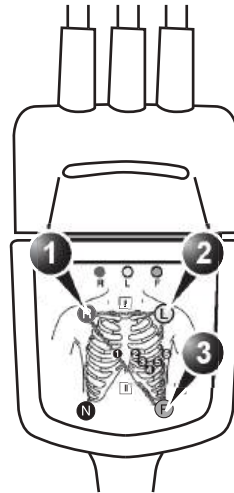
The color-coding of the electrodes follows one of two standards that are common in different parts of the world. The cable splitter device illustrates the color codes, names, and body locations for the two standard color codes (see Figure 4-21).

Introduction (continued)



AHA (USA)

1. RA: White
2. LA: Black
3. LL: Red



IEC (Europe, Asia, ROW)

1. R: Red
2. L: Yellow
3. F: Green

Figure 4-21. The cable splitter device with electrode placement conventions

To connect the internal ECG

1. Connect the round connector of the ECG Adapter Cable to Vivid iq.
2. Connect the rectangular connector of the ECG Adapter Cable to Multi-Link 3-lead ECG Trunk cable.
3. Connect the leadwire set to the electrodes. Verify that the ECG signal appears on the ultrasound screen.

To disconnect the internal ECG

Disconnect the ECG cable in the reverse order of connection.

Using Physios

Display ECG trace

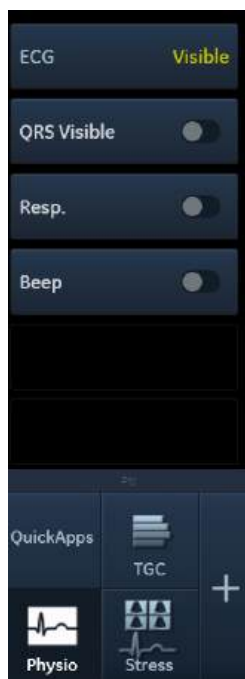


Figure 4-22. ECG controls

Display ECG trace (continued)

1. The ECG is displayed by default in all cardiac applications. For all other applications, select the shortcut **Physio** on the Shortcut Bar. and select **ECG** (Figure 4-22).

NOTE: The ECG button shows/hides the ECG trace. It does not turn off the ECG.

2. The following controls can be adjusted:
 - **Horizon. Sweep:** Adjusts the sweep speed stepwise (1, 2, 3, 4, 5, 6, 8, 12, and 16 sec. The default setting is 4 sec.)
 - **ECG Gain:** Adjusts the trace amplitude.
 - **ECG Position:** Moves the trace vertically.
 - **ECG Lead:** Selects the desired lead:
 - Lead 1: RA (-) to LA (+) (right, left, or lateral)
 - Lead 2: RA (-) to LL (+) (superior inferior)
 - Lead 3: LA (-) to LL (+) (superior inferior)
 - **QRS visible:** Show/Hide the QRS marker on the ECG.

ECG Triggers

ECG trigger: Enables intermittent imaging based on the ECG.

1. Press **ECG Trig**.
2. Adjust **ECG Trig 1** to position the first trigger on the ECG (delay in ms from R-wave to triggered frame).
3. Adjust **Trig Interval** (number of cardiac cycles between triggered images).
4. Press **Dual Trig delay** (delay in ms from the first triggered frame to the second triggered frame).

Timer trigger: Enables intermittent imaging based on a timer.

1. Press **Timer Trig**.
2. Adjust the **Timer Delay**.

Removing/adding Triggers

In case of a noisy ECG the system could generate an erroneous QRS marker which produces a heart cycle loop in a wrong location. The user can correct this manually by adjusting the actual location of the relevant QRS marker.

To remove a QRS marker on a replayed loop:

1. Press **QRS visible** to display the QRS markers and identify any extra QRS marker to be removed.
2. Press **Pause** to stop the cineloop and place the small red bar in the vicinity of the QRS marker to be removed.
3. Press **Remove Trig.**

To add a trigger:

1. Place the small red bar on the place where a QRS marker is missing.
2. Press **Add Trig.**
The new QRS marker is added.
3. Press **Freeze** and store a copy of the cineloop with the new QRS markers.

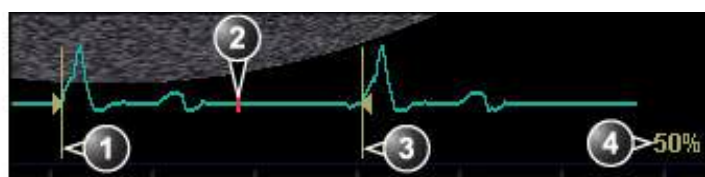
Display respiratory trace

1. Press the **Physio** tab on the touch screen.
2. Press **Resp.**
The respiratory signal appears in addition to the ECG signal.
3. The following controls can be adjusted:
 - **Resp Lead:** select the one that provides a stronger signal.
 - **Horizon.Sweep:** adjusts the sweep speed.
 - **Resp. Gain:** adjusts the trace amplitude.
 - **Resp. Position:** moves the trace vertically.

Cineloop

Cineloop overview

When the scan mode is frozen, the unit automatically displays cineloop boundary markers on either side of the last detected heart cycle. The cineloop boundaries can be adjusted using the cineloop controls on the Operation Panel to cover one or more heart cycles.



1. Left marker (cineloop start)
2. Current frame
3. Right marker (cineloop end)
4. Cine speed

Figure 4-23. Cineloop display

Using cineloop

Selection of a cineloop

1. Press **Freeze** on the Control Panel.
The left and right markers are displayed on either side of the last detected heart cycle on the ECG trace.
2. Press **Pause** on the Control Panel.
The selected heart beat is played back.
3. Press **Pause** to freeze the cineloop.
4. Scroll through the acquisition and find the sequence of interest by using trackpad.
5. Adjust **Cycle select** to move from heart beat to heart beat and select the heart cycle of interest.
6. Adjust **Num cycles** to select the number of heart beats to play back.
7. Adjust **Left marker** and **Right marker** to trim or expand the cineloop boundaries.
8. Press **Pause** to run the cineloop and **Store** to store the cineloop or **Freeze** to return to live scanning.

NOTE: *Cineloop storage can be configured to store heart cycles with additional time before and after the R-wave and to display a preview before storage ('Global imaging settings' on page 5-88).*

Adjustment of cineloop playback

1. Select **Speed** on the Shortcut Bar and adjust **Speed** to set the speed of the cineloop playback.

The speed factor (%) is displayed on the right side of the ECG.

To view a cineloop frame by frame

1. In freeze, adjust **Frame** to scroll through the cineloop frame by frame.

To synchronize playback of several cineloops

1. Press **Sync** to phase synchronize playback of several cineloops running on the screen.

NOTE: *For synchronization to work as expected in DICOM images, they must fulfill one of the below requirements:*

- Images are acquired with ECG on a scanner that supports DICOM with R Wave Time Vector (see the DICOM conformance statement for the scanner type being used.)
- Images are single cycle loops where the first image frame corresponds to the R wave.

Storage of a cineloop

See 'Storing a cineloop' on *page 10-8*.

Zoom

Introduction

The unit supports two types of zoom:

- Display zoom: Magnifies the image display of a selected area.
- High resolution (HR) zoom: Concentrates the image processing on a selected area of the image, resulting in improved image quality and a higher frame rate in the chosen region of interest (ROI).

Display zoom

1. Press **+** or **-** tab beside “Zoom” tab on the Gain Bar
The resulting magnified image appears in the acquisition window. An un-magnified image is displayed in the left corner showing the outlined zoomed region.



Figure 4-24. Zoom control

2. Move the zoom area over the desired portion of the image.
3. To turn off the Display zoom, keep pressing - tab.

HR zoom

1. Move zoom area over the desired portion of the image by touch.
2. Increase size as desired by pressing “+” tab.
3. Press “-” until HR zoom is turned off.

Annotations

Introduction

Text annotations may be inserted anywhere in the image area. The annotation can be free text or a pre-defined text from an application-specific annotation library displayed on the Side Bar.



Annotations (text, arrow, and bodymark) are created on separate layers. When viewing annotated images on a different system or when zooming the image, the position of the annotations on the image may be slightly changed.

To insert an annotation

Free text

1. Press **Text** on the Shortcut Bar.
2. Type the desired text using the alphanumeric keyboard.
To change/add line press  tab on the alphanumeric keyboard.
3. Use trackpad to move the text entered to the position, and press **Set**.

Pre-defined text

1. Press **Text** on the Shortcut Bar. The **Library...** with pre-defined annotations displays on the Side Bar at the right side of the screen..

The *Text* folder with annotations specific to the current application is displayed on the Side Bar.

NOTE: To select annotations from another application, press the **Library...** tab and select the desired application library.

2. On the Side Bar, press the pre-defined text to insert.

The word is displayed on the screen.

NOTE: Some buttons toggle between two or three related annotation texts (e.g. pressing the annotation **Left** will insert the text "Left" and toggle the button to the annotation **Right**). Annotation buttons with toggle functionality are marked with a circular arrow.

3. Position the text on the screen by touch on the right position or use the trackpad to move the text to the right position.

Pre-defined text (continued)



1. Library...: Selects application specific library
2. Clear: Clear the arrow
3. Bodymark: Displays Bodymarks
4. Exit: Exit annotation
5. Keyboard: Expand the keyboard to type the text
6. Arrow Size +, Arrow Size -, Arrow, Delete All Arrows: Inserts arrow, adjust arrow size and delete all arrows. Use trackpad to move the arrow to the desired position and rotate it.

Figure 4-25. Annotation Shortcut Bar

Editing annotations

To move annotations

1. While in Annotation mode, use trackpad to move the text marker over the annotation to move and press **Set** or touch the trackpad.
2. Move the selected annotation using trackpad to a new location and press **Set**.

To edit annotations

Replacing text

1. While the text is set, move the text marker over the annotation to edit. Touch the touch pad or press **Set**.
2. Type a new text, the right part of the annotation from the text marker is replaced by the new text.

Adding text

1. Move the text marker over the annotation to edit and press **Set**.
2. The text in the selected annotation can be edited using the following alphanumeric keys:
 - **Right arrow**: Moves the text cursor forward.
 - **Left arrow**: Moves the text cursor backward.
 - **Tab**: Moves the text cursor forward by word.
 - **Shift + Tab**: Moves the text cursor backward by word.
 - **Enter**: Moves the cursor to the next line.
 - **Backspace**: Deletes backward.
 - **Delete**: Deletes forward.

To erase annotations

To erase all annotations:

- Press **Clear** on the Shortcut Bar.

Bodymark

Bodymarks are small graphic images that represent the examined anatomy. Using bodymarks, the user can indicate the position that the probe was in during the examination.

Inserting a bodymark

1. Press **Bodymark** on the Shortcut Bar.

The bodymarks specific to the current application are displayed.

*NOTE: To select bodymarks from another application, press the button under the label **Library...** and select the desired application library.*

2. Press the bodymark to insert.

The selected bodymark with a probe marker is displayed on the scanning screen.

3. Using the trackpad, adjust the position of the probe marker.

4. Adjust **Rotate probe marker** to set the probe marker orientation.

5. To move the bodymark:

- Press **Move pattern**.
- Move the bodymark to a new location with the trackpad.
- Press **Move pattern** to anchor the bodymark to the new location

To delete bodymark

Select **Delete** on the Shortcut Bar to delete the bodymark.

Annotation and bodymark configuration

Annotation and bodymark configuration enable the user to:

- Create new application specific text and bodymark libraries.
- Edit existing application specific text and bodymark libraries.
- Delete user-defined libraries.

A library is a list of up to 24 text inputs accessible from the Side Bar.

To access to the Annotation and bodymark configuration screen:

1. Press **Config** on the Shortcut Bar and log on as administrator if required.
2. Select the **Meas/Text** category and **Text** or **Bodymark** subgroup.

The corresponding screen is displayed (Figure 4-27).

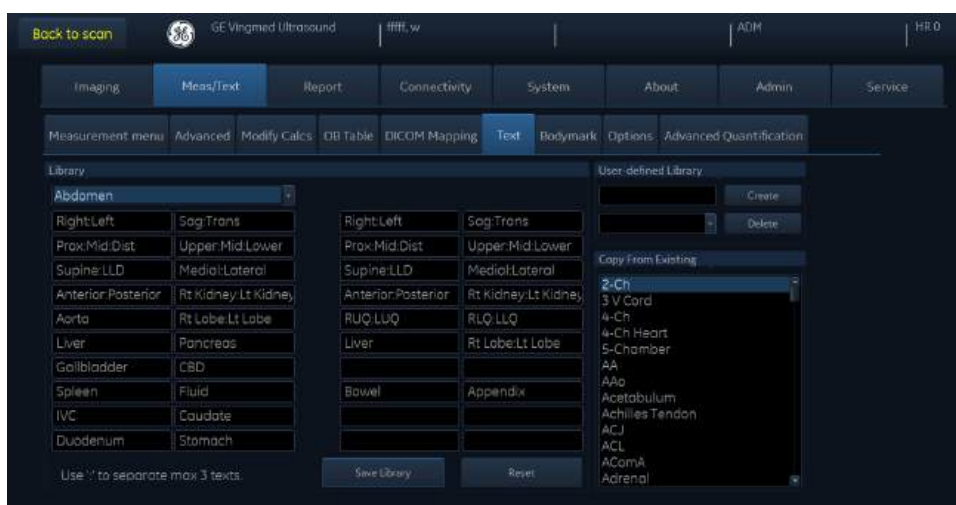


Figure 4-26. The Text sheet

Annotation and bodymark configuration (continued)

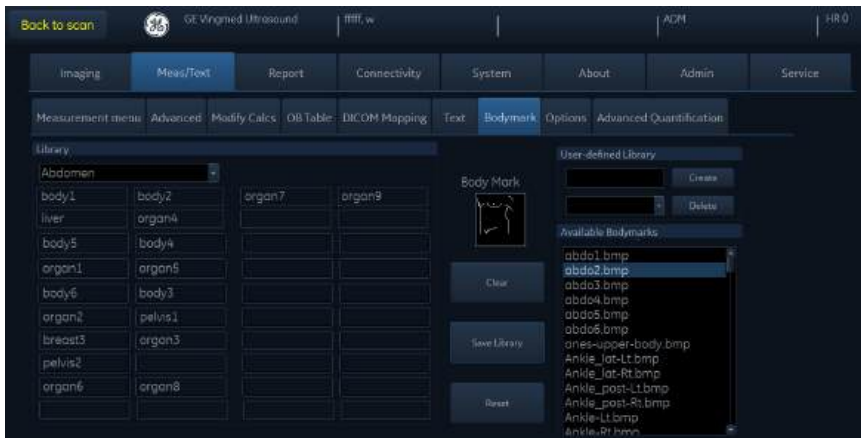


Figure 4-27. The Bodymark sheet

To edit an existing library

1. In the *Library* field, select the library to edit.
2. To change or add a pre-defined text, select the text entry or a blank location and do one of the following.
Annotation library:
 - Type a text.
 - Select a text from the *Copy from existing list*.Bodymark library:
 - Select a bodymark form the *Bodymark available* field.
3. Press **Save library**.

NOTE: If a factory library is edited, the original library can be restored by pressing **Reset**.

Toggling pre-defined annotations

It is possible to assign up to three related texts to one location enabling the user to toggle between the text entries when pressing the button on the Side Bar (e.g. pressing the toggling annotation **Left** will insert the text “Left” and toggle the button to the annotation **Right**). Annotation buttons with toggle functionality are marked with a circular arrow.

To create a toggling annotation:

1. Enter up to three text entries separated by a colon in the desired location (e.g. “Left:Right”).

To create a library

1. In the *User-defined library* field, type a name for the library to be created, then select **Create**.
2. Enter pre-defined texts as described in step 2 above.
3. Press **Save library**.

Automatically enter Bodymark

Annotation has the ability to configure Active Function at freeze in 2D and Color flow modes as: None, Body Mark or Text.

If Body Mark is selected, the default bodymark will appear automatically at 'Home' position. See bottom left in Figure 4-21. The default bodymark is the first in the list, see Figure 4-21.

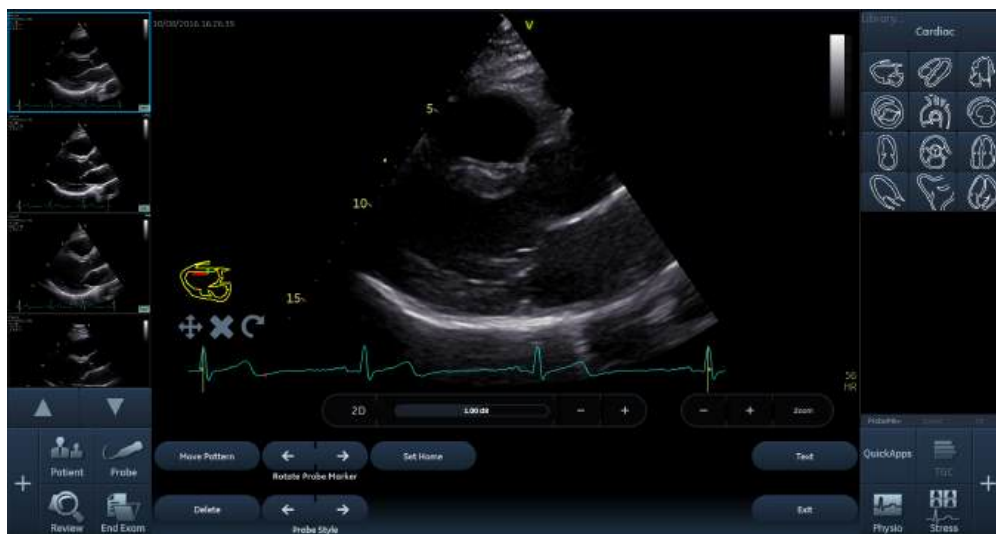


Figure 4-28. Home position

When Bodymark is activated, Probe Mark position is moving by default. The left "Set" key can be used to switch between Probe Mark Move and Body Mark Move. The system will stay in Bodymark or text mode after Probe Mark position is adjusted. In Freeze, "Depth" control can be used to rotate Probe Mark when Bodymark is active.

The system will stay in Bodymark or text mode when Active side is changed.

General options

Text, bodymark, and arrow default options can be specified from the *Option* category.

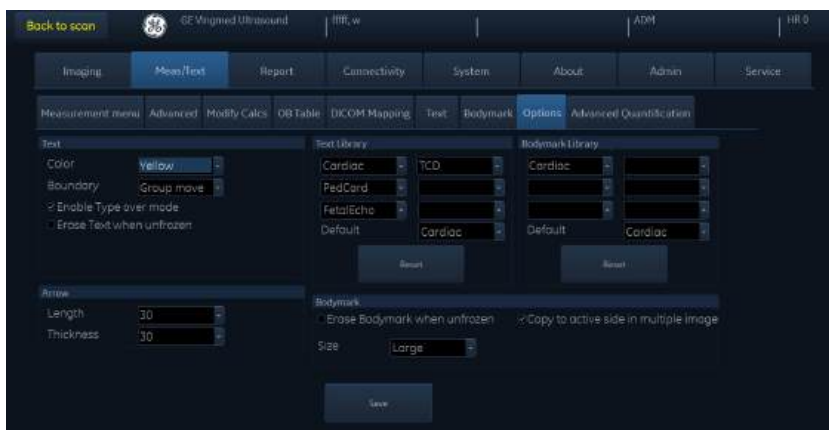


Figure 4-29. The Options sheet

Parameter	Description
Text color	Select the color for annotation text.
Text boundary	Select Group Move or Word Wrapping
Enable type over mode	When selected, the user can place the cursor in an existing annotation and start typing to insert new text.
Erase text when unfrozen	Deletes annotations when unfreezing the image.
Erase Bodymark when unfrozen	Deletes bodymark when unfreezing the image.
Copy to active side in multiple image	Copies bodymark to active side in dual or quad screen.
Arrow length	Select the default arrow length.
Arrow thickness	Select the default arrow thickness.
Text and bodymark library	Set availability for up to six libraries for the current application and select the default library. Reset reloads the factory default setting.
Bodymark size	Select Normal or Large bodymark size. Default is Large.

Configuration – System and Users

About system Configuration

The configuration package enables customization of the global configuration of the unit, application-specific settings, system connectivity, and data management settings.

The configuration management package is divided into different setup categories with subgroups.

Only users with administrative rights have access to all the subgroups.

Setup category	Description	Subgroup	Access
Imaging	Global imaging, application, TEE probe button assignment and Scan Assist Pro configuration	Global	All
		Scan Info	All
		Application	All
		Probe Buttons	
		Probe Test	All
		FlexiViews	All
		4D Marker	All
		Scan Assist Pro	Admin
		Scan Coach	

Setup category	Description	Subgroup	Access
Meas/Text	Measurements and Annotation configuration	Measurement Menu	All
		Advanced	All
		Modify Calcs	All
		OB Table	All
		DICOM Mapping	All
		Text	All
		Bodymark	All
		Options	All
		Advanced Quantification	All
Report	Report configuration	Template	All
		Diag. Codes	All
		Comments Texts	All
		Structured Findings	All
		Options	All
Connectivity	System connectivity	Network	
		DICOM	All
		Dataflow	
		Transfer	
		Buttons	
		Tools	
		Remote Path	Admin
		Disk Management	Admin
		Tricefy	All
		Printer	
		Other	

Setup category	Description	Subgroup	Access
Security		Users	
		User policies	
		LDAP	
		System password	
		Disk encryption	
		Login banner	
		Audit	
System	General system settings and system test	Settings	Admin
		TrackPad	Admin
		Test	Admin
About	System information	System Version	All
		SW Version	All
		Firmware Version	
		HW Version	All
Admin	Data management and user account	Backup	Admin
		Restore	Admin
		Licenses	
		Activity Report	
Service	Service	Service	Admin

General system settings

1. Press **Config** on the Shortcut Bar and log on as administrator if required.
2. Select the **System** category and **Settings** subgroup.

The *Settings* sheet is displayed.

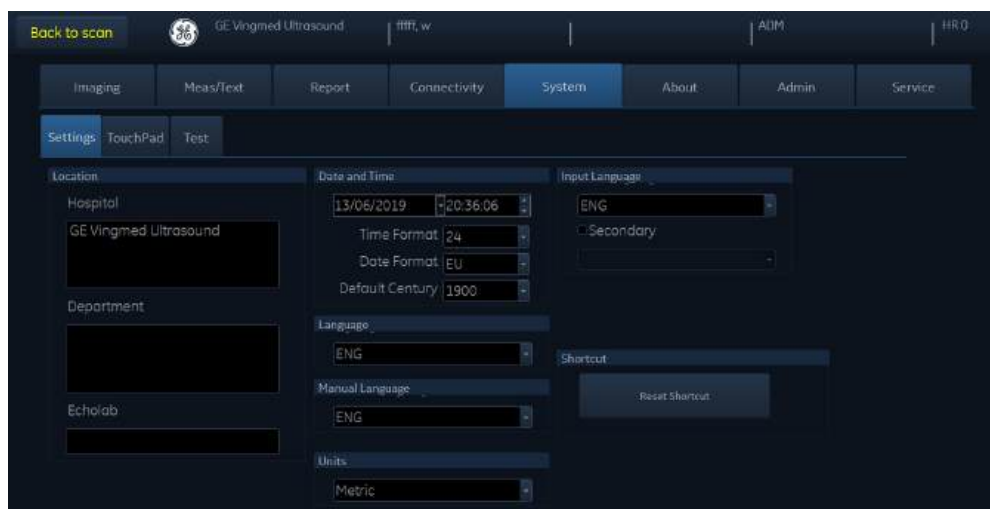


Figure 4-30. The Settings sheet

Location

1. **Hospital:** Enter the hospital name. This information is displayed on the scanning screen's *Title bar* and on the image properties of all saved images.
2. **Department:** Enter the department name. This information is displayed on the image properties of all saved images.

Date and time

Changes will be effective only after rebooting the system.

1. **Date:** Select the correct date from the pop-up window.
2. **Time:** Select either hour, minute or second, and then press the arrow head buttons to set the time.
3. **Time Format:** Select the desired format (24 or 12 AM/PM) from the pop-up menu.
4. **Date Format:** Select the desired format (EU or US) from the pop-up menu.
5. **Default Century:** Select the default century.

Language, units and video settings

Changes will be effective only after rebooting the system.

- **Language:** Select the desired language for the system from the drop-down menu.
- **Manual Language:** Select the desired language for the Online manual from the drop-down menu. If not available the English manual will be displayed as default.
- **Input Language:** Select the default alphanumeric keyboard language configuration on the Shortcut Bar.

NOTE: *The display of the alphanumeric keyboard on the Shortcut Bar may be turned off. To turn on the display of the alphanumeric keyboard, press the keyboard button on the right bottom corner of the screen.*

To define a secondary language configuration for the alphanumeric keyboard, check the **Secondary** option and select a language from the drop-down menu.

After reboot of the system, press **Lang** on the alphanumeric keyboard to toggle between the two language configurations.

- **Units:** Select the desired units (Metric or US) from the drop-down menu.

Shortcut Bar configuration

The shortcuts on the Shortcut Bar can be configured by the user, so that the most used functions are readily available on the left and right sides.

1. Press either of the plus button on both sides of the Shortcut Bar to show all the shortcuts.



Figure 4-31. Show all the shortcuts

2. Keep pressing the most often used function and move it to the highlighted locations.



Figure 4-32. Move to desired location

Wireless Network Configuration

The following procedure is used to configure the Ultrasound System for a wireless network environment. This procedure is required for every new wireless network.

NOTE: Do not use any type of wireless network adaptor other than a GE-approved adaptor.

Wireless protocols on Vivid *iq* Ultrasound Sysem

The following wireless protocols are supported:

- IEEE 802.11a
- IEEE 802.11b
- IEEE 802.11g
- IEEE 802.11n
- IEEE 802.11ac

The following security protocols are supported on the wireless interface:

- No authentication (Open)
- WPA2-Personal
- WPA-Personal
- WPA2-Enterprise
- WPA-Enterprise
- 802.1X

Configuring the Wireless Network Adaptor

Follow this procedure to configure the Wireless Network Adaptor:

1. Press **Config** and log on as **Adm.**
2. Select **Connectivity**.
3. Select the **Network** tab.
4. Click the **Configuration** button (see Figure 4-33.)

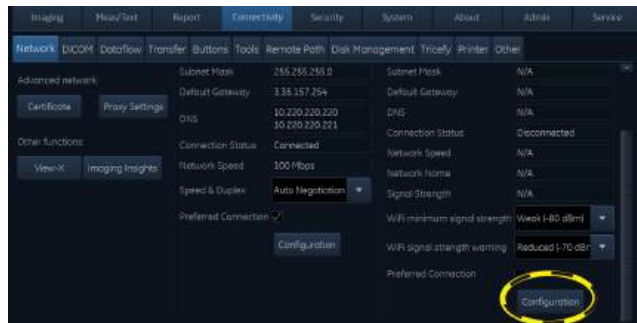


Figure 4-33. Connectivity - Network Tab

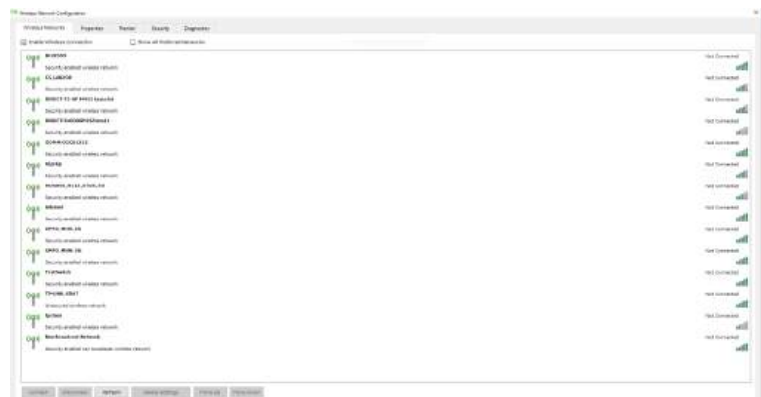


Figure 4-34. Wireless Settings Main Screen

Configuring the Wireless Network Adaptor (continued)

NOTE: *If a wireless network adapter is not connected, or if the connected wireless network adapter is not the correct model, no wireless networks will be listed in the Wireless Settings page.*

5. Either double-click or select the network you want to connect to, and press the **Connect** button.
If this is the first time you attempt to connect to the network, a dialog will pop up on screen asking you to configure the network setting.

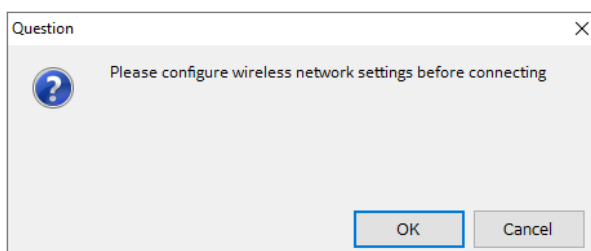


Figure 4-35. First Time Connection Dialog

6. Press **OK** in the dialog window. A new window for setting up your connection will open

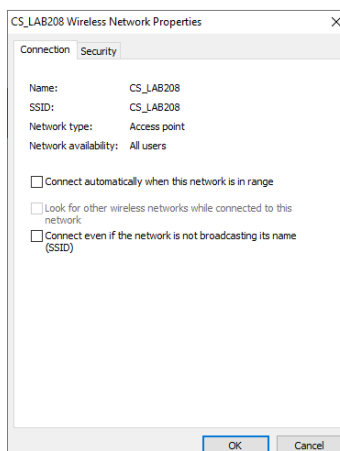


Figure 4-36. Network Settings Window - Connection

Configuring the Wireless Network Adaptor (continued)

7. Select check-boxes according to preference.
If **Connect automatically when this network is in range** setting is selected, then this network will auto-connect when available, without needing to enter the **Wireless Settings** page.
8. Set up security options in the Security tab of connection setup dialog.

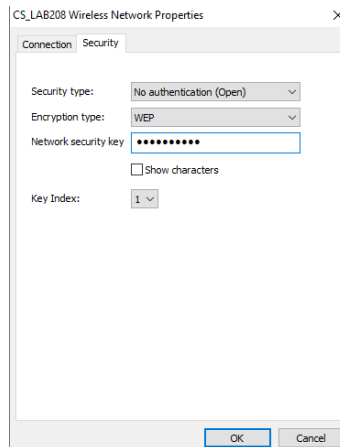


Figure 4-37. Network Settings Window - Security

Configuring the Wireless Network Adaptor (continued)

- 9. If the wireless network is to be configured for WPA/WPA2 Enterprise and a customer specific certificate is to be installed on the system, this can be done by use of the certificate dialog available from the LDAP config page.
 - a. First go to LDAP config,

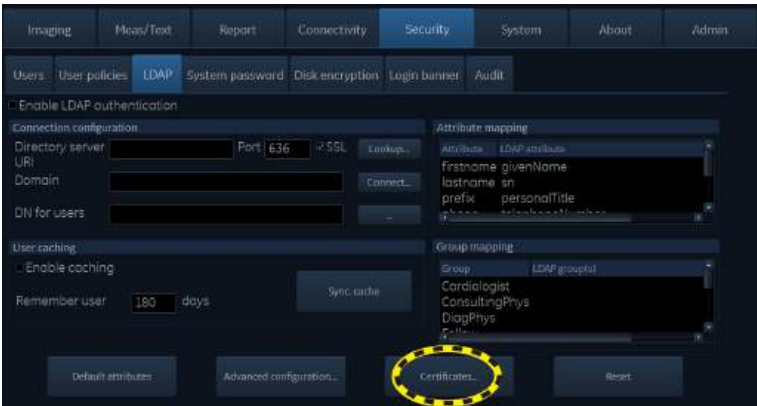


Figure 4-38. LDAP Config Screen

- b. Then click on the Certificates... button to open the Certificate dialog,

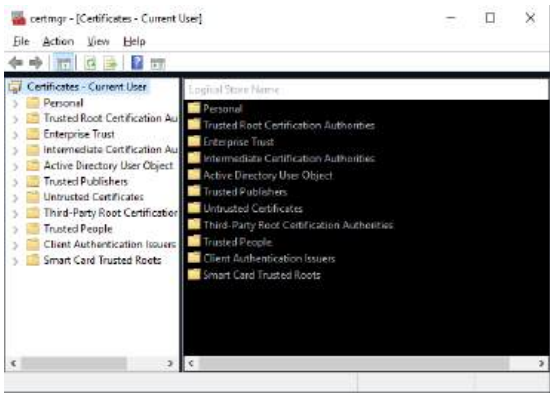


Figure 4-39. Certificate Dialog

Configuring the Wireless Network Adaptor (continued)

10. After you have finished setting up your connection press **OK**. The ultrasound system will then try to establish a connection to your network. A dialog will be shown on screen while this is in progress.

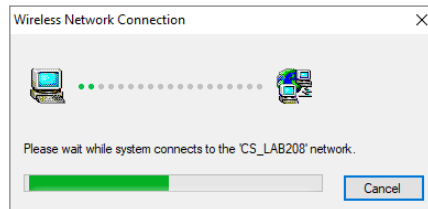


Figure 4-40. Connecting to Network Dialog

11. Once a connection has been established you will see the status **Connected** in the **Wireless Settings** page, next to the network you have connected to.

All network connections that are configured will also be displayed with a star icon.

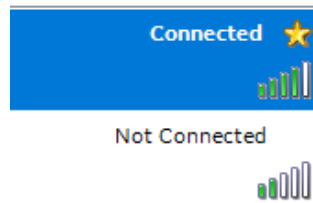


Figure 4-41. Connection Established

NOTE: *The system is now connected to the desired Wireless Network. In future, as long as the same Wireless Network is available, connection will be automatic.*

NOTE: *Whenever connection to a new/different Wireless Network is required, it will be necessary to repeat all steps above.*

Data Streaming

- NOTE:

The **StreamServer** option key should be installed to enable streaming live ultrasound data.
- NOTE:

Only sector and TEE probes are supported for streaming live ultrasound data.

The system has the capability to stream live ultrasound image data (both 2D and 3D) over the network connection to enabled devices. To configure this capability perform the following steps:

Enable data streaming

1. Press **Config...** on the shortcut bar.
2. Select the tab **Connectivity**, then **Network**.
3. Press the **StreamSever** button.
4. Check **Enable Streaming** on the **Data Streaming Settings** dialog
5. Enter stream server **Port No** (or use the default port).

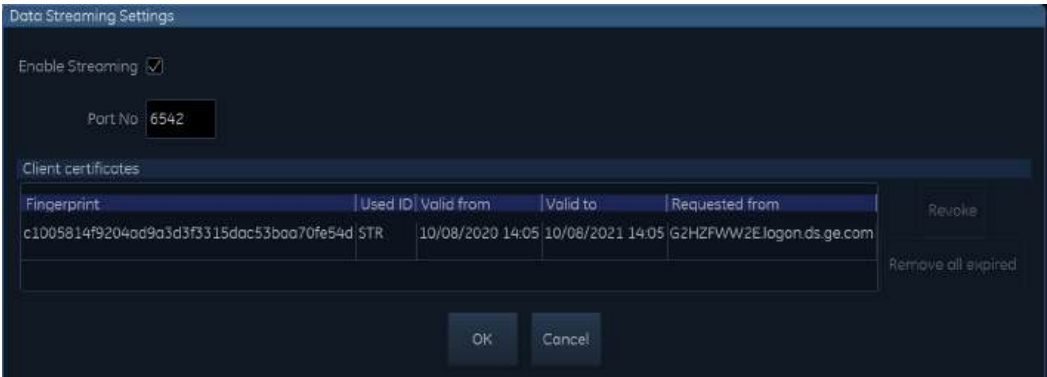


Figure 4-42. Data Streaming Settings

User setup for data streaming

Only a member of the group “ConsultingPhys” will have permission to receive streamed data.

See example of users who can receive streaming data below.

The screenshot displays the 'Security' configuration window, specifically the 'Users' sub-tab. On the left, the 'User List' shows three users: ADM, STR (highlighted in blue), and USR. Below the list are 'New' and 'Delete' buttons. The main area is divided into two sections: 'Identity' and 'Member of Group(s)'. The 'Identity' section contains fields for 'Id' (STR), 'Last Name' (STR), 'First Name', 'Email', 'Address', 'Title', and 'Phone Number'. There are also checkboxes for 'Blocked' and 'Change password at next login'. The 'Member of Group(s)' section shows a list of groups with 'ConsultingPhys' selected. Below this is the 'Operator Rights' section, which includes a list of permissions with 'ReceiveStreaming' selected. At the bottom left, there are settings for 'Autologin' (Disable), 'Auto screenlock (min)' (30), 'Prohibit default password', and 'Show login history'.

Figure 4-43. User setup for data streaming

If LDAP authentication is enabled, at least one of the LDAP groups that the user belongs to must be mapped to the group “ConsultingPhys” in order to allow the user to receive streaming data.

User setup for data streaming (continued)

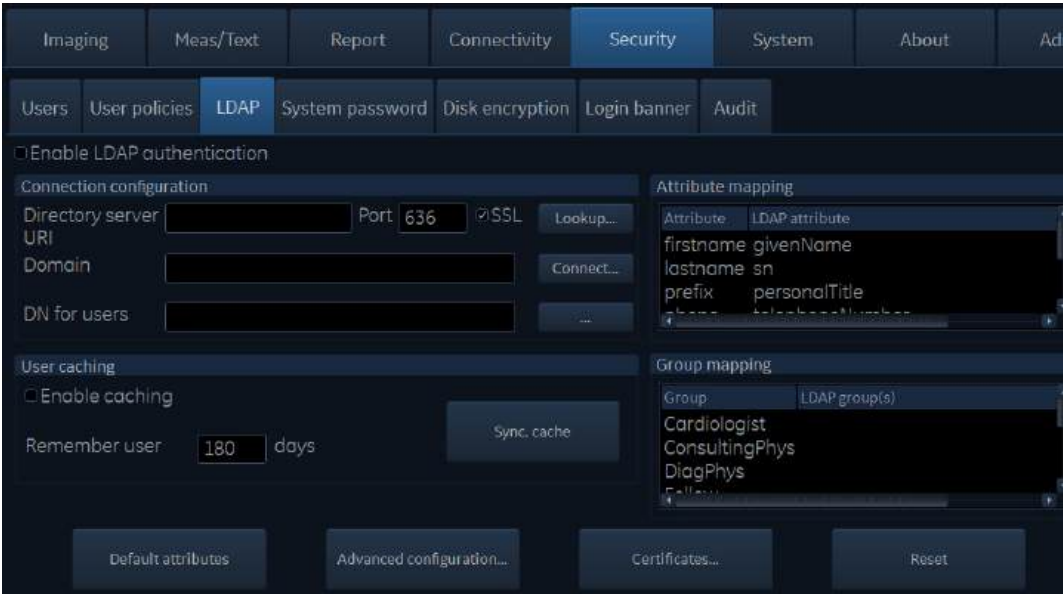


Figure 4-44. LDAP configuration

Authentication

Before an enabled device can receive streamed live ultrasound data, authentication is required to start. The user will be authenticated using both username/password (configured as described in 'System Users' on *page 4-61*) and a PIN code generated by the system upon first connected. Subsequent connections will use a certificate generated after the first successful connection. The client will be asked to enter a PIN code if the client application has no valid client certificate. The system shows a dialog window with the PIN code (Figure 4-45).

After entering correct PIN code, client certificate will be issued and sent to client application automatically. The next attempts of connection do not require entering PIN code as long as the certificate is valid.

NOTE: *The certificate will automatically expire after one year.*

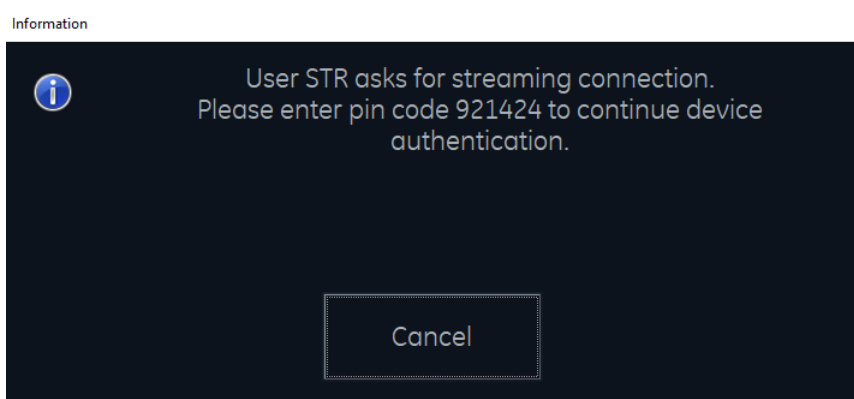


Figure 4-45. PIN code window

NOTE: *Operator can refuse streaming data by pressing **Cancel** button.*

Revoke Client certificate

All issued client certificates are listed in the *Data Streaming Settings* dialog. See ‘Enable data streaming’ on page 4-56.

To revoke a client certificate:

- 1. Select a client certificate
- 2. Press **Revoke**

NOTE: At the next attempt to connect, this client will be asked for authentication again (see page 4-59).

Press **Remove all expired** to clear the list of client certificates.

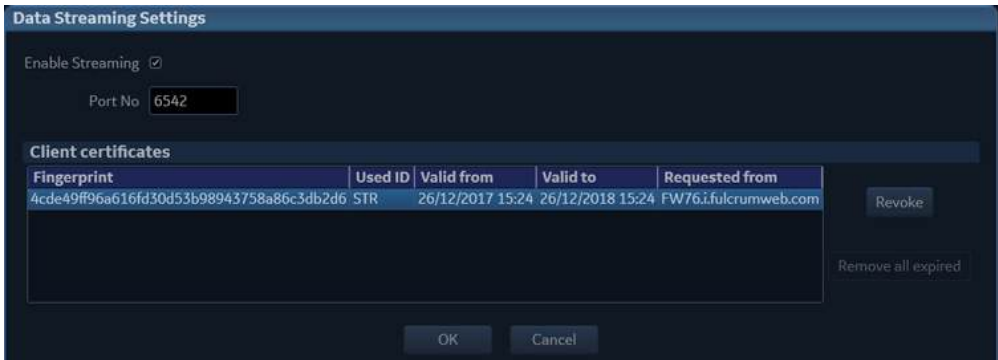


Figure 4-46. Client certificate example

System Users

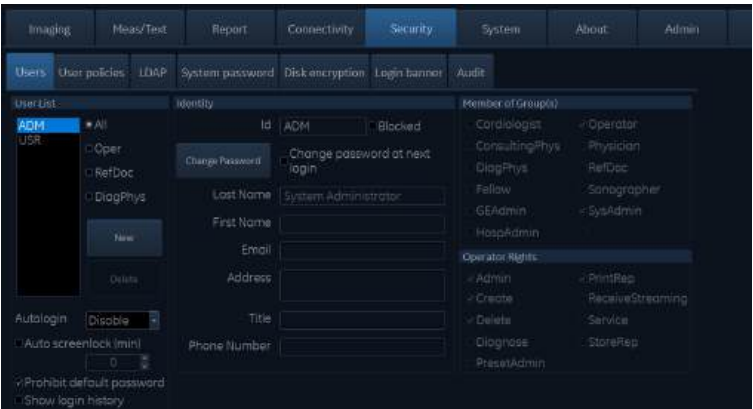


Figure 4-47. The Users sheet

The ultrasound unit requires operator registration.

The users are divided in groups with different rights as shown below.

Group	Right (see definition below)								Service
	Create	Delete	Diagnose	Preset admin	Print report	Store report	Admin	Receive Streaming	
Cardiologist	+	+			+	+			Activated with a Dongle
Consulting Physician								+	
Diagnosing Physician			+						
Fellow	+				+				
GE Admin	+	+			+		+		
Hospital Admin				+	+				
Operator									
Physician	+				+				
Referring Doctor									
Sonographer	+				+				

Group	Right (see definition below)								
	Create	Delete	Diagnose	Preset admin	Print report	Store report	Admin	Receive Streaming	Service
Sys Admin	+	+			+		+		

The rights associated to the user groups are:

Right	Definition
Admin	• System administration
Create	Create and update patient record, examination, user and referring members. Transfer patient records and examinations. Move examinations.
Delete	Delete patient record, examination, user and referring members.
Diagnose	Make the Diagnosing physician available in the <i>Patient info and exam</i> screen. Sign off report.
Preset admin	Make application presets protected. Delete protected application presets.
Print report	• Print a report
Receive streaming	• The user will be allowed receiving Vivid images on a remote client,streamed from the system by the Data streaming feature.
Service	• Access to the service platform
Store report	• Store reports, sign and unsign reports

NOTE: *When adding or modifying local users, the changes will not take effect until the system is restarted.*

1. Press **Config** on the Shortcut Bar and log on as administrator if required.
2. Select the **Security** category and **Users** subgroup.

The *Users* sheet is displayed.

Creating a user or a referring member

1. Press **New**.
2. Enter username and password, then press **OK**.
3. Enter additional user information.
4. Select the type of user/referring member in *Member of Group(s)*.



CAUTION

To be able to login on the system, the group Operator **MUST** be selected.

Editing a user configuration

1. Select the actual user in the *User list*.
2. Make the desired changes.
3. Press **Back to scan** or any active scanning key to exit the Configuration management package.

Deleting a user

1. Select the actual user in the *User list*.
 2. Press **Delete**.
- The user is removed from the *User list*.

Auto logon

1. Select the desired logon setup from the pull down menu:
 - **Disabled:** No default user is selected when logging on.
 - **Last user:** The last user is selected automatically when logging on.
 - **User:** Select one of the users to be the default user when logging on.

Auto screen lock

You can define Automatically Lock Screen via the **Config->Security->Users** page by checking the Auto screenlock(min) box and designate after how many minutes the screen should be locked after the column below.

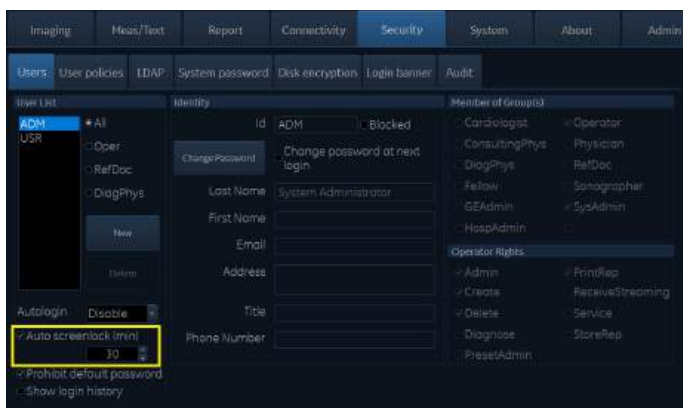


Figure 4-48. Auto Screenlock

The screen will lock after the designated time. To reactivate the system, the user will need to login again.

Manual screen lock

The user can invoke screen lock manually by the user by pressing <ALT> + L with an external keyboard or pressing '**Lock Screen**' on the tray menu at any time.

NOTE: Screen lock can only be unlocked by an authenticated user.

User Policies

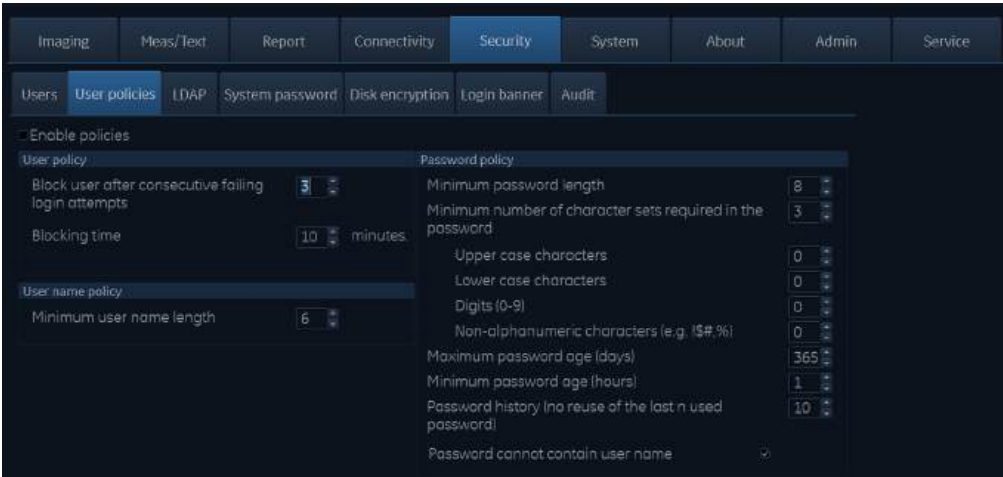


Figure 4-49. The User Policies sheet

User Policies can be enabled to enforce user account policies for all users on the system. The rules can be configured to set requirements for user name length, password complexity and for blocking of users. By default users policies are disabled.

LDAP

Figure 4-50. The LDAP sheet

Enable "LDAP authentication" to utilize services from an external Directory Server for authenticating users when logging in to the system. If enabled it will not be possible to login to the system with users defined as local users on the system, except for the ADM user.

NOTE: *If LDAP is configured, the log-in dialog indicates the log-in domain.*

The system can be configured to use authentication services from a Microsoft Active Directory server or from another LDAP compatible Directory Server.

	Definition
Connection configuration	Set directory server, domain, and DN for users.
User caching	Set number of days user will be remembered without needing to log in with network access. When disabling this option, the cached user data will be deleted
Attribute mapping	Map LDAP attributes to system user attributes.
Group mapping	Map LDAP groups to system groups. An LDAP group can be mapped to zero or more system groups. Several LDAP groups can be mapped to the same system group.

LDAP (continued)

To define the LDAP properties:

1. Enter the configuration properties.
2. Press **Connect** to test the connection and enter a valid user name and password for the LDAP server in the dialog that appears.
3. Define group mapping for the LDAP user groups that shall be grant users access to the system.

The user will be assigned one or more system groups according to the group mapping and which of these LDAP groups the user is a member of.

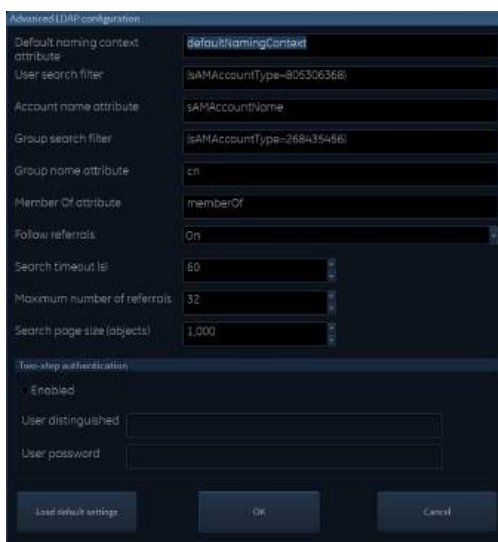


Figure 4-51. The Advanced LDAP configuration screen of the LDAP sheet

If the Directory Server does not support anonymous connection for the authentication service, two step authentication is needed. Then valid user credentials for a user with access to the Directory Server must be entered here.

NOTE: *The user credentials will be stored on the system unencrypted.*

System password

The screenshot shows a software interface with a top navigation bar containing tabs: Imaging, Meas/Text, Report, Connectivity, Security (selected), System, About, Admin, and Service. Below this is a sub-navigation bar with tabs: Users, User policies, LDAP, System password (selected), Disk encryption, Login banner, and Audit. The main content area has a dark background. At the top of this area is a warning message: "System password is the password for the underlying Windows OS user running this application. Do not change this password unless you are the system administrator of the device. This password is not needed for users of the system. It will only be needed by GEHC service in special situations. If you change the password, be sure to keep the new password secured and available if needed by GEHC service." Below the warning are three input fields: "Old password" with a text box and a note "Old password must not be empty", "New password" with a text box and a note "Password must not be empty", and "Confirm" with a text box.

Figure 4-52. The System Password sheet

The System Password is the password for the underlying Windows OS user running this application. Do not change this password unless you are the system administrator of the device. This password is not needed for users of the system. It will only be needed for GEHC service in special situations. If you change the password, be sure to keep the new password secured and available if needed by GEHC service.

Storage encryption



Figure 4-53. The Disk Encryption sheet

Disk encryption can be enabled for patient data stored on the system. By default, Disk encryption is disabled.

When enabling disk encryption you will be prompted to choose an encryption password as well as a storage location for the recovery key.

NOTE: *While the system is undergoing encryption, it will not be available for use. We highly recommend performing disk encryption overnight or when the system is not needed for use for an extended period of time.*

NOTE: *Should the system power down during disk encryption or otherwise cease to function, a prompt will appear when restarting the system to continue disk encryption.*

NOTE: *Patient data on the system will be lost if the disk encryption key is lost and it is recommended that users should make a copy of the encryption key.*

Storage encryption (continued)

When starting up the system, the encrypted disk must be unlocked for the users to access images, local archive, and other patient information. The disk can be unlocked in one of the following ways:

- Enter the previously chosen Encryption Password.
- Insert a USB memory stick with the stored recovery key in the system at start-up or when the Unlock dialog is presented.
- Enter the recovery key manually.



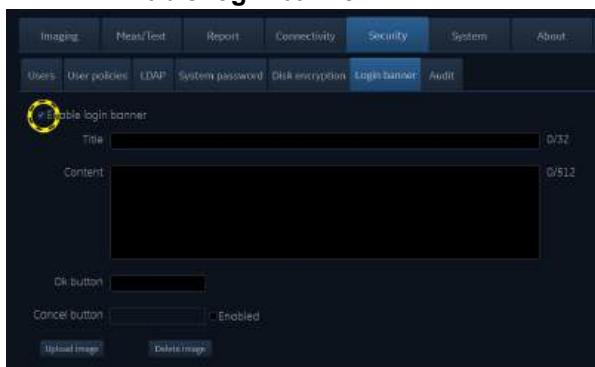
Without the Encryption Password or Recovery Key it will not be possible to access the patient information, images, or local archive. GE has no access to this information or the ability to undo encryption in the event that the Encryption Password and Recovery Key are lost. Maintaining the Encryption Password and Recovery Key are solely the user's responsibility.

Login banner

The Login Banner provide an option to display information to the user when logging in to the system. When enabled, the user is required to accept the message to complete the login process. The login banner is configurable for an administrator of the system.

Enable the Login Banner

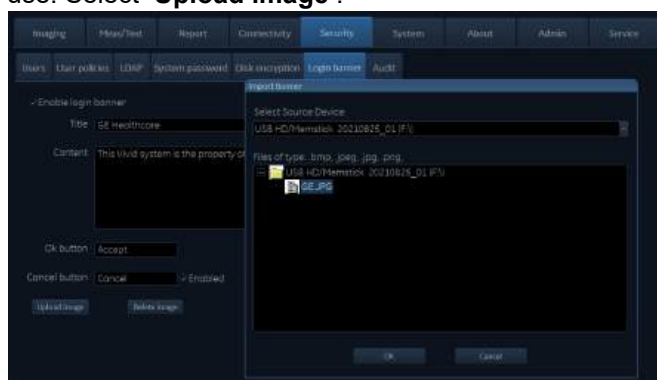
1. Press **Config** on the shortcut bar as administrator.
2. Select **Security** category and the **Login banner** subgroup.
3. Check the '**Enable login banner**'.



4. Enter the title text to be displayed into **Title** field.
5. Enter the text to be displayed into **Content** field.
6. Enter text to be displayed on the '**OK**' button.
7. (Optionally) Check '**Enable**' for showing a '**Cancel**' button and enter the text to be displayed on the '**Cancel**' button.

Login banner (continued)

8. (Optionally) Upload an image to be displayed on the Login Banner. Insert the USB Flash Drive with the image file to use. Select **'Upload image'**.



NOTE: Image formats acceptable are .jpg, .jpeg, .png and .bmp.

At next login to the system, the login banner is shown to the authenticated user. Press the **'OK'** button to complete the login.



Last login information

Check the '**Show login history**' in **Config->Security->Users** to display the last login attempt for this user ID. When enabled, the information is displayed to the user after a successful log in.

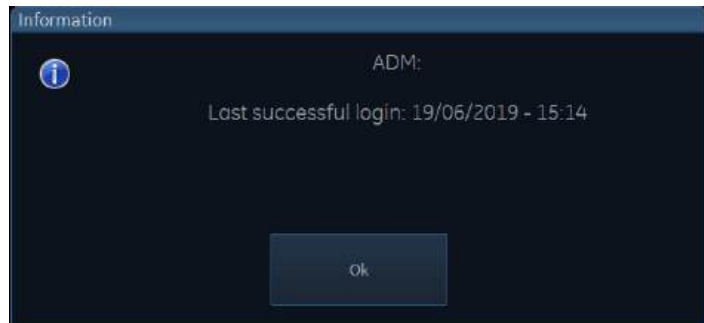


Figure 4-54. Last Login History

Prohibit default password

If '**Prohibit default password**' in **Config->Security->Users** is selected, a warning message is display at startup if the passwords of the ADM and USR user IDs are not changed from default values.

Chapter 5

Scanning Modes

This chapter describes:

‘2D-Mode’ on page 5-3

‘M-Mode’ on page 5-7

‘Color Mode’ on page 5-12

‘PW and CW Doppler’ on page 5-17

‘Tissue Velocity Imaging (TVI)’ on page 5-20

‘Tissue Tracking’ on page 5-22

‘Strain Rate’ on page 5-25

‘Strain’ on page 5-27

‘Tissue Synchronization Imaging (TSI)’ on page 5-29

‘Additional Scanning Features’ on page 5-33

‘Contrast Imaging’ on page 5-48

‘Strain Elastography’ on page 5-55

‘Elastography Analysis’ on page 5-59

‘Image Controls’ on page 5-62

‘Scan Assist Pro’ on page 5-70

‘Scan Coach’ on page 5-80

‘Configuration – Imaging’ on page 5-88.

2D-Mode

2D-Mode overview



1. Probe orientation marker
2. Parameter window

Figure 5-1. The 2D screen (cardiac)

Using 2D-Mode

The 2D-Mode is the system's default mode.

1. Press **2D** on the Control Panel to access 2D mode.
2. Optimize the image by adjusting the image controls (see below).

Optimizing 2D

The use of preset gives optimum performance with minimum adjustment. If necessary, the following controls can be adjusted to further optimize the 2D image:

- Press **Auto Tissue** on the Side Bar.
 - **Soft**: optimizes the radial and lateral uniformity and brightness of the tissue continuously in real-time.
The mention "Soft" is displayed on the upper right corner of the image area
 - **Sharp**: further enhances the image display by optimizing the grayscale curve.

The mention "Sharp" is displayed on the upper right corner of the image area

The Auto Tissue setting (Soft or Sharp) can be turned on/off by pressing **Auto Tissue** on the Side Bar. The last used setting is then applied.

The Auto Tissue settings are only available in live scanning and cannot be turned off when the image is stored.

- If available, press **Virtual Apex** (probe dependent) to improve near field imaging, allowing increased visibility up to the width of the full probe aperture close to the surface.

Optimizing 2D (continued)

- If available, press **Virtual Convex** (probe dependent) to provide a larger field of view in the far field.
Activating Virtual Convex may change the TI and/or MI. Observe the output display for possible effects.
- Use the **Gain** and **TGC** controls to optimize the overall image.
Gain increases or decreases the amount of echo information displayed. TGC compensates for depth-related attenuation in the image.
- Use the **Depth** control to adjust the range to be imaged.
- Use the **Frequency** control (move to higher frequencies) or the **Frame rate** control (move to lower frame rate) to increase resolution in image.
- Use the **Frequency** control (move to lower frequency) to increase penetration.
- Use the **Reject** control to reduce noise in the image.
- Use the **DDP**(Data Dependent Processing, refer to 'Image controls' on *page 5-62* for detailed information.) control to optimize imaging in the blood flow regions and make a cleaner, less noisy image.
- Use **UD Clarity** (Cardiac) or **UD Speckle reduce** (non-cardiac) to reduce image speckle. Extra care must be taken to select the optimal Speckle reduction level, as too much filtering of speckle can mask or obscure desired image detail.
- Adjust **Octave** to toggle between Fundamental and Harmonic mode.
- Press **Color maps** and select a gray map from the menu on screen.

NOTE: *TDI and TVM are available in 2D mode.*

Optimizing 2D (continued)



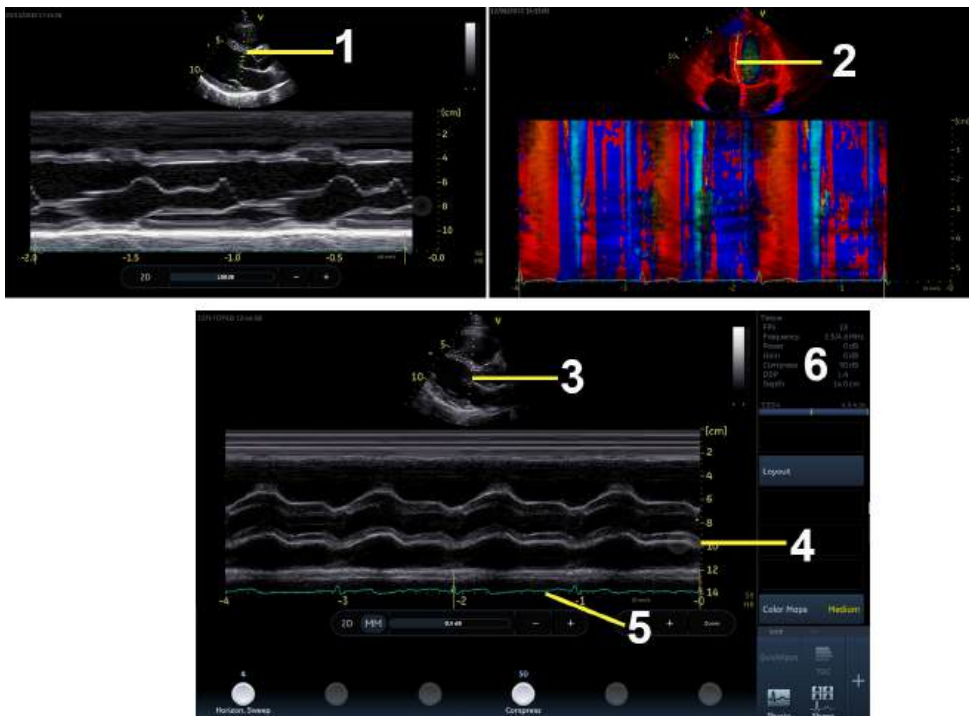
WARNING

Always use the minimum power required to obtain acceptable images in accordance with applicable guidelines and policies.

M-Mode

M-Mode overview

M mode is available in 2D mode.



1. Time motion cursor anatomical M-Mode
2. Time motion cursor curved anatomical M-Mode
3. Time motion cursor conventional M-Mode
4. Depth scale
5. Time scale
6. Parameter window

Note: The sweep speed information displayed in the bottom right corner of the image represents the user selected sweep speed and should be used only as a reference to confirm that the image was acquired at the selected sweep speed. It is not to be used for measurements or analysis. This is not an absolute value, but simply a reference number. Users performing studies using standardized protocols may find this sweep speed information useful for reading studies from other institutions.

Figure 5-2. The M-Mode screen (composite)

M-Mode overview (continued)

This unit has three types of M-Mode:

- Conventional M-Mode (MM): displays a distance/time plot of a cursor line in the axial plane of the 2D-image.
- Anatomical M-Mode (AMM): displays a distance/time plot from a cursor line, which is independent from the axial plane. AMM is available in 2D, color, TVI, Tissue Tracking, Strain rate and Strain modes.
- Curved Anatomical M-Mode (CAMM): displays a distance/time plot from a free-drawn cursor line. CAMM is available in 2D, color, TVI, Tissue Tracking, Strain rate and Strain modes.

Conventional M-Mode can be combined with Color Mode.

Using M-Mode

Conventional M-Mode

1. To access M-Mode from any other scan mode, press **MM** on the Control Panel.
2. Use the trackpad to position the cursor over the required area of the image.
3. Press **Freeze**.
4. Use the trackpad to scroll through the data acquired.

Anatomical M-Mode

1. In M-Mode or 2D-Mode Freeze, press **AMM** on the Side Bar.

NOTE: Anatomical M-Mode can also be used with previously acquired digitally stored 2D images. More than one heart cycle should be stored if performing M-Mode in post processing. AMM is also available in Color mode.
2. Use the trackpad to position the cursor over the required area of the image, or you can move the cursor line over the area of the image by touching the screen.
3. Press **Trackpad** to allow free rotation of the solid full-length cursor line throughout the 2D image (trackpad assigned function: *Angle*).
4. Adjust the solid cursor line to the desired direction.

Curved Anatomical M-Mode

1. In M-Mode, press **Curved AMM**.
2. Use the trackpad to position the starting point of the time motion curve.
3. Press **Set** to anchor the starting point of the time motion curve.
4. Use the trackpad to position the next point of the time motion curve.
5. Press **Set** to anchor the point of the time motion curve.
6. Repeat step 4 and 5 up to draw a complete time motion curve.

NOTE: *The time motion curve can be edited by following the curve back to the desired point and redraw.*

7. On the last point, press **Set** twice to terminate the curve.

NOTE: *To edit the time motion curve, select a point, move it to a new position and press **Set**.*

NOTE: *Curved AMM is also available in Color mode.*

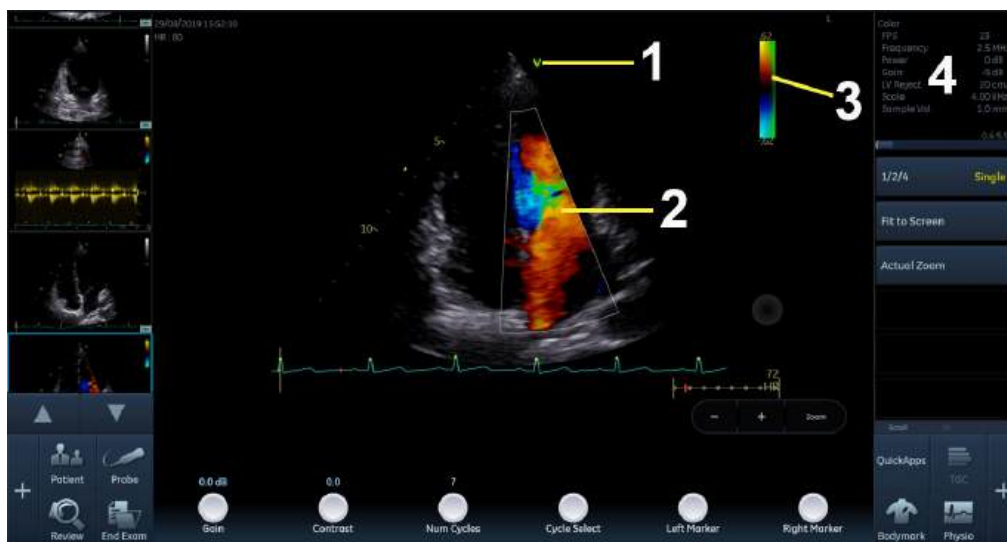
Optimizing M-Mode

The use of preset gives optimum performance with minimum adjustment. If necessary, the following controls can be adjusted to further optimize the M-Mode display:

- Adjust **Horizontal sweep** to optimize the display resolution.
- Adjust **Gain** and **TGC** controls to adjust the range to be imaged.
- Use the **Frequency** (move to higher frequencies) or the **Frame rate** control (move to lower frame rate) to increase resolution in image.
- Adjust **Dynamic range** to optimize the useful range of incoming echoes to the available grayscale.
- Adjust **Compress** to further optimize the display.
- Adjust **Reject** to reduce noise while taking care not to eliminate significant low-level diagnostic information.

Color Mode

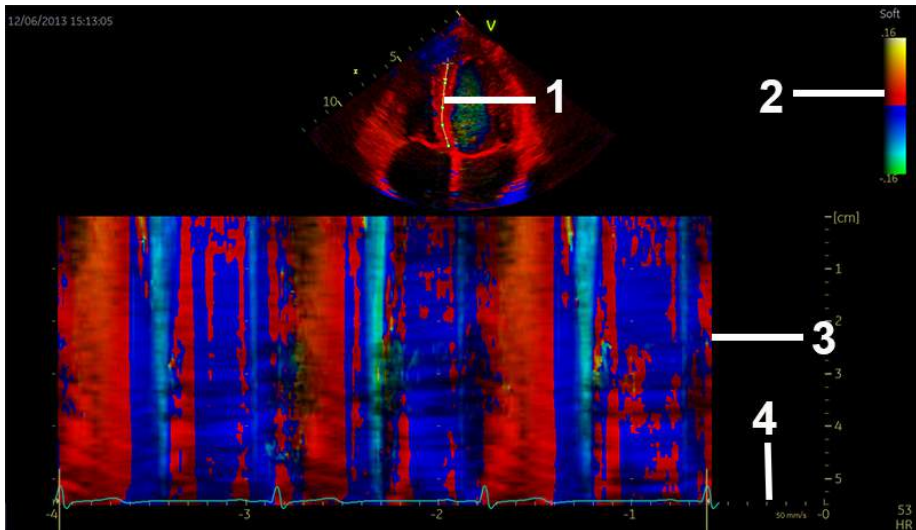
Color 2D Mode overview



1. Probe orientation marker
2. Color sector marker
3. Color bar
4. Parameter window

Figure 5-3. The Color Mode screen

Color M-Mode overview



1. Time motion cursors
2. Color bar
3. Flow sector marker
4. Time scale

Figure 5-4. The Color M-Mode screen (composite)

Using Color Mode

Color 2D

1. From an optimized 2D image, press **Color** on the Control Panel.
2. Use the trackpad (assigned function: *Pos*) to position the color ROI frame over the area to be examined.
3. Press **Set**. The instruction *Size* should be highlighted in the trackpad status bar.

NOTE: *If the trackpad control **Pointer** is selected, press **Trackpad** to be able to select between *Position* and *Size* controls.*

4. Use the trackpad to adjust the dimension of the color ROI.

Color M-Mode

1. From M-Mode press **Color**.
2. Use the trackpad (assigned function: *Pos*) to position the color area in the M-Mode display.
3. Press **Set**. The instruction *Size* should be highlighted in the trackpad status bar.

NOTE: *If the trackpad control **Pointer** is selected, press **Trackpad** to be able to select between *Position* and *Size* controls.*

4. Use the trackpad to adjust the dimension of the color area.

Optimizing Color Mode

The use of preset gives optimum performance with minimum adjustment. If necessary, the following controls can be adjusted to further optimize the Color Mode display:

- Adjust **Scale** to the highest setting that provides adequate flow detection.

NOTE: The scale value may affect FPS, Low Velocity Reject, and Sample Volume.

- Adjust **Low Velocity Reject** to remove low velocity blood flow and tissue movement that reduces image quality.
- Adjust **Variance** to detect flow disturbances.
- Adjust **Sample volume** (SV) to a low setting for better flow resolution, or a higher setting to more easily locate disturbed flows.
- Adjust **Frequency** to optimize the color flow display. Higher settings improve resolution. Lower settings improve depth penetration and sensitivity. This does not affect the frequency used for 2D and M-Mode.

NOTE: Frequency setting may affect FPS, SV and Low Velocity Reject.

- Adjust **Power** to obtain an acceptable image using the lowest setting possible.

NOTE: The Power setting affects all other operating modes.

Optimizing Color Mode (continued)

Adjust the following settings to further optimize display of the image:

- Use **Invert** to reverse the color assignments in the color flow area of the display.
- Use **Tissue priority** to emphasize either the color flow overlay, or the underlying greyscale tissue detail.
- Use **Baseline** to emphasize flow either toward or away from the probe.

NOTE: *Press the **Reset** control button to reset the baseline.*

- Use **Radial** and **Lateral Averaging** to reduce noise in the color flow area. Radial and Lateral Averaging smooths the image by averaging collected data along the same horizontal line. An increase of the lateral averaging will reduce noise, but this will also reduce the lateral resolution.



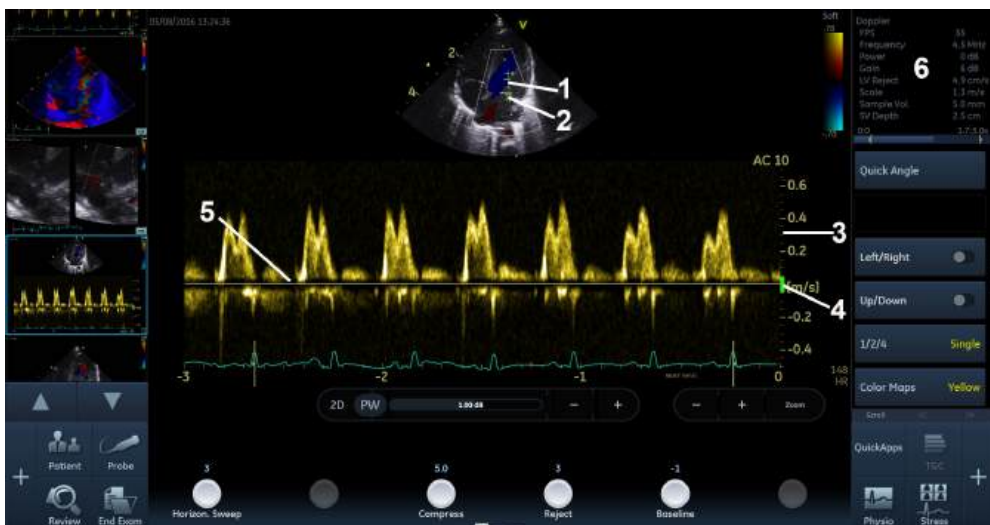
CAUTION

Use all noise reduction controls with care. Excessive application may obscure low level diagnostic information.

PW and CW Doppler

PW and CW Doppler overview

Angio (Power Doppler Imaging) and CW Doppler mode are available.



1. Sample volume (PW only)
2. Angle correction marker
3. Velocity scale
4. Low velocity reject
5. Doppler baseline
6. Parameter window

Note: the sweep speed information displayed in the bottom right corner of the image represents the user selected sweep speed and should be used only as a reference to confirm that the image was acquired at the selected sweep speed. It is not to be used for measurements or analysis. This is not an absolute value, but simply a reference number. Users performing studies using standardized protocols may find this sweep speed information useful for reading studies from other institutions.

Figure 5-5. The PW/CW Doppler Mode screen

Using PW/CW Doppler modes

1. Press **PW** or **CW**. A scanning screen is displayed with a Doppler cursor on the 2D mode image and a Doppler spectrum in the lower part of the screen.
2. Use the trackpad to position the Doppler cursor line and in PW the sample volume location over the area of interest.
3. In PW, adjust the **Sample Volume**.

NOTE: Sample Volume adjustment may affect the Scale, Frame rate and LV rej. settings.

NOTE: HPRF is supported in PW mode.

Optimizing PW/CW Doppler modes

The use of preset gives optimum performance with minimum adjustment. If necessary, the following controls can be adjusted to further optimize the PW/CW modes display:

- Adjust the **Active Gain** to set the gain in the spectral Doppler area.
- Adjust **Low velocity reject** to reduce unwanted low velocity blood flow and tissue movement.
- In PW mode, adjust **Sample volume** to low setting for better resolution, or higher setting to more easily locate the disturbed flows. Adjustment of the Sample volume may affect the PRF (Nyquist limit) settings.
- Adjust the **Compress** setting to balance the effect of stronger and weaker echoes and obtain the desired intensity display.
- Adjust **Frequency** to optimize flow display. Higher setting will improve resolution and the lower setting will increase the depth penetration.

NOTE: Frequency and Frame rate settings may affect the Low Velocity Reject.

Optimizing PW/CW Doppler modes (continued)

- Adjust **Power** to obtain an acceptable image using the lowest setting possible. This is particularly important in CW mode, as the energy duty cycle is 100% (constant).

NOTE: *The Doppler Power setting affects only Doppler operating modes.*



CAUTION

Use all noise reduction controls with care. Excessive application may obscure low level diagnostic information.

Adjust the following settings to further optimize the display of the image.

- Use the **Horizontal sweep** to optimize the sweep speed.
- To view signal detail, adjust **Scale** to enlarge the vertical spectral Doppler trace. Velocity range directly controls the pulse repetition frequency, which is responsible for the setting of the Nyquist limit (the ability to detect maximum velocity without aliasing).
- Use **Invert** to reverse the vertical component of the spectral Doppler area of the display.
- Use **Quick angle** and **Angle correction** to steer the ultrasound beam to the blood flow to be measured (Not typically required during cardiac studies).
- Press **Auto** on the Operation Panel to activate Automatic Spectrum Optimization (ASO). ASO is used to automatically adjust baseline and scale of the PW/CW spectrum to optimize the spectral display. It will avoid the display of a folded spectrum and stretch the spectrum vertically as large as possible. ASO optimization is not continuous but performed instantaneously each time **Auto** is pressed.

NOTE: *PW/CW is available in 2D/Color mode.*

NOTE: *CW is available in 2D/Color mode with 6VT-D probe.*

Using TVI

1. While in 2D mode press **TVI** on the Control Panel.
2. Use the trackpad (assigned function: *Pos*) to position the ROI frame over the area to be examined.
3. Press **Set**. The instruction *Size* should be highlighted in the trackpad status bar.

*NOTE: If the trackpad control Pointer is selected, press **Trackpad** to be able to select between Position and Size controls.*

4. Use the trackpad to adjust the dimension of the ROI.

Optimizing TVI

The use of presets gives optimum performance with minimum adjustment. If necessary, the following controls can be adjusted to further optimize the TVI display:

- To reduce quantification noise (variance), the Nyquist limit should be as low as possible, without creating aliasing. To reduce the Nyquist limit: reduce the **Scale** value.
- TVI provides velocity information only in the beam direction. The apical view typically provides the best window since the beams are then approximately aligned to the longitudinal direction of the myocardium (except near the apex). To obtain radial or circumferential tissue velocities, a parasternal view must be used. However, from this window the beam cannot be aligned with the muscle for all the parts of the ventricle.

NOTE: PW will be optimized for Tissue Velocities when activated from inside TVI.

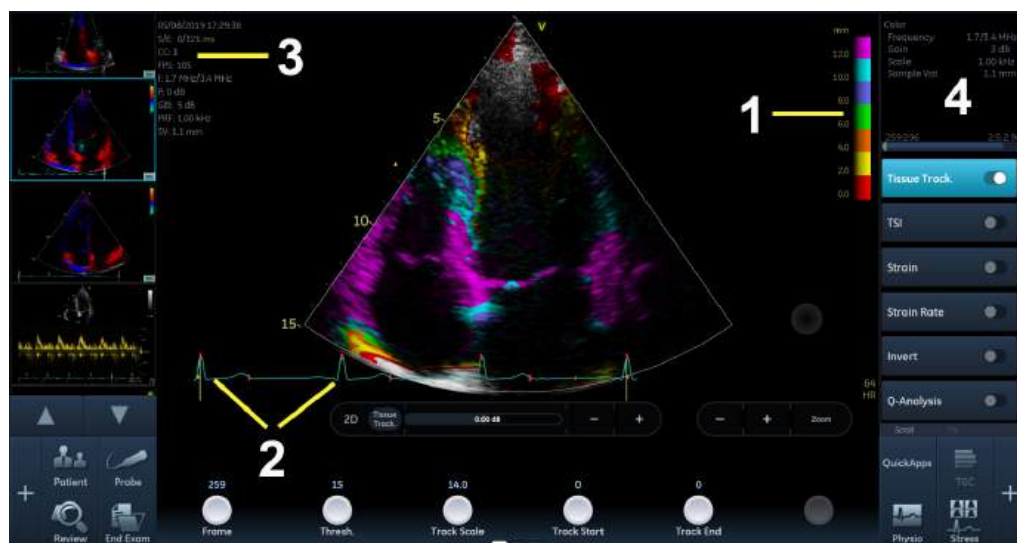
Tissue Tracking

Tissue Tracking overview

Tissue Tracking is not available for Vivid *iq* Standard package.

Tissue Tracking calculates and color-codes the displacement in the tissue over a given time interval, typically the systole. The displacement is defined as the distance the tissue moves during this time interval. The displacement is found as the time integral (sum) of the tissue velocities during this interval.

Only displacements in the beam direction are found. Only positive (systolic) displacements are mapped into colors, negative displacements are mapped into greyscale.



1. Tissue Tracking color bar
2. Track start and track end markers
3. Tracking start and end from detected QRS
4. Parameter window

Figure 5-7. The Tissue Tracking Mode screen

Using Tissue Tracking

1. From TVI Mode, press **Tissue Tracking**.
2. Adjust **Tracking start** close to the R-peak.
3. Adjust **Tracking end** to end systole.
4. Use the trackpad to position the ROI frame over the area to be examined.
5. Press **Set**. The instruction *Size* should be highlighted in the trackpad status bar.

NOTE: *If the trackpad control **Pointer** is selected, press **Trackpad** to be able to select between *Position* and *Size* controls.*

6. Use the trackpad to adjust the dimension of the ROI.

Optimizing Tissue Tracking

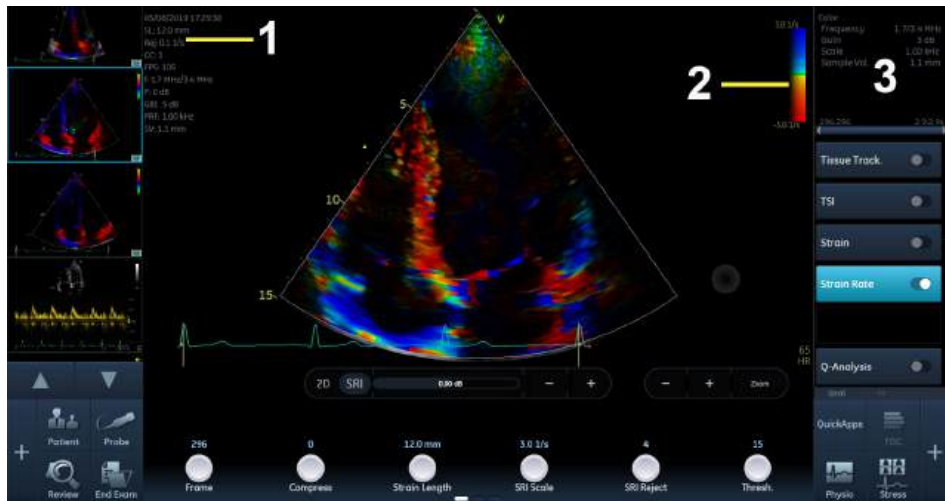
- To reduce quantification noise (variance), the Nyquist limit should be as low as possible, without creating aliasing. To reduce the Nyquist limit, reduce the scale while in TVI.
- To check for aliasing, freeze the loop and apply velocity trace (Press **Freeze** and **Q-Analysis**), see also Chapter 8 on page 8-1).
- The main use of Tissue Tracking is to map positive systolic displacements. This means that **Tracking start** and **Tracking end** controls should be adjusted to pick out the systolic phase of the cardiac cycle. Adjust **Tracking start** close to the R-Peak. Adjust **Tracking end** to end systole, typically near the T-wave.

NOTE: *Tissue Tracking on TEE acquisitions displays negative displacements. Make sure **Invert** is selected to display positive displacements.*

- Negative displacement can be mapped by pressing **Invert**. **Tracking start** and **Tracking end** must then be adjusted to pick out the diastolic phase of the cardiac cycle.
- The maximum displacement that is color-coded can be adjusted using **Tracking scale**. If set too low, most of the wall will show the color indicating maximum displacement. If set too high, the maximum displacement color is never reached.
- Tissue Tracking provides velocity information only in the beam direction. The apical view typically provides the best window since the beams are then approximately aligned to the longitudinal direction of the myocardium (except near the apex).

Strain Rate

Strain rate overview



1. Strain length and Strain rate reject
2. Strain rate color bar
3. Parameter window

Figure 5-8. The Strain rate mode screen

Strain rate calculates and color-codes the deformation per unit time i.e the speed at which the tissue deformation occurs.

Strain rate is calculated as the spatial gradient of velocity data.

Using Strain rate

1. From TVI Mode, press **Strain rate**.
2. Use the trackpad to position the ROI frame over the area to be examined.
3. Press **Set**. The instruction *Size* should be highlighted in the trackpad status bar.

*NOTE: If the trackpad control Pointer is selected, press **Trackpad** to be able to select between Position and Size controls.*

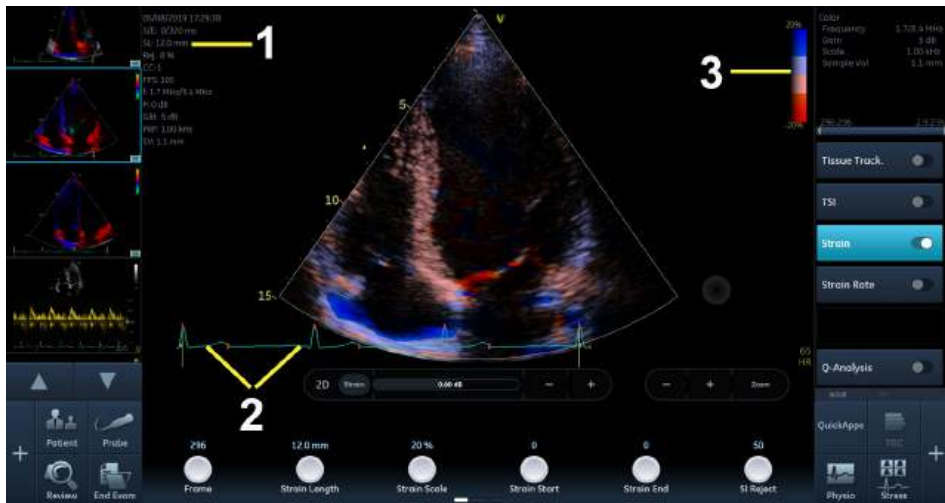
4. Use the trackpad or touchscreen to adjust the dimension of the ROI.

Optimizing Strain rate

- To reduce quantification noise (variance), the Nyquist limit should be as low as possible, without creating aliasing. To reduce the Nyquist limit, reduce the scale while in TVI.
- To check for aliasing, freeze the loop and apply velocity trace (Press **Freeze** and **Q-Analysis**), see also page 8-1).
- Strain rate provides information only in the beam direction. The apical view typically provides the best window since the beams are then approximately aligned to the longitudinal direction of the myocardium (except near the apex).
- There is a trade-off between noise and spatial resolution controlled by the **Strain length** control. To minimize noise the **Strain length** should be maximized.
- The maximum Strain rate that is color-coded can be adjusted using the **SRI scale** control. If set too low, most of the wall will show the color indicating maximum Strain rate. If set too high, the maximum Strain rate color is never reached.
- Low strain rates may be masked out with a green color using the **SRI Reject** control.

Strain

Strain overview



1. Strain start and end from detected QRS and Strain sample size
2. Strain start and end markers
3. Strain color bar
4. Parameter window

Figure 5-9. The Strain mode screen

Strain calculates and color-codes the extent of tissue deformation (lengthening or shortening) relative to the original size over a given time interval, typically the systole.

Using Strain

1. From TVI Mode, press **Strain**.
2. Adjust **Strain Start** close to the R-peak.
3. Adjust **Strain end** to end systole, typically near the T-wave.
4. Use the trackpad to position the ROI frame over the area to be examined.
5. Press **Set**. The instruction *Size* should be highlighted in the trackpad status bar.

NOTE: *If the trackpad control Pointer is selected, press **Trackpad** to be able to select between Position and Size controls.*

6. Use the trackpad or touchscreen to adjust the dimension of the ROI.

Optimizing Strain

- From an optimized Strain rate display adjust strain tracking to pick out the systolic phase.
- The main use of Strain is to map negative systolic deformation. This means that **Strain start** and **Strain end** should be adjusted to pick out the systolic phase of the cardiac cycle: Adjust **Strain start** close to the R-Peak. Adjust **Strain end** to end systole, typically near the T-wave.
- The maximum deformation that is color-coded can be adjusted using the **Strain scale** control. If set too low, most of the wall will show the color indicating maximum deformation. If set too high, the maximum deformation color is never reached.
- Strain provides information only in the beam direction. The apical view typically provides the best window since the beams are then approximately aligned to the longitudinal direction of the myocardium (except near the apex).
- Low strain values may be masked out with a different color using the **SI Reject** control.

Tissue Synchronization Imaging (TSI)

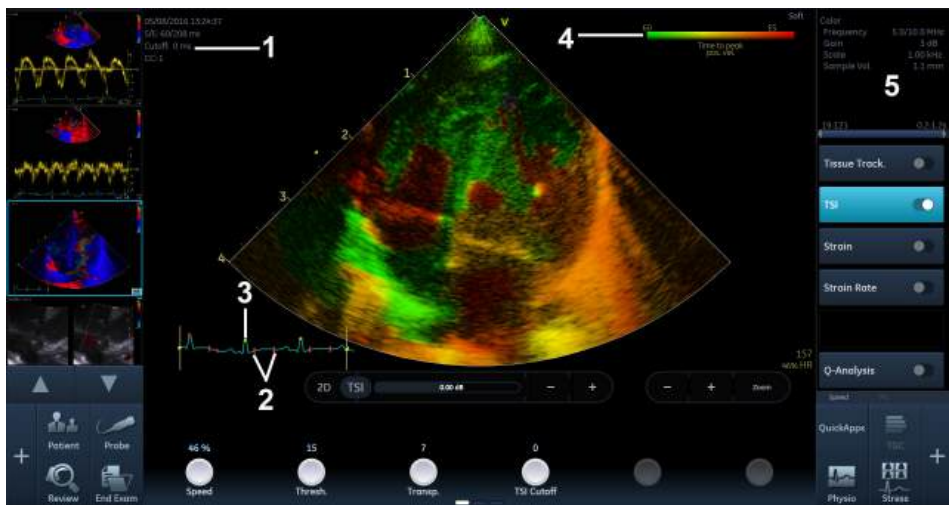
TSI overview

TSI calculates and color-codes the time from detected QRS to a detected event, typically the time to peak systolic velocity.



CAUTION

TSI is only recommended for adult cardiac images acquired with the following probes: M5Sc-RS, 3Sc-RS, 6Tc-RS or 6VT-D. The measurement accuracies of the TSI time-to-peak values reported in the Reference manual are verified with these probes.



1. TSI start/end and TSI Cut-off
2. TSI start and end markers
3. QRS marker
4. TSI color bar
5. Parameter window

Figure 5-10. The TSI mode screen

Using TSI



CAUTION

TSI requires correct QRS detection to function properly. Therefore always check that the yellow circle markers on the ECG are positioned correctly on each QRS complex before proceeding with the analysis.

1. Ideally, perform the AVO and AVC Event Timing measurements prior to starting TSI. See 'Event timing measurements' on *page 8-22*.
2. From TVI, Tissue Tracking, Strain or Strain rate mode, select **TSI**.
3. Use the trackpad or touch panel to position the ROI frame over the area to be examined.
4. Press **Set**. The instruction *Size* should be highlighted in the trackpad status bar.

NOTE:

*If the trackpad control Pointer is selected, press **Trackpad** to be able to select between Position and Size controls.*

5. Use the trackpad or touchscreen to adjust the dimensions of the ROI.

TSI markers adjustments

The default TSI markers settings are:

- **TSI start:** The time of the Event Timing measurement Aortic Valve Opening (AVO). (If no AVO measurement is available, 60 ms from the detected QRS is used.)
- **TSI end:** The time of the Event Timing measurement Aortic Valve Closure (AVC). (If no AVC measurement is available, an estimated time of end systole is used.)

The system can be configured to not use AVO and AVC for TSI start and end, or to use other events.

The configuration alternatives are:

- **TSI start:** AVO, 60, 80, 100, 120 ms, or Manual control
- **TSI end:** AVC, AVC - 200 ms, AVC - 150 ms, AVC - 100 ms, AVC - 50 ms, AVC, AVC + 50 ms, AVC + 100 ms, AVC + 150 ms, AVC + 200 ms, MVO, MVO + 100 ms, MVO + 160 ms, MVO + 200 ms, MVO + 260 ms, ES - 200 ms, ES - 150 ms, ES - 100 ms, ES - 50 ms, ES + 50 ms, ES + 100 ms, ES + 150 ms, ES + 200 ms or Manual control.

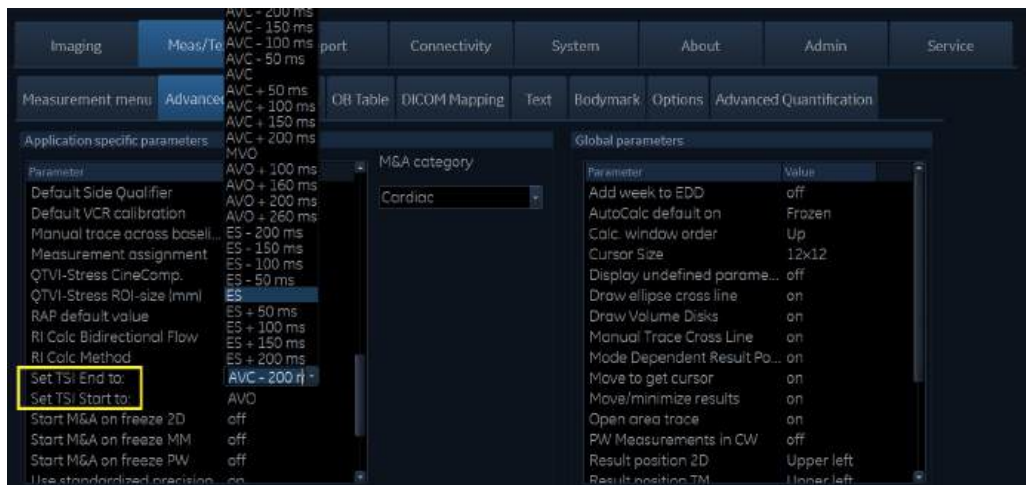


Figure 5-11. TSI start and TSI end configuration

TSI markers adjustments (continued)

*NOTE: Manual adjustment of TSI start and TSI end markers is available in Q Analysis. To store the modified marker settings, press **Store** and choose the configuration setting **Manual control** to avoid automatic adjustment of the markers.*

To configure TSI markers:

1. Press **Config** on the Shortcut Bar and select the category **Meas/Text**.
2. In the *Measure category*, select the sheet **Advanced**.
3. In the *Application specific parameters section* adjust TSI start and TSI end parameters by selecting a new value from the combo menu displayed upon selection.

Additional Scanning Features

Contents in this section

The following topics are covered in this section

- 'LogiqView' on *page 5-34*
- 'Compound' on *page 5-35*
- 'B-Flow' on *page 5-36*
- 'Blood flow imaging' on *page 5-37*
- 'Virtual Convex' on *page 5-47*

LogiqView

LogiqView provides the ability to construct and view a static 2D image which is wider than the field of view of a given transducer. This feature allows viewing and measurements of anatomy that is larger than what would fit in a single image.

LogiqView constructs the extended image from individual image frames as the operator slides the transducer along the surface of the skin in the direction of the scan plane.

Using LogiqView

1. Perform a detailed examination of the anatomy/pathology. Optimize parameters for tissue texture and visible window prior to activating LogiqView.
2. Press **LogiqView**.

NOTE: *LogiqView is not available with Compound on. Press **Compound** on the Side Bar to turn off Compound first.*

3. To start acquiring the image, press **Pause** key.
Scan slowly and in a uniform motion lengthwise.
 - Continuous contact is required throughout the length of the extended image.
 - Always keep the transducer perpendicular to the skin surface.
 - Keep the motion within the same scan plane.
 - Do not make abrupt changes in speed of motion.

Using LogiqView (continued)

4. If required, press **Pause** again to restart LogiqView.
5. To complete the scan, press **Freeze**.

NOTE: The quality of the resulting image is somewhat user-dependent and requires some additional skill and practice to develop proper technique.

Compound

Compound is a process of combining three (default) or five frames from different steering angles into a single frame. The combined single image has the benefits of reduced speckle noise, reduced clutter, and continuity of specular reflectors. Therefore, this technique can improve contrast resolution.

Compound is available with all curved and flat linear probes. Compound is on by default.

Using compound

1. Press **Compound**.
A three frames compounded image is produced.
2. To change the number of compounded frames, adjust **Compound frames**. Three or five frames can be selected.

B-Flow

B-Flow provides an intuitive representation of non quantitative hemodynamics in vascular structures. B-Flow enables visualization of complex hemodynamics and highlights moving blood and tissue. There are no artifacts such as bleeding, blooming, or aliasing.

Using B Flow

1. While in Color flow, press **B-Flow**.
2. Adjust **Flow speckle**. Increased Flow speckle enhances hemodynamics.

The greater the speed, the better the image scatter density and size. If the scan direction is the same as the flow direction, then the image scatter is elongated; if the scan direction is the opposite as the flow direction, then the image scatter is tighter. Therefore, have the scan direction opposite to that of flow direction. Switch the way you hold the probe, with the probe orientation marker inferior to maintain correct orientation on the monitor. Flow starts from where the focal zone is located.

Blood flow imaging

Blood flow imaging (BFI) is a Color flow mode with added speckle information. The speckle information visualizes the blood flow direction.

BFI Angio is also available for the system.

NOTE: When scanning in BFI triplex mode it is normal to have a time delay between the Doppler display / Doppler audio and the BFI color display.

Using blood flow imaging

1. While in Color flow, press **BFI**.
2. Adjust **Flow speckle**. Increased Flow speckle enhances hemodynamics.

View-X

View-X is an option that enables streaming from an external video signal in a dedicated window on the system. The video signal is received by means of multimedia streaming over the IP network and without audio. For instructions to connect and set up View-X, consult the documentation for the device itself and the Service Manual.

Video streaming setup is described in 'Network Configuration for View-X' on page 5-39.

In Side Bar, there is a Show View-X button to control the On/Off of streaming window. When toggled On a dedicated window showing the streamed video appears in the lower right corner by default (Figure 5-12).

NOTE: *Network connection quality may impact streaming quality. Under ideal networking conditions a delay of approx. 1 sec will still persist.*

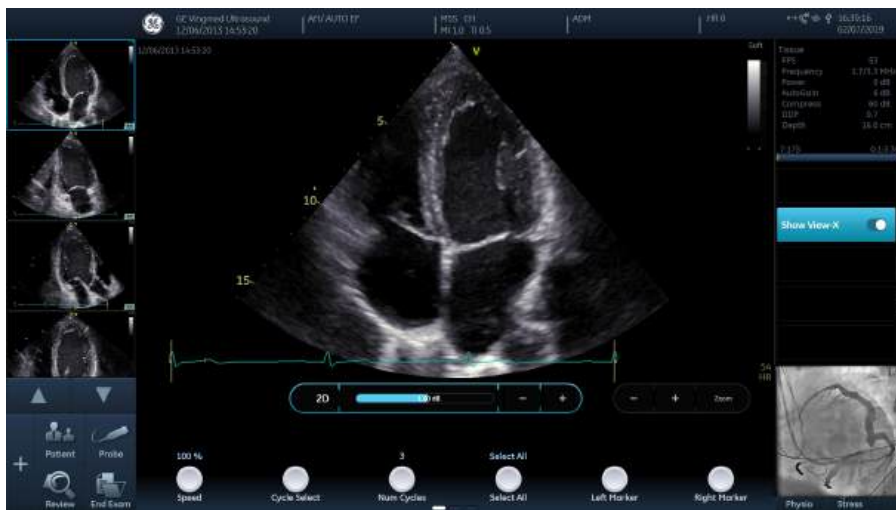


Figure 5-12. Scanning window with View-X on.

Network Configuration for View-X

Streaming source and client configuration is set through the **View-X** settings:

1. Press **Config** on the shortcut bar and log on as administrator if required.
2. Select the **Connectivity** category and the **Network** subgroup.
3. Select **View-X** (Figure 5-13).

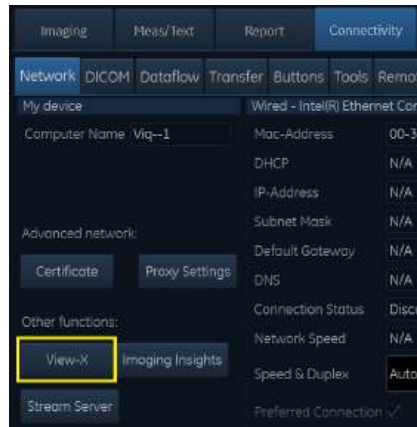


Figure 5-13. Video Streaming under network configuration.

4. Configure the *View-X* server and client as necessary (Figure 5-14).

Network Configuration for View-X (continued)

View-X

Server

IP Address

192.168.255.250

Content Path

stream.sdp

RTSP (TCP) Port No

554

Direct Connection

☒

Client

RTP (UDP) Port No

50000

Buffer Length

100

Window Crop

Left, Top (%)

0

0

Right, Bottom (%)

100

100

OK

Cancel

Figure 5-14. View-X Video streaming setup

View-X Direct

Activating View-X Direct

The View-X Direct button is available on the top right tray menu when Direct Connection is enabled in Config (default=enabled). See 'Enable Direct Connection' on *page 5-43* for information related to Direct Connection, if needed.

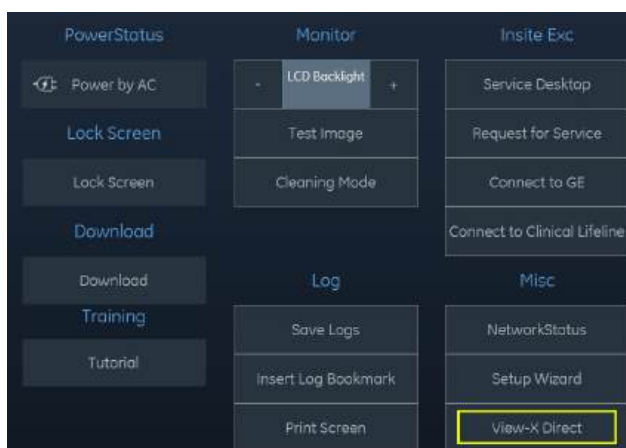


Figure 5-15. View-X Direct button on the Utility page

Typical Use Scenario

Prepare for examination:

- If needed, load worklist using the worklist dataflow while connected to the hospital network. It will still be available offline. Pull up the patient from Local Archive.
- If not using a network, start the exam with Patient name/ID in Local Archive. Connect to the Epiphan DVI Broadcaster:
 1. Connect the Epiphan DVI Broadcaster to the ultrasound system with the crossover network cable.
 2. Open the Utility tab and click View-X Direct to toggle on. This activates the IP addresses that allow the Epiphan DVI Broadcaster and the ultrasound system to communicate.
 3. Complete the study.
 4. Click View-X Direct to toggle off the setting.
 5. To transfer the study, connect back to the hospital network and transfer the study/exam/patient from Local Archive as needed.

NOTE: *The Epiphan DVI Broadcaster static IP address is 192.168.255.250 and the ultrasound system's underlying static IP address when View-X Direct is enabled is 192.168.255.249. These addresses cannot be changed while View-X Direct is active. When View-X Direct is not active, the system reverts to default TCP/IP settings.*

Enable Direct Connection

Follow these sections to select the Direct Connection to the Epiphan DVI Broadcaster for video streaming.

1. Ensure that the network cable from the Epiphan DVI Broadcaster is connected to the ultrasound system, and that the Epiphan DVI Broadcaster is switched on.
2. On the ultrasound system, enter: **Config > Connectivity > Network** and activate **View-X**. The *View-X* dialog opens.

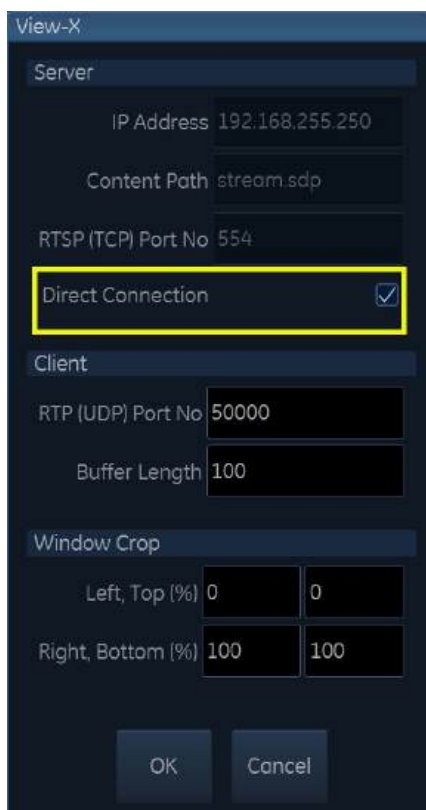
The screenshot shows the 'View-X' dialog box with the following fields and options:

- Server**
 - IP Address: 192.168.255.250
 - Content Path: stream.sdp
 - RTSP (TCP) Port No: 554
 - Direct Connection: ☐
- Client**
 - RTP (UDP) Port No: 50000
 - Buffer Length: 100
- Window Crop**
 - Left, Top (%): 0, 0
 - Right, Bottom (%): 100, 100
- Buttons: OK, Cancel

Figure 5-16. The Video Streaming dialog

3. Click the **Direct Connection** check box to activate direct connection to the Epiphan DVI Broadcaster.

Enable Direct Connection (continued)



The screenshot shows the 'View-X' configuration window. It has three main sections: 'Server', 'Client', and 'Window Crop'. In the 'Server' section, the 'IP Address' is '192.168.255.250', 'Content Path' is 'stream.sdp', and 'RTSP (TCP) Port No' is '554'. The 'Direct Connection' checkbox is checked and highlighted with a yellow rectangle. In the 'Client' section, 'RTP (UDP) Port No' is '50000' and 'Buffer Length' is '100'. In the 'Window Crop' section, 'Left, Top (%)' is '0' and 'Right, Bottom (%)' is '100'. At the bottom are 'OK' and 'Cancel' buttons.

Server	
IP Address	192.168.255.250
Content Path	stream.sdp
RTSP (TCP) Port No	554
Direct Connection	☒

Client	
RTP (UDP) Port No	50000
Buffer Length	100

Window Crop			
Left, Top (%)	0	0	
Right, Bottom (%)	100	100	

OK Cancel

Figure 5-17. Activate Direct Connection

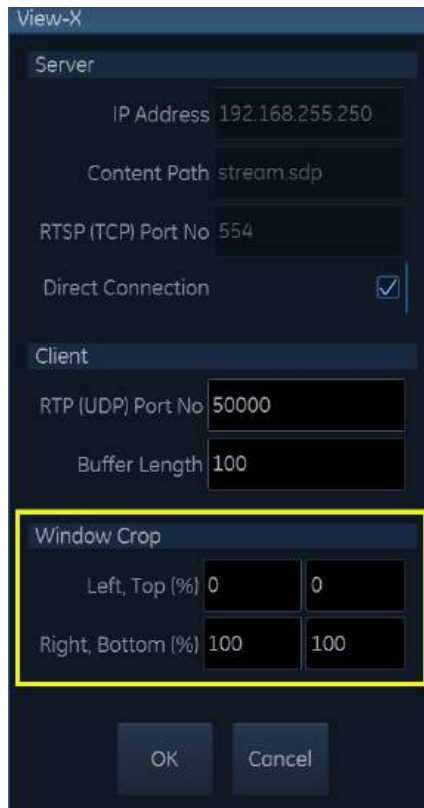
Selecting *Direct Connection* enables the **View-X Direct** button on the Utility page which will set the ultrasound system to a static IP so it can connect to the factory default static IP on the Epiphan DVI Broadcaster.

4. Select **OK** to exit.
5. Log out of the ultrasound system.

Adjust Cropping of the Video Stream

Overview

By adjusting the Window Crop values, the user can crop incoming video stream. This way only a useful/interesting part of the video can be shown. The aspect ratio is preserved.



The screenshot shows the 'View-X' configuration window. It has a dark blue background with white text. The window is divided into sections: 'Server', 'Client', and 'Window Crop'. The 'Server' section includes fields for 'IP Address' (192.168.255.250), 'Content Path' (stream.sdp), 'RTSP (TCP) Port No' (554), and a checked 'Direct Connection' checkbox. The 'Client' section includes 'RTP (UDP) Port No' (50000) and 'Buffer Length' (100). The 'Window Crop' section is highlighted with a yellow border and contains two rows of percentage values: 'Left, Top (%)' with values 0 and 0, and 'Right, Bottom (%)' with values 100 and 100. At the bottom are 'OK' and 'Cancel' buttons.

Server	
IP Address	192.168.255.250
Content Path	stream.sdp
RTSP (TCP) Port No	554
Direct Connection	☒

Client	
RTP (UDP) Port No	50000
Buffer Length	100

Window Crop	
Left, Top (%)	0
Right, Bottom (%)	100

OK Cancel

Figure 5-18. Window Crop

Overview (continued)

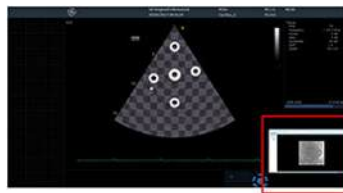
The crop box is described with four values: left, top, right, bottom positions given in percentage regarding to the original input video. These values define (left, top) and (right, bottom) corners of the crop box.

By default, the values are set to (left=0, top=0) and (right=100, bottom=100); meaning that the full input video is shown. If the values are set to (left=0, top=0) and (right=50, bottom=50), only the upper left quadrant of the input video will be visible. The visualized subpart will be stretched (and this visually enlarged) to fit dedicated video windows on the scanner. Aspect ratio is still preserved.

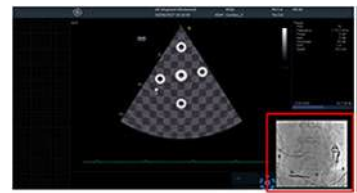
Adjust the Window Crop

Follow these steps to adjust the Window Crop:

1. Go to **Config > Connectivity > Network** and activate the *View-X dialog*.
2. Adjust the values in the four Window Crop fields to crop the video stream window so the area of interest is displayed.
3. Select **OK** to set the new values.



Full Video Image



Cropped Video Image

Virtual Convex

Virtual Convex is designed to provide a wider field of view in the far field, and is available on linear probes. While in 2D-mode, use the **Virtual Convex** to turn virtual convex ON or OFF. When Virtual convex is turned on, you may enter other scanning modes such as Color, Doppler or M-mode and Virtual convex will remain active on the 2D image.

NOTE: Virtual Convex is only available for linear probes.

NOTE: While Virtual Convex is turned on, the Zoom function will always activate in “Display-zoom” mode only.

*NOTE: While using any linear probe in **Virtual Convex** mode while in split-screen. The vertical depth-scale bar is missing. In this case, the measurements calipers cannot measure across the two parts of the screen. When Virtual convex is turned off, the vertical scale bar appears and calipers may measure across the two screens.*

Contrast Imaging

The two basic steps of contrast imaging are data acquisition and quantification. Data acquisition is described in this chapter. Quantification is described in Chapter 8 on page 8-1.

Data acquisition



WARNING

Appropriate training

Only physicians or echo technicians who have received appropriate training can use the contrast applications.



WARNING

Always read and follow carefully the manufacturer instructions on the contrast agent label to use the appropriate contrast agent.

NOTE: *This system is designed for compatibility with commercially available contrast agents. Because the availability of these agents is subject to government regulation and approval, product features intended for use with these agents may not be commercially marketed nor made available before the contrast agent is approved for use.*



CAUTION

Cardiac rhythm disturbances during cardiac studies using gas ultrasound contrast agents have been observed in the diagnostic range of Mechanical Index (MI) values. See the specific package insert for the contrast agent being used for further details.

Cardiac imaging

- **Left Ventricular Contrast imaging:** The LV Contrast and LVO Stress application are optimized for endocardial border detection and assessment of wall motion and wall thickening. LVO Stress is optimized for higher heart rates. Both applications require the LVO Contrast option enabled.
- **Contrast Low MI imaging:** The Contrast Low MI application is optimized for improved assessment of perfusion of the myocardium. The application requires the Advanced Contrast option enabled.

NOTE: Vascular / Abdominal and Advanced Contrast Imaging application availability is subject to government regulation and approval and might not be available in your regions. Vascular/Abdominal and Advanced Contrast Imaging is not available in the U.S.

Quantification

Quantification enables the user to perform the following analysis:

- **Time-Intensity analysis:** allows instant time-intensity calculation from up to eight regions of interest.
- **Curve fitting analysis:** for research studies of myocardial contrast agent concentration rates.
- **Arbitrary Anatomical M-Mode (Curved and Straight):** M-Mode applied to intensity data calculates and color-codes tissue along a path drawn by the operator vs. time.



Misdiagnosis based on image artifacts

Misdiagnosis in ultrasound contrast images may be caused by several artifacts, most importantly:

Motion artifacts: gives rise to signals independently of contrast presence. This may be caused by patient movement; including respiration, or by probe movement influenced by the operator.

Regional drop outs: caused by unintentional destruction of the contrast agent, too low concentration of contrast agent, poor acoustic penetration due to rib/lung shadows or system failing to detect the contrast agent due to erroneous settings induced by the operator.

Tissue harmonics: gives contrast-like signals independently of the presence of contrast agent.

Useful link

The Contrast Echo Box: the European Society of Cardiology provides useful information on contrast echocardiography on the Internet here: <http://www.esccardio.org/communities/EACVI/education/echo-box/contrast-echo-box/Pages/welcome.aspx>.

Left Ventricular Contrast Imaging

LV Contrast is not available for Vivid *iq* Standard package.

The Left Ventricular (LV) Contrast application has an optimized system preset for optimal resolution of endocardial borders and for optimal assessment of wall motion and wall thickening.

The LVO Contrast application may help to identify LV thrombus and evaluate wall motion.



1. Parameter window

Figure 5-19. The LV Contrast acquisition screen

Using LVO Contrast

The LV Contrast application works with the 3Sc-RS, M5Sc-RS, 6Tc-RS, 6VT-D probes.

1. Press **Probe** on the Shortcut Bar.
A list of the connected probes with respective applications is displayed.
2. Select **LVO Contrast** application.
3. Turn on and adjust **Tissue Visualization** if needed, to re-orient the probe after the application has been selected.
4. Once oriented, turn off **Tissue Visualization** for optimized contrast detection and perform the acquisition.

NOTE: *If the amount of contrast injected is too high, you may press **Flash** to destroy some of the contrast.*



WARNING

Always read and follow carefully the manufacturer instructions on the contrast agent label.

Using Contrast Low MI

Contrast Low MI application works with the M5Sc-RS probes.

- Press **Probe** on the Shortcut Bar.
A list of the connected probes with respective applications is displayed.
- Select **Contrast Low MI** application.

Optimizing LVO Contrast

If a swirling pattern is observed and persists after the LV cavity has been filled with contrast agent, the power should be reduced until homogenous opacification is obtained.



CAUTION

Too high Power setting will destroy the contrast agent in the LV cavity.

Vascular/Abdominal Contrast Imaging

NOTE: *This system is designed for compatibility with commercially available contrast agents. Because the availability of these agents is subject to government regulation and approval, product features intended for use with these agents may not be commercially marketed nor made available before the contrast agent is approved for use. Vascular/Abdominal Contrast features are only enabled on systems for delivery in countries or regions where the agents are approved for use or for investigational or research use.*

Vascular Contrast is intended for visualization of ultrasound contrast agents in large vessels (for example carotid artery and femoral artery).

The Vascular Contrast application works with the 9L-RS and L4-20t-RS probes.

Abdominal Contrast optimized to visualize contrast agents in abdominal organs.

The Abdominal Contrast application works with the C1-5-RS probe.

1. Press **Probe** on the shortcut bar. A list of the presets are displayed.
2. Select the **Contrast** application.

NOTE: *If the orientation of the image has been lost, Tissue Visualization can be used to re-orient the probe after the application has been selected.*

NOTE: *The Vascular and Abdominal Contrast applications require the Vascular/Abdominal Contrast option enabled.*

NOTE: *If the amount of contrast injected is too high, you may press **Flash** to destroy some of the contrast. Some applications may limit how often **Flash** can be activated due to probe temperature restrictions. The **Flash** control will be grayed out during this time.*

The MI and TI values transmitted during the Flash sequence is displayed parenthetically in the title bar along with the current imaging MI and TI values.

Strain Elastography

Description

Elastography shows the spatial distribution of tissue elasticity properties in a region of interest by estimating the strain before and after tissue distortion caused by external or internal forces. The strain estimation is filtered and scaled to provide a smooth presentation when displayed.

Below is an example of Strain Elastography. The image is displayed in dual mode with the color map/bar of the Strain Elastography on the left side and the imaging parameters on the right side of the display below E.

Elastography can be activated via the virtual button on the touch panel or via Flex button on the control panel.

Using Strain Elastography

The Elastography image is achieved by pulsating the probe while you are scanning the anatomy of interest. Here are some criteria to use:

Handheld elasticity imaging can be very dynamic as the size of distortion depends on the movement of the hand-held probe. To maintain stable and consistent displayed strains, pay attention to the Quality indicator. One form of feedback is provided. An ideal manual compression is indicated by a high value feedback. In addition, apply the following post-processing controls: Smoothing, Window, Scaling, and Frame Averaging.

Strain Elastography displays firmer tissue in blue and softer tissue in red. To enhance Blue, increase Hard Compress; to enhance Red, increase Soft Compress. To enhance strain elastography contrast, reselect the Color Map.

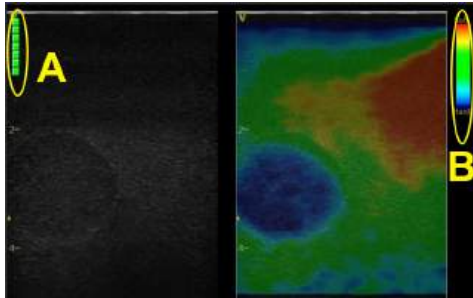
If you need more resolution, reduce Smoothing, increase Frequency, or reduce Window.

If you need a smoother image, increase Window or Smoothing.

If the images seem too flashy, decrease Frame Reject to 1.0 and Noise Reject to have consistent imaging throughout.

Using Strain Elastography (continued)

Table 5-1: Strain Elastography

Using Strain Elastography	
Manual Compression: 1. Press "Elastography" virtue button on the screen to activate. 2. Adjust the position of the ROI to place the suspicious area at the center. 3. Adjust the size to include surrounding tissue (sample area size = x3 dimension of the lesion per axis). Manual compression depends on the type of probe. 1. Linear probes: Perform slight compressions keeping transducer perpendicular to the skin. Duration: 5 sec or 10 compressions. 2. Convex probes: Turn the patient on his left side more than 90 deg. Pressing with the probe above the lesion, allowing the heart and lungs to create the compressions. <i>Note1: Any very soft (vessel, cyst, air) or very stiff (bone) tissue above the lesion or the reference area may cause interference with the compressions. You may want to attempt from a different view.</i> <i>Note2: keep the lesion within the image and keep the quality indicator remaining green for more than 2 seconds.</i>	Select the frame to analyze: • Press "Freeze." • Using the trackpad or "frame by frame" knob, select a frame when the quality indicator reaches its high peak.  Image 1: Elastography image, quality indicator (A) and elasto color bar (B). The relation between elastography colors and area's stiffness is given at the elastography color bar (image 1, B).

Strain Elastography Controls

Table 5-2: Strain Elastography Touch Panel Description

Parameter	Description
AxSmoothing	Controls the smoothness of the elastography image in the axial direction. A higher value means a smoother image.
LaSmoothing	Controls the smoothness of the elastography image in the lateral direction. A higher value means a smoother image.
WindowLength	Controls the RF data segment size for the motion tracking. A higher Window value gives a better signal to noise ratio (SNR) at the cost of axial resolution.
Color Maps	Controls the elastography maps. Six different maps are available with various contrast and color schemes, including a grayscale map. Selections: E0-5, E-Gray, and E-Invert
Frame Average	Controls the persistence of the elastography images.
Frequency	Controls the transmit frequency.
Soft Compress	Individually controls the image enhancement for the softer than average tissues.
Hard Compress	Individually controls the image enhancement for the harder than average tissues.
Scale	Controls the time interval between consecutive firings. A lower value dictates a higher sensitivity to weak manual motion.
Transp.	High values bring out the tissue behind the elastography data. You adjust via the Color Gain control; this imaging parameter appears as a “T” on the right-hand portion of the display.
Frame Reject	Controls how many frames get rejected due to low quality vertical motion. A higher value means more frames get rejected. A rejected frame has a completely transparent ROI with the B-Mode background showing through.
Noise Reject	Controls how many frames get rejected due to lateral and elevational motion. A higher value means more frames get rejected. A rejected frame has a completely transparent ROI with the B-Mode background showing through.
Frame Rate	Optimizes B-Mode frame rate or spatial resolution for the best possible image.

Elastography Analysis

Overview

The Elastography Mode detects strains by correlating the echo amplitudes of the tissue when compressed and uncompressed. Different displacement of echoes is an indicator for different stiffness (strain) of the tissue. High strain means that the tissue is softer, low strain means that it is stiffer. Zero is absolutely stiff without any elasticity. Elastography Analysis is a strain ratio comparative tool that enables users to compare the strain of one tissue to the surrounding tissue.

Using Elastography Analysis

1. Activates Elastography mode via touch window or FLEX button.
2. Perform the scan. Proper manual compression/decompression is indicated by a fully green quality indicator.
3. Press **Freeze** and scroll the Trackpad for a frame with high quality according to the quality indicator for Elastography analysis
4. Enter Measurement, in the application of SmallParts, choose Elasto Ratio(trace) in the folder of Elastography.
5. Activate the cursor and move it over the Elastography image, press **Set** then a manual trace will appear, it will be the reference sample area and should be placed in the normal tissue. Move the Trackpad to draw the trace and then press **Set** on the second time to end the first trace.
6. After completing the first trace, the cursor is ready to draw the second trace. Press **Set** and move the Trackpad again. A new sample area appears which should be placed on the abnormal area.
7. After pressing **Set** to end the second trace, the Elasto Index and the Elasto ratio will be displayed together. The ratio value indicates how many times the tissue of an abnormal area is harder or softer than the tissue of the reference sample area.

NOTE: ***Elasto Index** represents the mean elasticity value inside one specific trace. Elasto Index provides relative measurement, so these values themselves are not providing a value in kPa (Young's Modulus). **Elasto Ratio** is the ratio between Elasto Index of two drawn traces.*



HINTS

Use the trackpad to scroll the Cine Loop quickly.

NOTE: *The maximum strain value in human tissue can be up to 2%.*

NOTE: *The ratio value indicates how many times the tissue of a sample area is harder or softer than the tissue of the Reference sample area.*

Additional Notes for Elastography Analysis



HINTS

Limitations:

- This is a relative quantification tool based on freehand manual palpation technology. It cannot show the stiffness by the kPa (kilopascal).
- There is no compatibility among manufacturers regarding the value. It depends on their strain imaging technology and definition of the value.
- Colors indicate degree of stiffness and do not directly correlate to a specific tissue type. Interpretation of what the tissues are and how to apply these ratios clinically is at the discretion of the user.
- Elastography physics dictates that cystic structures will be displayed with a three-layer pattern. This three-layer pattern will start with blue on the Vivid xx factory default map (which corresponds to hard), then progresses to green and then to red (which corresponds to soft). The posterior displacement of elastography patterns also may cause the B-Mode cyst to consist primarily of blue with the green to red being posterior to the B-Mode cyst. You need to be aware of the three-layer pattern of a cyst in elastography. Utilizing Elastography Analysis and setting the sample area in the blue portion of the three-layer pattern on the cyst and then setting the sample area in the “normal” tissue may cause you to misinterpret the Elastography Analysis ratio as the cyst to be hard as compared to the “normal” tissue.



CAUTION

Elastography images can only be provided as a tool to assist the physicians or sonographers in making a clinical diagnosis. It is recommended to compare images scanned with other systems or use other non-ultrasound means for diagnosis determination.



WARNING

Improper handheld movement (such as excessive compression or fast moving) may result in mechanical injury to patient.

Image Controls

Image controls

	2D Gain
2D	Press “+” or slide on the bar to the right, to increase the overall gain applied to the received echo signals equally for all depth.

	Dual Focus
2D	Activates Dual focus mode. To adjust the Dual focus, rotate the Focus Pos.

	Time Gain Compensation TGC
2D	Compensates for depth-related attenuation in an image. The sliders nearest the bottom affect the far field. TGC amplifies returning signals to correct for the attenuation caused by tissue at increasing depths.

	Depth
2D	Sets the maximum (far field) distance that will be imaged. Depth and frame rates are related. Decreasing the depth may allow higher frame rates. Increasing the depth may allow lower frame rates.

	Up/Down
2D, M-Mode, CF	Up/Down: enables the 2D image to be flipped 180 degrees.

	Left/Right
2D, CF	Left/Right: enables a mirror image of the 2D image to be created. The left/right reference marker V moves to the other side of the image.

	Tilt
2D, TVI, TT	Enables the axis of the 2D image to be tilted to the left or right. By default the axis of symmetry of a 2D image is vertical.

	Auto Tissue
2D	Two settings are available: • Soft: optimizes the radial and lateral uniformity and brightness of the tissue continuously in real-time. • Sharp: further enhances the image display by optimizing the gray scale curve. The Auto Tissue setting (Soft or Sharp) can be turned on/off by pressing Auto on the Control Panel. The last used setting is then applied. The Auto Tissue setting is preserved when switching to 2D duplex mode. The Auto Tissue settings are only available in live scanning and cannot be turned off when the image is stored.

	Virtual Apex
2D (Cardiac)	Improves near field imaging, allowing increased visibility up to the width of the full probe aperture close to the surface.

	Invert
CF	Enables the color scheme assigned to positive and negative velocities to be inverted. Invert is available in live and cine replay.
Doppler	Enables the Doppler spectrum to be flipped 180 degrees, so that negative velocities are displayed above the baseline and positive velocities below the baseline. Invert is available in live and cine replay.
TVI	Enables the color scheme assigned to positive and negative tissue velocities to be inverted. Invert is available in live and cine replay.
TT	Enables the color scheme assigned to the tissue displacements to be inverted. Invert is available in live and cine replay.
SRI	Enables the color scheme assigned to strain rate to be inverted. Invert is available in live and cine replay.
SI	Enables the color scheme assigned to shortening and elongation tissue deformation to be inverted. Invert is available in live and cine replay.

	Color Maps
All modes	Displays the <i>Color</i> menu for selection of different color maps.

	Variance
CF	Controls the amount of variance data added to a color display. Variance enables computer-aided detection of turbulent flow (e.g. jets or regurgitation). Variance is available in live and cine replay.

	LPRF
PW Doppler	Sets the Pulse Repetition Frequency (PRF) for the PW Doppler acquisition of flow data. Enables toggling between high and low Pulse Repetition Frequency (PRF). When the Doppler PRF is raised beyond a certain limit, more than one Doppler gate is displayed on the screen.

	Angle Correction and Quick Angle
Doppler	Enables correction of the Doppler velocity scale by defining the angle between the Doppler beam and the investigated blood vessel or blood flow. A thin cross bar on the Doppler cursor will rotate as the control is adjusted. Angle correction is available in both Live and Freeze. Angle correction adjusts the angle between zero and 90 degrees with one degree increment. Quick angle adjusts the angle by 60 degrees. When the corrected angle is exceeding 60 degrees, the angle correction (AC) will turn from yellow to red as a warning.

	Tissue Track./Strain Rate/Strain/TSI
TVI, TT, SRI, SI	Refer to 'Tissue Tracking' on <i>page 5-22</i> for detailed function of Tissue Track Refer to 'Strain Rate' on <i>page 5-25</i> for detailed function of Strain Rate Refer to 'Strain' on <i>page 5-27</i> for detailed function of Strain Refer to 'Tissue Synchronization Imaging (TSI)' on <i>page 5-29</i> for detailed function of TSI

	AMM	Curved AMM
M-Mode, TVI, TT, SRI, SI	Starts Anatomical M-Mode.	Starts Curved Anatomical M-Mode.

	Update/Menu
CF, TVI, TT, SRI, SI, TSI	Enables simultaneous display of a 2D image and a 2D image with color coded mode.

	TVI visible
TVI	Turns TVI display on/off.

	Q Analysis
TVI, TT, SRI, SI, TSI (In Freeze)	Starts the Quantitative analysis application.

	Line Density
2D (non-cardiac)	Controls the spatial resolution of the image versus the image update rate.

	Width/2D width
2D, CF, TVI, TT, SRI, SI, TSI	Controls the size or angular width of the 2D image. A smaller angle generally produces an image with a higher frame rate.

	Frequency
2D, M-Mode	Adjust the probe's operating frequency. The selected frequency is displayed in the <i>Parameter</i> window. For some probes/applications the lowest frequency settings will be Octave imaging settings. Push to turn Octave imaging on/off.
CF, Doppler, TVI, SRI	Enables the adjustment of the transmission frequency to control the sensitivity or the level of penetration. The selected frequency is displayed in the <i>Parameter</i> window. Adjusting Frequency may affect Sample Volume and LVR settings.

	Frame rate
2D, CF, Doppler, TVI, TT, SR, SRI, TSI	Adjusts frame rate (FPS). The relative setting of the frame rate is displayed in the <i>Parameter</i> window. When adjusting frame rate, there is a trade off between spatial and temporal resolution.

	Compress
2D, M-Mode	Controls the amount of contrast in the 2D image. An index number is displayed on the control to indicate the relative level of compression.
Doppler	Enables control over the contrast of the Doppler spectrum. When compression is raised, the spectrum image becomes softer and some low level background noise may appear. Compress is available in both Live and Freeze.
TVI, SRI	Controls the amount of color compression. The color bar is adjusted accordingly.

	Reject
2D, M-Mode	Adjusts the rejection level. When this control is increased, low-level echoes are rejected and appear darker in the 2D image. An index number is displayed on the control to indicate the relative level of rejection.
Doppler	Enables undesirable background noise to be removed from the Doppler spectrum resulting in a darker background. Reject is available in both Live and Freeze.

	Data Dependent Processing (DDP)
2D	Performs a temporal processing which reduces random noise without affecting the motion of significant tissue structures. An index number is displayed on the control to indicate the relative DDP level.

	UD Clarity
2D (Cardiac)	Reduces the unwanted effects of speckle in the ultrasound image. Image speckle usually appears as a grainy texture in otherwise uniform areas of tissue. Its appearance is related to image system characteristics, rather than tissue characteristics, so that changes in system settings, such as probe type, frequency, depth, and others, can change the appearance of the speckle. Too much speckle can impair image quality and make it difficult to see the desired detail in the image. Likewise, too much filtering of speckle can mask or obscure desired image detail. Extra care must be taken to select the optimal Speckle reduction level. A decrease of UD Clarity creates a smoother image, though keeping boundaries sharp. An increase of UD Clarity creates a crisper image.

	UD Speckle reduce
2D (non-Cardiac)	Reduces the unwanted effects of speckle in the ultrasound image. Image speckle usually appears as a grainy texture in otherwise uniform areas of tissue. Its appearance is related to image system characteristics, rather than tissue characteristics, so that changes in system settings, such as probe type, frequency, depth, and others, can change the appearance of the speckle. Too much speckle can impair image quality and make it difficult to see the desired detail in the image. Likewise, too much filtering of speckle can mask or obscure desired image detail. Extra care must be taken to select the optimal Speckle reduction level.

	Edge Enhance
2D, M-Mode (non-cardiac)	Controls image processing related to the extent of edge enhancement applied to an image.

	Power
2D, M-Mode, CF, Doppler, TVI, TT, SRI, SI, TSI	Controls the amount of acoustic power applied in all modes. When power is set to maximum, it is equal to or less than the maximum acoustic power permitted by the FDA. The Thermal Index (TI) and the Mechanical Index (MI) are displayed on the screen. When power is reduced, it reduces the signal-to-noise ratio, so that the image may become noisier.

	Horizontal sweep
M-Mode, Doppler	Adjusts the horizontal refresh rate of the M-Mode or Doppler area of the display. Horizontal sweep is available in live and cine replay.

	Scale
CF, TVI	Adjusts the repetition rate of the Doppler pulses transmitted to acquire the data for color flow mapping. The Scale (Nyquist limit) should be adjusted so that no aliasing occurs, while still having good resolution of velocities. The Nyquist limit should be somewhat above the maximum velocity found in the data.

	Scale
Doppler	Enables the vertical scale of the Doppler spectrum and the maximal detectable velocity to be modified. Velocity range directly controls the pulse repetition frequency, which is responsible for the setting of the Nyquist limit (the ability to detect maximum velocity without aliasing).

	Baseline
CF	Adjusts the color map to emphasize flow either toward or away from the probe. Baseline is available in both Live and Freeze.
Doppler	Enables the Doppler baseline to be shifted up and down. The default Doppler baseline is set at the center of the vertical aspect of the Doppler display, dividing evenly the flow toward and away from the probe. By adjusting the baseline a larger portion of the analysis is assigned to the flow direction present. Baseline is available in live and cine replay.
TVI	Adjusts the color map to emphasize tissue motion either toward or away from the probe. Baseline is available in both Live and Freeze.

	Sample volume
CF	Adjusts the size of the color flow Doppler sampling area. Lower setting gives better flow resolution while a higher setting increases sensitivity and helps to locate turbulent flows.

	Low Velocity Rejection (LVR)
CF	LVR, also called Wall motion filter, enables the extent of low velocity removal to be adjusted. Color data produced by very low flow may cause interference.
Doppler	Enables the low velocity portions of the spectrum to be filtered, since the Doppler spectrum and audio may contain strong wall-motion signals. The amount of Low Velocity Reject is indicated by the green vertical bar at the right end of the baseline.

	Tissue priority
CF	Emphasizes either the color of the color mode or the grey scale tissue detail of the 2D image. Tissue priority is available in both Live and Freeze.

	Lateral averaging
CF, TVI, TT, SRI, SI	Smooths the image by averaging collected data along the same horizontal line. An increase of the lateral averaging will reduce noise, but this will also reduce the lateral resolution.

	Radial averaging
CF, TVI, TT, SRI, SI	Smooths the image by averaging collected data along the same radial line. An increase of the radial averaging will reduce noise, but this will also reduce the radial resolution.

	Sample volume
PW Doppler	In PW mode, sets the longitudinal size of the region to be sampled for measurement. Adjusting Sample volume may affect the PRF (Nyquist limit) settings. SV does not apply to CW mode, where the volume sampled is the full length of the area indicated by the cursor line.

	Threshold
TVI, TT, SRI, SI, TSI	Controls the level of greyscale intensity that is used as a threshold for color.

	Transparency
TVI, TT, SRI, SI, TSI	Controls the degree of transparency of the color display.

	Track start
TT	Controls the time after ECG R-peak when the integration should start.

	Track end
TT	Controls the time after tracking start when the integration should end.

	Track scale
TT	Controls the color cut-off value of max displacement displayed. The chosen values are shown on the color bar.

	SRI scale
SRI	Defines the scale for the color coding of the strain rate.

	Strain length
SRI, SI	Determines the strain sample volume size. There is a trade-off between noise and spatial resolution controlled by the Strain length. To minimize noise the Strain length should be maximized. A value of 12mm is typical for adult cardiac patients.

	SRI reject
SRI	Adjusts the cut-off level of the low Strain rate to be discarded when generating the color image. Rejected values are displayed in green.

	Strain start
SI	Controls the time after ECG R-peak when the strain calculation should start. The strain start time is displayed on the screen and is represented on the ECG by a red marker.

	Strain end
SI	Controls the time after strain start when the strain calculation should end. The strain end time is displayed on the screen and is represented on the ECG by a red marker.

	Strain scale
SI	Defines the scale for the color coding of the tissue deformation.

	Strain reject (SI reject)
SI	Adjusts the cut-off level of the low tissue deformation to be discarded when generating the color image. Rejected values are uncolored.

	Cine compound
TT, SRI, SI, TSI (Freeze only)	Calculates and displays cineloops generated from a temporal averaging of multiple consecutive heart cycles. The number of cycles averaged is user adjustable. The number of averaged cycles is displayed on the top left corner.

	TSI Cut-off
TSI	Controls the cut-off time: using this control it is possible to color all parts of the TSI image that has a time to peak less than a certain cut-off time.

	T1/T2 (Timer)
Stress echo	Starts a timer.

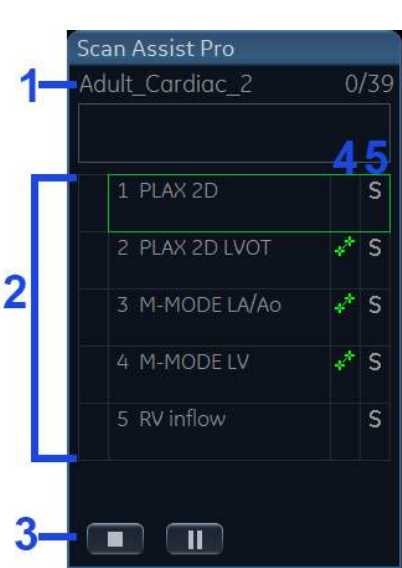
	Num Cycle
2D, CF, TVI, TT, SRI, SI, TSI	Cineloop storage adjustment. Press the rotary to toggle between Num Cycle and Time span . • Num Cycle : adjust number of heart cycles to store.

Scan Assist Pro

Introduction

Scan Assist Pro provides an automated examination script that guides you through an examination step-by-step. The system automatically invokes the correct mode and imaging parameters, advances to the next step in an examination, annotates the image, initiates measurements, and assigns the measurements to the worksheet/report.

Scan Assist Pro overview



The screenshot shows the 'Scan Assist Pro' window. At the top, it displays 'Adult_Cardiac_2' and '0/39'. Below this is a list of five steps: '1 PLAX 2D', '2 PLAX 2D LVOT', '3 M-MODE LA/Ao', '4 M-MODE LV', and '5 RV inflow'. Each step has a status indicator (green checkmark or 'S') and a column for scanning mode or action. Callout 1 points to the protocol name and step count. Callout 2 points to the list of steps. Callout 3 points to the navigation buttons (stop and pause) at the bottom.

Step	Step Name	Status	Mode/Action
1	PLAX 2D	S	
2	PLAX 2D LVOT	✓	S
3	M-MODE LA/Ao	✓	S
4	M-MODE LV	✓	S
5	RV inflow	S	

1. Protocol name
Completed steps/number of steps
2. Protocol steps
Check mark: completed step
Frame: current step (The frame is green when the Protocol is active or yellow when it is paused.)
3. Navigation: Stop, Pause/Continue the Protocol.
4. This column indicates the scanning mode or when a measurement needs to be made.
5. This column indicates the action to move the Protocol to the next step.

Figure 5-20. Scan Assist Pro window

Setting up Scan Assist Pro

Scan Assist Pro is ready to use with factory Protocols. However user-defined Protocols customized to better suit the user's needs can be added to the list of available Protocols on the Vivid *iq*.

User-defined Protocols are created using the Scan Assist Pro Creator program, either on scanner or off scanner (see 'Scan Assist Pro Creator' on *page 15-2*).

To set up Scan Assist Pro with user-defined Protocols you need to:

- Import the user-defined Protocol that was created using the Scan Assist Pro Creator.

NOTE: *You do not need to import the user-defined Protocol if it was created with the on scanner Scan Assist Pro Creator program.*

- Add the Protocol to the Protocol selection so that it is available.

Importing a Protocol

1. Insert the media with the saved Protocol from the Scan Assist Pro Creator or exported Protocol from another Vivid *iq*.

Refer to 'Scan Assist Pro Creator' on *page 15-2* for more information on how to create a Protocol.

2. Press **Config** on the Shortcut bar and log on if required.
3. Select **Imaging/Scan Assist Pro**.

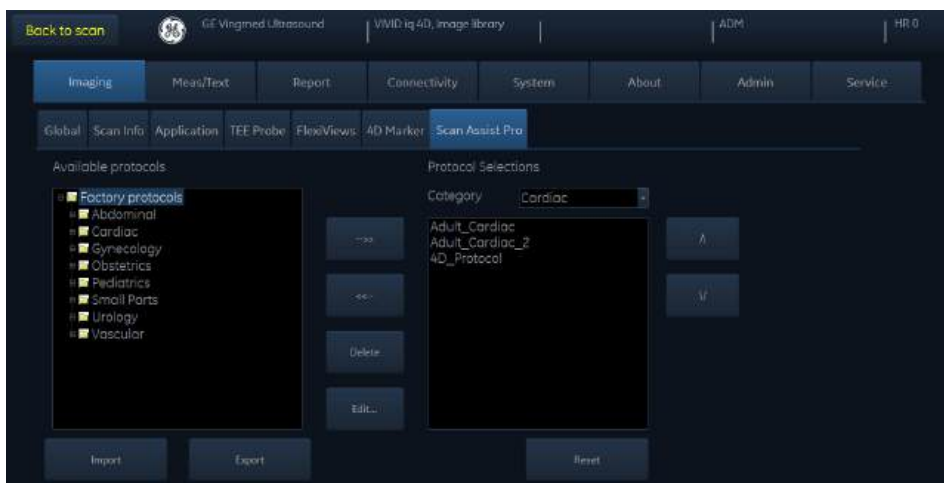


Figure 5-21. The Scan Assist Pro sheet

Importing a Protocol (continued)

4. Select **Import** from the *Scan Assist Pro* sheet.
The *Import Protocols* window is displayed.

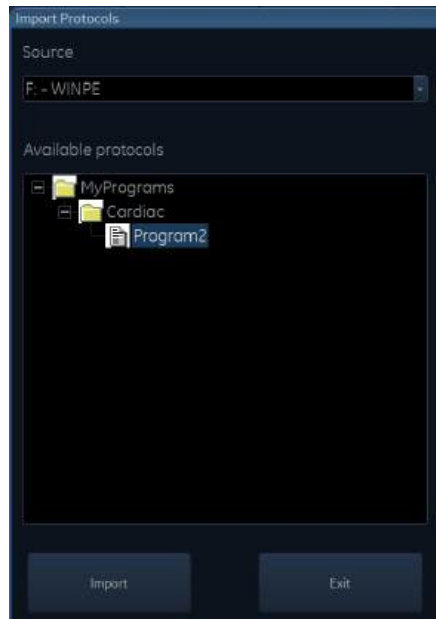


Figure 5-22. Import Protocols

5. In the *Source* field, select the media that the Protocol is stored on.
6. Highlight the Protocol(s) to be imported. If a folder is highlighted, all Protocols in the folder are selected.
7. Select **Import**. The Protocol(s) are stored to the Vivid *iq*.

NOTE: *If the Protocol(s) already exist a confirmation dialog is displayed asking the user to confirm the replacement of the existing Protocol(s).*

Add the imported Protocol to the Protocol selection

The imported Protocol(s) must be added to the Protocol selection to be available on the Scan Assist Pro.

1. Select the desired **Category** under Protocol Selections on the right-hand side of the *Scan Assist Pro* sheet (Figure 5-21 on page 5-72).
2. Select the imported Protocol from Available Protocols/ Custom Protocols on the left-hand side of the *Scan Assist Pro* sheet. Press the **Right arrow** button to add the imported Protocol to the selected exam category.

NOTE: Use the **Up** and **Down arrow** buttons to move the Protocol up and down in the list that will be displayed on the *Scan Assist Pro*.

Using Scan Assist Pro

1. Press **Scan Assist** on the Shortcut bar to run on the Touch screen.

NOTE: *The Protocols displayed on the Touch screen correspond to the current exam category. To use a Protocol from another exam category, Press **Category** on the Touch screen and select a Protocol from a different category.*

The *Scan Assist Pro* window is displayed on screen with the first step active. In the example below the annotation for the first step has been automatically added on the image, ready for you to scan the specified anatomy.



Figure 5-23. Scan Assist Pro screen

Using Scan Assist Pro (continued)

2. Follow the steps indicated in the Protocol: image/measure the appropriate anatomy.
3. Press **Store** to move to the next step in the Protocol.
4. To pause or unpause Scan Assist Pro, press the **Pause** button either in the *Scan Assist Pro* window or on the LCD Touch panel. You can also press the **Left/Right arrow** key on the keyboard.
5. To stop a Protocol, press the **Stop** button either in the *Scan Assist Pro* window or on the LCD Touch panel. A dialog is displayed to confirm the operation.
6. To restart a Protocol, press **Restart**. A dialog is displayed to confirm the operation.
7. To skip a step or move to a certain step, press the **Up/Down arrow** key on the keyboard or select the step you want to move to using the trackpad.

Pre/Post

Pre-Post Compare is a workflow enhancement feature that allows the user to indicate the state, Pre or Post, such that all acquired images and all measurements performed within that state will be tagged with either Pre or Post. When performing interventional procedures or other specific exams implied by an event, it may be useful for the user to acquire images and take measurements before and after the event/procedure to compare them.



Figure 5-24. LA Area measurement and image tagged with “Pre”

Pre/Post (continued)

NOTE: Pre/Post is not applicable for generic measurement and is not applicable for recall images.

Pre/Post measurement label is also indicated in the worksheet. In the worksheet, Pre and Post measurements are displayed separately and transferred to the report as two distinguished measurements. Measurements also have the Pre/Post modifiers in the DICOM SR and this info is available for external reporting tools.

Height		Weight	
Parameter	Value	Mth	m1m2m3
2D Area			
LA Area			
LA Area, Pre	15.0 cm2	Av	15.0
LA Area, Post	10.5 cm2	Av	10.5

Figure 5-25. Worksheet showing “Pre” and “Post” measurements separately

Using Pre/Post

1. Create a new patient.
2. Go to Scan Assist Pro to start the feature.
3. Switch the **Pre/Post** button on. The *Pre* label will appear on the screen.
4. Press the **Activate Pre** or **Activate Post** button on the touch screen according to the stage you are in. The label on the screen will change accordingly. The label will also be applied to measurements and will be stored with the image.
5. Press **End Exam** to exit labelling.



Figure 5-26. Press Activate Post/Pre to select “Pre” or “Post” stage

Scan Coach

Introduction

Before performing Scan Coach function on the system, please read and accept the Statement, Disclaimer and Limitation of liability described as below:

Statement

- Scan Coach IS NOT MEANT TO REPLACE TRAINING, OR TUTORIALS/HANDS-ON. IT IS MERELY A REFRESHER TOOL OF ALREADY RECEIVED EDUCATION AND TRAINING.
- Scan Coach IS AN ON -DEMAND REFRESHER AND REMINDER TOOL WHICH DISPLAYS INFORMATION IN THE FORM OF DICOM IMAGES AND ANIMATIONS; THE PROVIDED REFERENCE MATERIAL MAY HELP USER IN ACQUIRING ULTRASOUND IMAGES.
- Scan Coach DOES NOT PROVIDE A DIAGNOSIS, BUT DOES PROVIDE REFERENCE MATERIAL FOR SOME TYPES OF ACQUISITIONS.
- Scan Coach IS MEANT TO PROVIDE REFERENCE MATERIAL FOR ACQUISITION, BUT IT IS NOT INTENDED TO IDENTIFY DIAGNOSTIC IMAGE QUALITY. ACTUAL IMAGES, INCLUDING IMAGE QUALITY, OF THE DEVICE MAY VARY VERSUS THE PROVIDED REFERENCE MATERIAL.

Disclaimer

Scan Coach AND THE CONTENT AVAILABLE THROUGH IT ARE PROVIDED ON AN "AS IS" AND "AS AVAILABLE" BASIS. YOU EXPRESSLY AGREE THAT USE OF Scan Coach AND/OR ITS CONTENT IS AT YOUR SOLE RISK. TO THE FULLEST EXTENT PERMISSIBLE PURSUANT TO APPLICABLE LAW, GE AND ITS AFFILIATES DISCLAIM ALL WARRANTIES OF ANY KIND, WHETHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT. YOU EXPRESSLY AGREE THAT USE OF Scan Coach, INCLUDING ALL CONTENT, IS AT YOUR SOLE RISK.

ANY RESPONSIBILITY FOR IMAGE ACQUISITION, IMAGE INTERPRETATION, IDENTIFICATION OF ANATOMICAL PARTS, ANATOMICAL MEASUREMENTS AND CLINICAL DIAGNOSIS LIES WITH YOU, THE ULTRASOUND USER.

TO THE FULLEST EXTENT PERMISSIBLE PURSUANT TO APPLICABLE LAW, GE AND ITS AFFILIATES DISCLAIM ALL LIABILITY AND RESPONSIBILITY FOR ANY DAMAGES SUFFERED BY A USER, OR PATIENT OF A USER INCLUDING, BUT NOT LIMITED TO, DAMAGES ARISING OUT OF LOSS OR INACCURACY OF CONTENT OF Scan Coach.

IT IS THE RESPONSIBILITY OF YOU, THE ULTRASOUND USER, TO UNDERTAKE ALL NECESSARY AND CUSTOMARY TRAINING, AND TO MEET ALL OTHER REQUIREMENTS OF APPLICABLE LAWS AND REGULATIONS, BEFORE USING THE ULTRASOUND DEVICE.

Limitation of Liability

UNDER NO CIRCUMSTANCES, INCLUDING, WITHOUT LIMITATION, NEGLIGENCE, SHALL GE OR ITS PARENTS, SUBSIDIARIES, AFFILIATES, OFFICERS, DIRECTORS, EMPLOYEES, AGENTS, OR SUPPLIERS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING FROM OR IN CONNECTION WITH THE USE OF OR THE INABILITY TO USE Scan Coach.

Introduction

Scan Coach is designed to display information which helps user acquire the right scan plane. The reference image indicates how the scan plane image for a given step might look like. The probe/beam anime image shows the corresponding probe placement, or beam formation for acquiring the desired scan plane. The schema anime shows the key anatomical structures to be visualized in two-dimensional mode. The schema anime shows the key anatomical structures to be visualized in two dimensional mode.

Scan Coach can be used as an on-demand refresher/reminder tool in live scanning.

Scan Coach Description

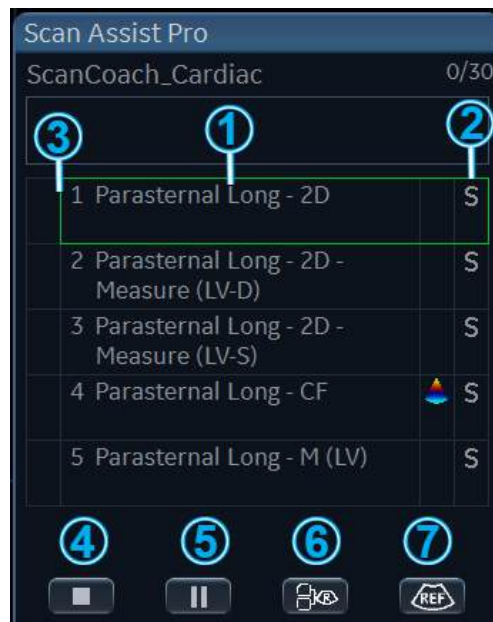


Figure 5-27. Scan Coach Display Description

1. Program step number and step name
2. Select this icon to store the image and move to the next step.
3. Active step. The box is green when the program is active or gray when it is paused.
4. Select to Exit Scan Coach.
5. Pause or Pause/Resume
6. Select this icon to activate Animation and Reference image.
7. Press to view both the Reference image and the Live image.

Using Scan Coach

1. Go to **Config -> Imaging -> Scan Coach**, select a protocol (i.e. **ScanCoach_Cardiac**) from the left column, and select **>>** to move it to the **Protocol Selections** column. Then select **Back to scan** on the touch panel to the scanning page.

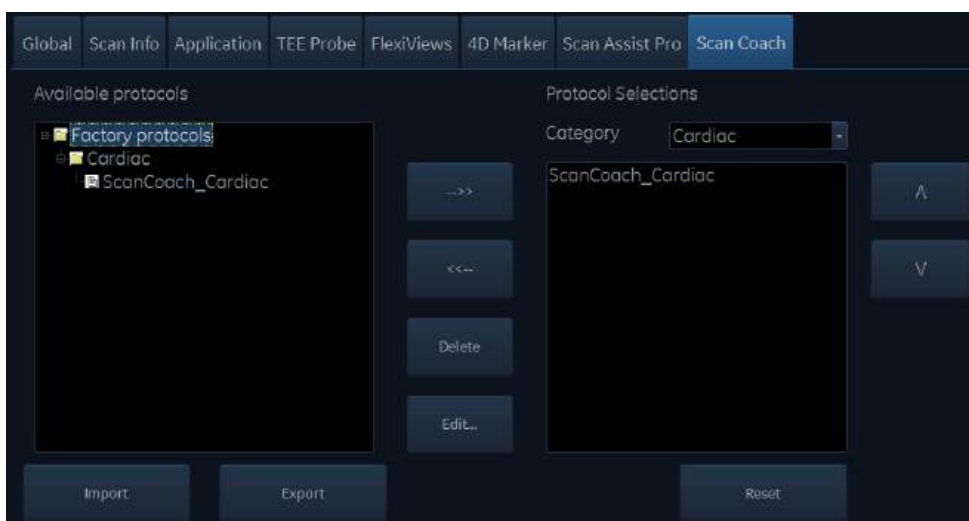


Figure 5-28. Select Scan Coach Protocol

Using Scan Coach (continued)

2. Press **Scan Coach** button  on the shortcut bar panel, and choose the **ScanCoach_Cardiac** protocol on the touch panel:



Figure 5-29. Protocol List

Using Scan Coach (continued)

3. Select the icon (marked as 6) to review the coach image.



Figure 5-30. Scan Coach Image

Using Scan Coach (continued)

4. Select the icon (marked as 7) to view both the Reference image and the Live image.

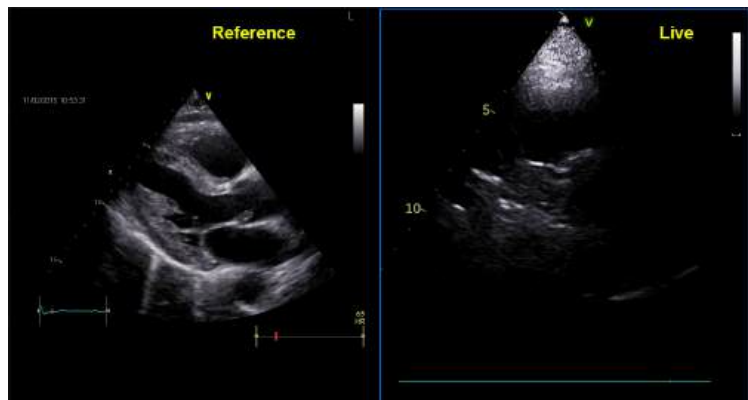


Figure 5-31. Scan Coach Image (2)

Configuration – Imaging

Global imaging settings

1. Press **Config** on the Shortcut Bar and log on if required.
2. Select **Imaging/Global**.

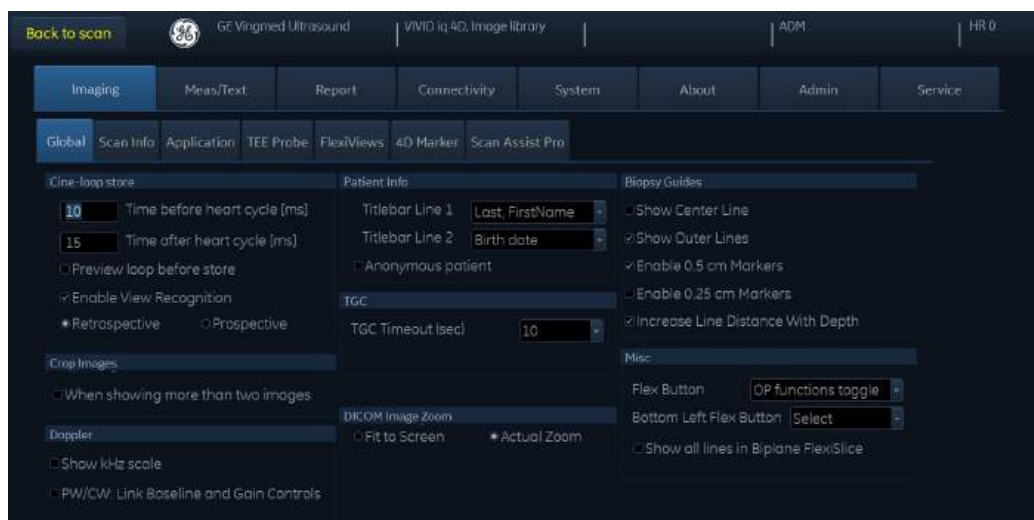


Figure 5-32. The Global sheet

Global imaging settings (continued)

The followings settings can be configured:

Parameter	Description
Cineloop store	• Time before/after heart cycle: sets the total storage time span of the cineloop in ECG mode. • Preview loop before store: when selected enable review of the selected cineloops before storage. • Enable View Recognition: Recognize standard views automatically when storing B-mode images. • Retrospective / Prospective • Retrospective: store the last elapsed defined number of cycles/seconds. • Prospective: store the forthcoming defined number of cycles/seconds.
Crop images	In the <i>Analysis screen</i> , removes top and bottom of the image when more than two images have been selected.
Doppler	• Show KHz scale: when selected, displays the KHz scale on the left side of the Doppler spectrum (see Figure 5-5 on page 5-17). • PW/CW: Link baseline and gain controls: when selected, baseline and gain settings are preserved when toggling between PW and CW Doppler modes.
Patient Info	• Title bar Line 1 & 2: selects from the drop-down menu the patient information to display on the <i>Title bar</i>. • Anonymous patient: when checked, no patient information is displayed on the <i>Title bar</i>.
TGC	TGC Timeout (sec): The amount of time after which the TCG display will disappear.
DICOM Image Zoom	Adjusting DICOM image display.
Biopsy Guides	Configure the biopsy guide zone display.
Misc	• Flex Button: config functions of the flexible button on the right top. • Bottom Left Flex Button: config functions of the flexible button on the left bottom. • Show all lines in Biplane Flexislice: • Show values on Operation Panel: display values for each specific control button on the operation panel. • Operation Panel Slider Timeout: timeout for operation panel slider display.

Application Preset

1. Press **Config** on the Shortcut Bar and log on if required.
2. Select **Imaging/Application**.

Application list configuration

The Application list for each connected probe can be configured to best suit the user's requirements.

The Application list is configured from the *Probe selection* screen.

1. Press **Probe** on the Shortcut Bar.
The *Probe selection* screen is displayed on the Touch screen ('Selecting a probe and an application' on *page 12-20*).
2. Press the **Preset config** button for the probe with the application list to config.
3. Press an application preset to adjust. The *Preset config* menu is displayed.



Figure 5-33. The Preset config menu

Application list configuration (continued)

4. The following can be done:

- Rename the selected preset
- Delete the selected preset

NOTE:

Only non-active unprotected user-defined application presets can be renamed or deleted.

- Remove/Add the selected preset from/to the *Application* menu.
- Lock/Unlock the selected preset by user with administrator rights.
- Activate the selected preset.

Deleting an application preset

Unprotected user-defined application presets can be deleted by any user with operator rights. Protected application presets can only be deleted by a user with Hospital admin rights ('System Users' on *page 4-61*). Factory application presets cannot be deleted.

1. Press **Probe**.

The *Probe selection* screen is displayed on the screen.

2. Press the **Preset config** button belonging to the probe with the application preset to delete.

3. Select the application preset to delete.

The *Preset config* menu is displayed.

4. Press **Delete**.

A *Confirmation* window is displayed.

5. Press **OK** to confirm deletion.

Generating a new preset

- Press **Probe**.

The Probe selection screen is displayed on the Touch screen.

NOTE: Any preset name which contains the GE tab in its top-right corner (see example in Figure 5-34) is a "factory preset" which cannot be modified.



Figure 5-34. Factory preset

To generate a new preset based on, for example, the factory-preset "Cardiac_E":

1. Activate the system using factory preset Cardiac_E.
2. Modify desired imaging setting in any imaging mode.
3. Activate the **Probe** screen.
4. Press **Preset Config** at the bottom of the preset list of the selected probe.
5. Press **Save/Create** at the bottom.
6. Provide a name for the new preset.
7. Press **Save**.

The new preset appears at the top of the preset list and becomes the default preset.

Note that the new preset button contains the name Cardiac_E in its bottom right corner (Figure 5-35). This allows you to identify the source for the new preset.



Figure 5-35. User preset

Updating a user preset

1. Activate the **Probe** screen and select a preset.
2. Modify the settings for image parameters.
3. Press the **Preset Config** button of the selected probe.
4. Press **Save/Create**.
A window appears with the name of the current preset.
5. Press **Save** to update the preset or edit the name and then press **Save** to generate a new preset.

To arrange the list of application presets

1. Touch the **Preset Config** button at the bottom of the column of the requested probe.
The **Preset Config** page appears (Figure 5-36).

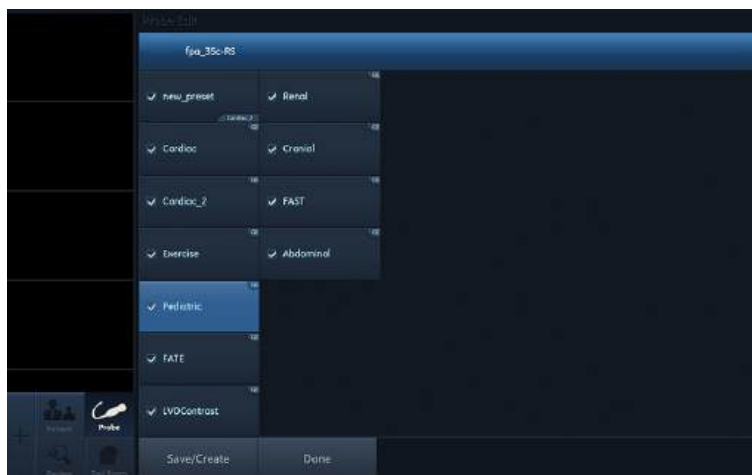


Figure 5-36. Preset config page

To arrange the list of application presets (continued)

2. Touch any preset.
A preset configuration menu appears.
3. Select **Remove from list** to clear the checkbox and remove this preset from the preset list.

NOTE: This removes the preset from the list but does not delete the preset from the Preset config. page.

4. Select **Move** and touch a new position to move the selected preset to a new position on the list.
5. Press **Done** to exit the Preset config page.

To modify additional settings for the selected application

In addition to the various imaging settings for the different scanning modes, other settings can be stored for each user preset. These can be found on the **Application preset config** page:

1. Activate the probe and application-preset to be modified.
2. Press **Config** on the Shortcut Bar and log on if required.
3. Select **Imaging/Application**.

The Application preset config page appears.

The following settings can be configured on this page:

Parameter	Description
Image Store settings	Single frame (live store)
Auto freeze	• ☒ Freeze 2D image in Doppler: the last 2D or color flow image is displayed when entering Doppler mode. • Auto freeze after: sets the time after which the system enters in freeze when not in use.
Footswitch functionality	Configure the footswitch pedals. For each pedal, select the operation to perform from the drop-down menu when in Live or in Freeze. Show indicator on screen: when selected, the assigned controls for the pedals are displayed on screen.
Templates and Packages	Defines the default stress protocol associated to the application.
☒ Auto invert on steer	In Color flow, the color bar is inverted when steering the color flow sector angle.
☒ Keep cursor when press 2D ☒ Keep cursor when changing mode	The PW, CW or M-Mode cursor is kept on the 2D display when pressing 2D on the Control Panel.
☐ Keep cursor when press 2D ☒ Keep cursor when changing mode	The PW, CW or M-Mode cursor is kept in the 2D display when turning off these modes (by pressing PW, CW or M-Mode on the Control Panel). The PW, CW or M-Mode cursor is removed in the 2D display when pressing 2D on Control Panel.
☒ Keep cursor when changing mode ☒ Stay in cursor state when cursor is active	If cursor is active while in PW, CW or M-Mode, display the Cursor when switching mode.

TEE probe (only for 6VT-D) and L4-20t-RS probe configuration

1. Press **Config** on the Shortcut Bar and log in if required.
2. Select **Imaging/Probe Button**.

The *Probe Buttons* sheet is displayed.

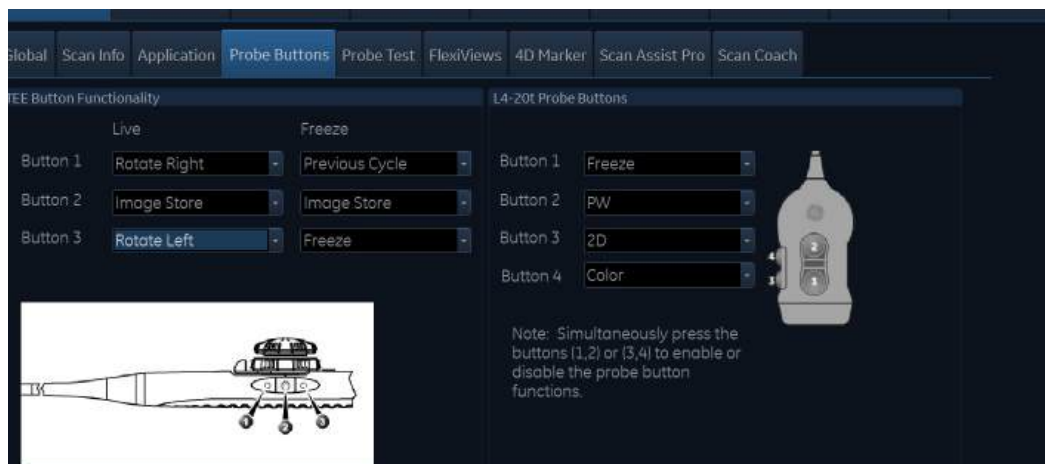


Figure 5-37. The Probe Buttons sheet

3. For each button on the probe handle, select the operation to perform from the drop-down menu when in Live or in Freeze.

Chapter 6

4D and Multi-plane Modes

This chapter describes:

‘4D-Mode’ on page 6-4

‘Multi-plane Mode’ on page 6-40

‘FlexiViews’ on page 6-51

4D-Mode

4D mode is only available on Vivid *iq* with 4D option.

Contents in this section

- 'Real-time, single beat 4D imaging' on *page 6-3*
- 'Real-time, multi beat 4D imaging' on *page 6-3*
- '4D-Mode' on *page 6-4*
- '4D Markers' on *page 6-16*
- '4D-Mode acquisition' on *page 6-5*
- '4D Color Flow mode' on *page 6-20*
- 'Flexi-Slice' on *page 6-26*
- 'Basic operations' on *page 6-29*
- '4D-Mode controls' on *page 6-36*

Real-time, single beat 4D imaging

The 4D probes on the Vivid *iq* enable real-time, single beat 4D tissue and color imaging. The volume data is displayed in real-time with volume rendering techniques for visualization of valves and structures.

Real-time, multi beat 4D imaging

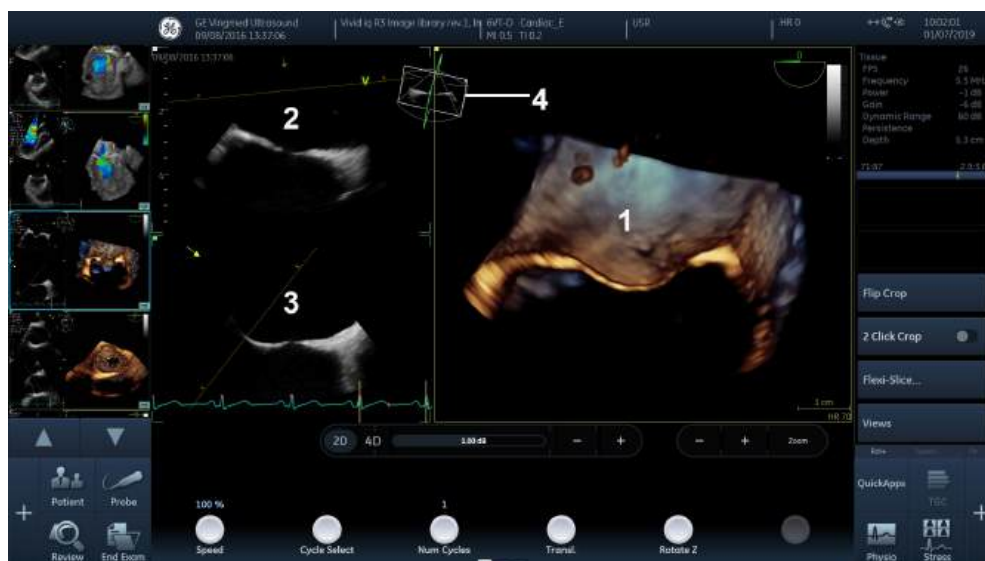
The 4D probes on the Vivid *iq* enable the acquisition of larger tissue/color volumes with ECG gated acquisition. The data acquired is displayed in real-time so that the user can control the quality of the data acquired throughout the scanning process.



The displayed image might not reflect the user defined name of the quick view button.

4D-Mode

Volume rendering screen



1. Volume rendering.
2. 2D image in the azimuth plane. The arrow indicates the viewing direction onto the volume rendering relative to the azimuth plane.
3. 2D image in the elevation plane. The arrow indicates the viewing direction onto the volume rendering relative to the elevation plane.
The brown line with X indicates the cropping applied to the Volume rendering.
4. Orientation window: displays a three-dimensional scene with acquisition sector and 2D image positions.

Figure 6-1. The 4D-Mode screen (Volume rendering)

4D-Mode acquisition

Real time single beat 4D acquisition

1. Select a 4D probe and an application.
2. Enter 4D either by pressing the **4D** button on the Control Panel or by selecting a 4D acquisition preset on the Touch Screen: **Medium** (medium size sector with top-down view, more suited for transthoracic acquisition of the mitral valve) or **Large** (large sector more suited for acquisition of the complete LV). If 4D was previously used Back to 4D button is available and it restores the last used 4D settings.

NOTE: *4D acquisition may also be done in Multi-Slice mode (see 'Multi-Slice acquisition' on page 6-11) and 4D Zoom prepare mode (see '4D Zoom prepare acquisition' on page 6-14).*

The volume acquisition is started.

3. The following parameters may be adjusted during acquisition:
 - **Volume size:** adjust the volume size. An increase of the volume size will reduce the volume rate.
 - **Volume shape:** adjust the ratio between the elevation and azimuth widths. Changing the volume shape from default will increase the volume rate.
 - **Frame rate:** adjust the frame rate. There is a trade-off between the frame rate and the image quality.
 - **Elevation tilt:** tilt the volume in the elevation plane and change the viewing direction accordingly.
 - Other parameters: Frequency and Octave.
 - **Views:** display different rendering views.
 - **Layout:** display different layout alternatives.

Real time single beat 4D acquisition (continued)

4. Optimize the image quality as necessary (2D Gain, 4D Gain, Volume Optimize and UD Clarity).

Press **Laser lines** on the side bar to visualize the 2D image locations in the volume rendering. The 2D image locations are shown as overlaying red or color coded lines following the surface in the volume rendering. The color of the laser lines corresponds to the color coding used for the 2D images.

5. Press **Store** to store the acquisition.



The lower the volume rate, the longer is the delay between acquisition of the different parts of the image. So settings with low volume rate may introduce geometrical distortions on fast moving structures.

Real time multi beat 4D acquisition

Real time multi beat 4D acquisition is based on ECG gated acquisition of at least two sub-volumes. This technique enables the acquisition of a larger volume without compromising the spatial and/or temporal resolution, by combining sub-volumes acquired over several heart cycles. When all sub-volumes have been recorded, the process is repeated replacing the oldest sub-volumes.



CAUTION

ECG gated acquisition may by nature contain artifacts.

Artifacts may be caused by:

- Movements of the probe caused by the operator during acquisition.
- Movements of the patient during acquisition, including movements caused by respiration.
- Irregular heart rate during acquisition.

To validate the acquisition, press **Multi-Slice** and perform a visual inspection. Stitching artifacts are shown as visible transitions between the sub-volumes (Figure 6-2).



CAUTION

The lower the volume rate, the longer is the delay between acquisition of the different parts of the image. So settings with low volume rate may introduce geometrical distortions on fast moving structures.

Real-time, multi beat 4D imaging (continued)

To avoid spatial artifacts, make sure that the probe and the patient are not moving during the acquisition. The patient should, if possible hold his/her breath. The ECG trace should be stable.

1. Connect the ECG device and make sure to obtain a stable ECG trace.
2. Select a 4D probe, and an application.
3. Enter 4D either by pressing the **4D** button on the Control Panel or by selecting a 4D acquisition preset on the Touch Screen: **Medium** (medium size sector with top-down view, more suited for transthoracic acquisition of the mitral valve) or **Large** (large sector more suited for acquisition of the complete LV). If 4D was previously used Back to 4D button is available and it restores the last used 4D settings.

NOTE: *4D acquisition may also be done in Multi-Slice mode (see 'Multi-Slice acquisition' on page 6-11) and 4D Zoom prepare mode (see '4D Zoom prepare acquisition' on page 6-14).*

The volume acquisition is started.

4. The following parameters may be adjusted during acquisition:
 - **Volume size:** adjust the volume size. An increase of the volume size will reduce the volume rate.
 - **Volume shape:** adjust the ratio between the elevation and azimuth widths. Changing the volume shape from default will increase the volume rate.
 - **Elevation tilt:** tilt the volume in the elevation plane and change the viewing direction accordingly.
 - Other parameters: Frame rate, Frequency and Octave.
 - **Views** (on the Side bar): display different rendering views.
 - **Layout** (on the Side bar): display different layout alternatives.

Real-time, multi beat 4D imaging (continued)

5. You may adjust **Num Beats** to change the number of heart beats the acquisition should be based on.
6. Press **Multi beat** on the side bar.

The gated acquisition is started. Ask the patient to hold her/his breath at end expiration. Keep the probe steady and look for stitching artifacts in both the volume rendering and the elevation plane in the lower left window of the screen, or use Multi-Slice (see page 6-11) to better assess the stitching quality.

Attention should be brought on stitching quality during acquisition rather than volume rendering quality.
7. You may adjust **Views** to get different rendering views. The default top/down view is best for stitching quality assessment.
8. Optimize the image quality as necessary (2D Gain, 4D Gain and UD Clarity).

Press **Laser lines** on the side bar to visualize the 2D image locations in the volume rendering. The 2D image locations are shown as overlaying red or color coded lines following the surface in the volume rendering. The color of the laser lines corresponds to the color coding used for the 2D images.
9. Press **Store** to store the acquisition.

NOTE: *It is recommended to acquire several heart cycles and use **Cycle select** to select the best one.*

Real-time, multi beat 4D imaging (continued)

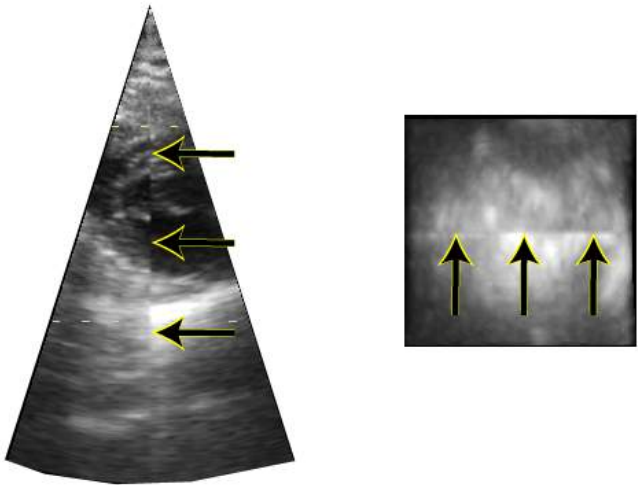


Figure 6-2. Stitching artifacts

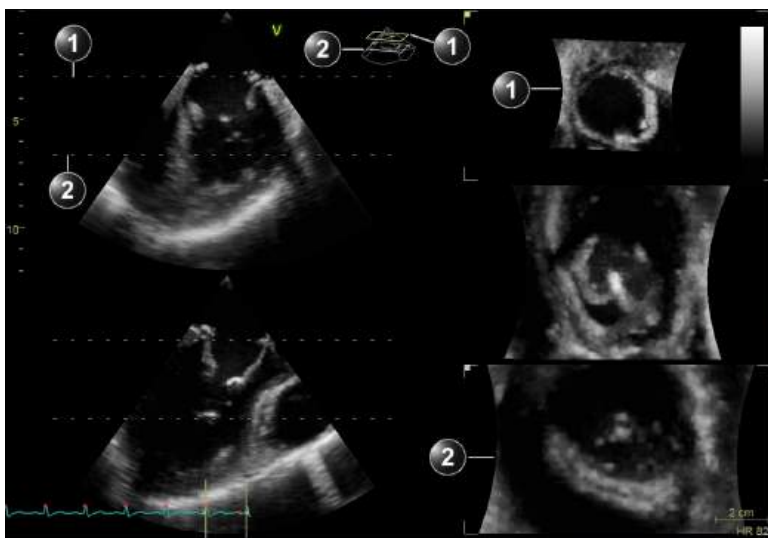
Multi-Slice acquisition

Multi-Slice acquisition provides full volume data acquisition in the same way as regular 4D single-beat or multi-beat acquisition.

When using Multi-Slice acquisition the volume rendering display is replaced by equidistant short axis views. The two Apical views displayed on the left are for probe orientation purpose, while the short axis views are used to ensure that the entire chamber is included in the volume and to evaluate presence of stitching artifacts (Figure 6-3).

1. While in 4D Live, press **Multi-Slice** on the side bar.

The *Multi Slice* screen is displayed showing equidistant short axis views (Figure 6-3). The short axis views are evenly distributed and maximized in size for best assessment (e.g image quality, presence and visibility of all walls, stitching artifacts when using real time multi beat acquisition). Apical views are displayed on the left side for orientation purpose.

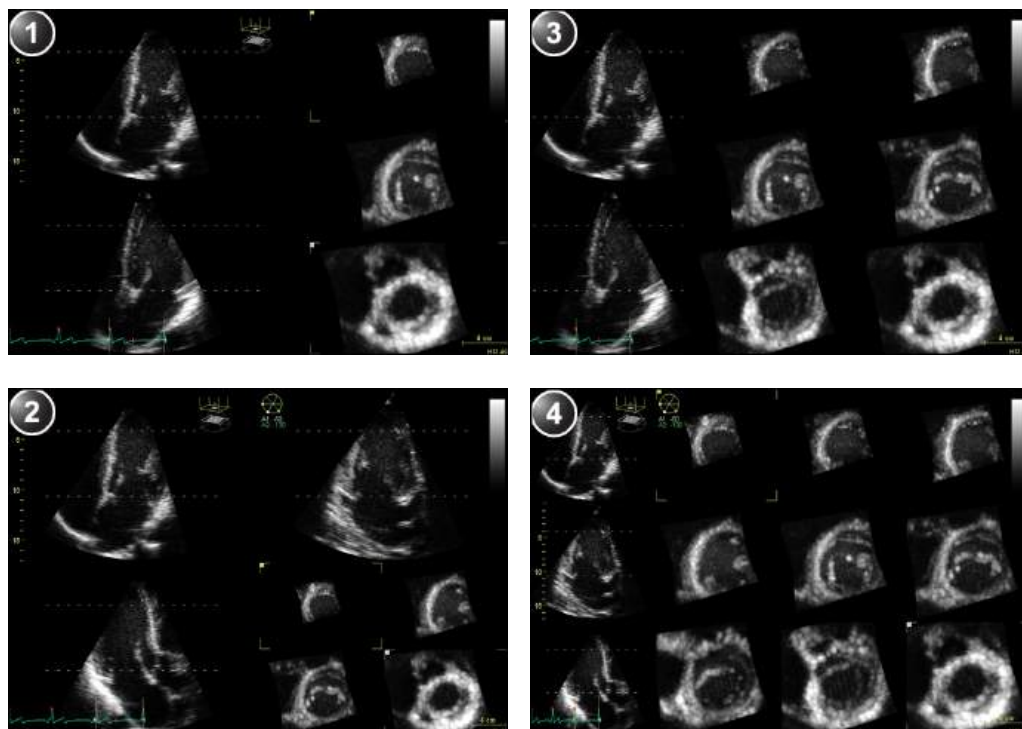


1. Upper slice
2. Lower slice

Figure 6-3. Multi Slice screen

Multi-Slice acquisition (continued)

NOTE: Press **Layout** on the side bar to get the following display alternatives.



- 1. 5 Slice
- 2. 7 Slice

- 3. 8 Slice
- 4. 12 Slice

Figure 6-4. Multi Slice alternative displays

If required, apply zoom. All short axis views are zoomed in simultaneously.

NOTE: *Multi-Slice is also available in replay.*

Multi-Slice acquisition (continued)

2. The following adjustments can be done:
 - Place the cursor in the middle section of the top or bottom slice intersection line in one of the apical views. The cursor is changed to . Drag to change the slicing area.
 - Place the cursor at one of the extremities of the top or bottom slice intersection line in one of the apical views. The cursor is changed to . Drag to rotate the slices backward/forward and sideways, to align the slices with the anatomical structure.
Alternatively, adjust the Axis controls touch on the screen.
 - Adjust **Translate** to move all slices up or down.

NOTE: *The default position can be displayed again by pressing **Clear** on the control panel.*

3. Press **Store** to save.
4. Press **Multi-Slice** to exit.

4D Zoom prepare acquisition

4D Zoom prepare acquisition is used to acquire real-time data of isolated structures at a higher frame rate than what can be obtained with a full volume acquisition. It is also useful because acquisition is restricted to the structure of interest, reducing the need for post processing.

4D Zoom prepare is available from 2D, Color Flow, 4D, 4D Color Flow and Multi-plane modes.

4D Zoom acquisition is done in two steps:

- Prepare step: positioning of the probe for optimal acquisition and adjustment of the zoom ROI in biplane mode.
- Acquisition step: Acquisition of zoomed 4D data.

1. To start 4D Zoom prepare:

- From 2D, Color Flow or Bi-plane mode: press **4D Zoom prepare** on the side bar.

A biplane screen is displayed showing a ROI in the azimuth and elevation planes.

NOTE:

*Transesophageal acquisition: press **Mitral valve**, or **Top Down** on the side bar to acquire a volume rendering of the corresponding view.*

4D Zoom prepare acquisition (continued)

2. Using the trackpad to adjust the position, size, width and tilt of the ROI so that the ROI is correctly covering the structure of interest in both planes.
 - Press **Set** to toggle the trackpad function between ROI position (**Pos**) and ROI size (**Width**).
 - Press **Ref. plane** on the side bar to toggle the trackpad function between **Pos/Width**.
 - Press **Set** to toggle the trackpad function between ROI width (**Width**) and ROI tilt. To tilt the ROI, move the ROI by touch on the screen. The Width and Tilt controls affect the ROI in the elevation plane only.
3. Press **4D** on the Control panel to acquire 4D data in the defined zoom area.

NOTE: You can do a single beat (see page 6-5) or a multi beat (see page 6-7) acquisition.

NOTE: The tissue sector is slightly increased if entering 4D Color Flow mode.

4. Press **Store** to store the acquisition.

4D Markers

4D Markers is a tool where one can place annotations on structures/objects of interest. Placement can be done either on 2D, on Multi-plane, on the slices derived from 4D datasets or on the rendered datasets themselves.

4D markers have defined coordinates in image space. They will rotate/translate/zoom when the 4D image is rotated/translated/zoomed. Therefore, they always stay in the correct position relative to the anatomical structures which are annotated as long as the probe is not moved. When switching from 4D to 2D or to Multi-plane, the 4D markers are maintained in the same position with respect to the probe. A legend with marker names is always shown if 4D Markers are present in the image.

The markers are shown as 3D-objects when a rendering is shown, and as circumferences in slices. In 2D slices derived from 4D, the markers will only be visible if there is an intersection between the slice and the marker. (Figure 6-5).

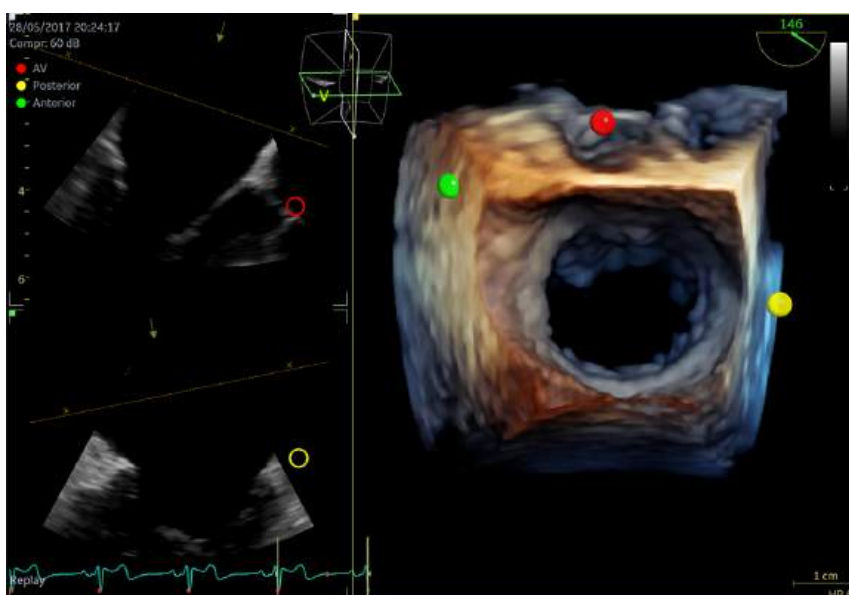


Figure 6-5. Image with 4D Markers

Inserting a 4D Marker

Select the **4D Marker** tab on the shortcut bar when in 4D mode. Select one of the pre-defined markers, or click **Free Text..** if you want to define your own text. The cursor changes to the cross symbol.

Place the marker either on a slice or directly in the 3D rendering by clicking. While positioning the marker, the legend displays the active marker being placed.

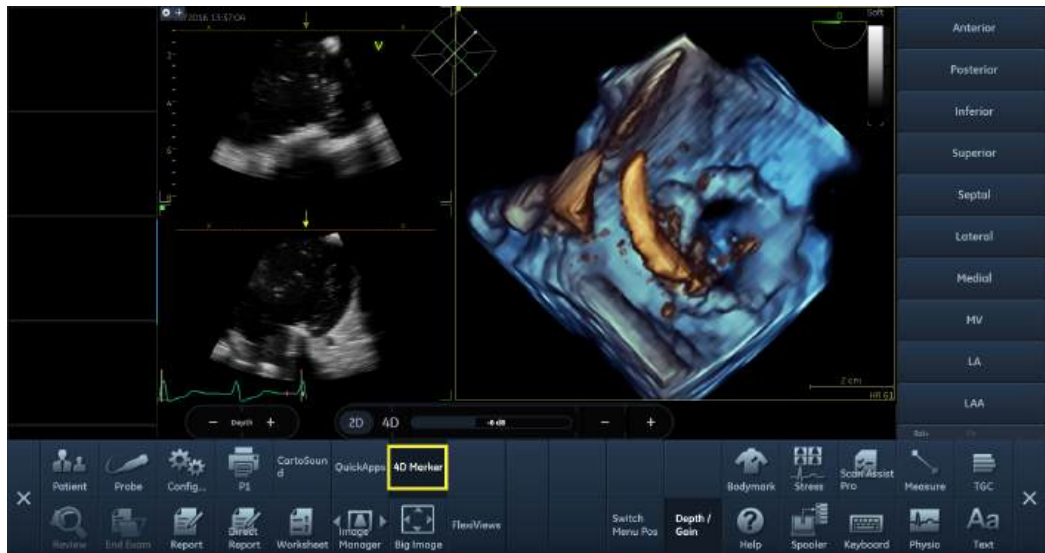


Figure 6-6. 4D Marker tab is available in 4D-mode.

Removing a 4D Marker

Press **Remove** to delete the last placed marker or **Clear** to delete all markers.

Changing size of 4D Markers

Use the **Size** rotary (other applications have sliders) to change the radius of the 4D markers. The selected size is applied to the 4D Marker which will be placed next. It does not influence the size of the remaining markers which are already placed.

Changing opacity of 4D Markers

Use the **Opacity** rotary (other applications have sliders) to change the opacity of the 4D markers. The selected opacity level is applied to all 4D Markers unless a particular marker is selected, in which case it affects only the selected marker.

Editing a placed 4D Marker

To edit an existing marker, press **Select...** on the side bar, move the cursor to the marker and click. Move the marker to the desired location and click again to place it.

NOTE: A selected marker is marked as Active in the legend. It is possible to change the size of an active marker by using the size and opacity controls, respectively.

Configuring the pre-defined 4D Markers

To customize the set of predefined 4D Markers, press **Config**. The current configuration of markers in use is shown in the *Enable 4D Markers* list (Figure 6-7). Select any item and use the up and down arrow buttons to reorder the list. Press **Remove** to remove a selected item. Alternatively, use the left and right arrow buttons to move the selected item to and from the Available 4D Markers list. This allows to remove a 4D Marker and re-introduce it later if needed. Use the empty text box field to define a custom marker name. Press **Factory** to reset the list to the default factory setting.

This configuration screen can be accessed at any time. Press **Config...** on the shortcut bar, and then select the **Imaging** category and **4D Marker** tab

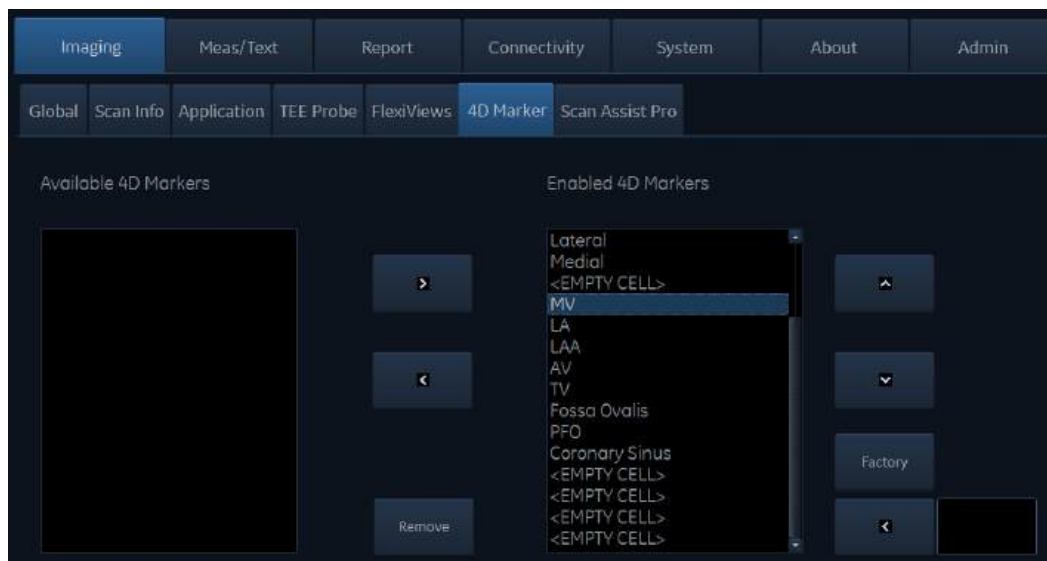


Figure 6-7. Configuration of predefined 4D Markers

4D Color Flow mode

Volume rendering screen



1. 2D Color Flow image in the azimuth plane. The arrow indicates the viewing direction onto the volume rendering relative to the azimuth plane.
2. 2D Color Flow image in the elevation plane. The arrow indicates the viewing direction onto the volume rendering relative to the elevation plane.
3. Orientation window: displays a three-dimensional scene with acquisition sector and 2D image positions.
4. Volume rendering display with Color Flow

Figure 6-8. 4D Color Flow screen (Volume rendering)



WARNING

Volume rendering of 4D color flow data acquired on software version 206 will visualize high bandwidth regions with higher opacity compared to data acquired on software versions older than version 206 when **Variance** is set to off. In particular high bandwidth jets will appear more opaque on software version 206 than prior software versions when **Variance** is set to off.

4D Color Flow acquisition

The 4D Color Flow acquisition is done in two steps:

- Prepare step: positioning of the probe for optimal volume acquisition and adjustment of the Color Flow ROI position to the desired location.
- Acquisition step: acquisition of 4D color flow volume.

NOTE: *The 4D Color Flow acquisition can also be started using the 4D Zoom prepare acquisition mode (see '4D Zoom prepare acquisition' on page 6-14).*

Real time single beat 4D Color flow acquisition

Color Flow can be enabled in 2D mode before entering 4D mode or when in 4D mode.

1. Select a 4D probe and a cardiac application.
2. While in 2D, press **Color**.
3. Optimize the image quality (Gain, Depth, TGC... etc.).
4. Press **4D** on the Control panel.

The 4D Color Flow Prepare mode is started.

NOTE: *If the color ROI position is not optimal, press **MultiD** on the Control Panel.*

5. Press **Store**.

Real time single beat 4D Color flow acquisition (continued)



CAUTION

Tissue structures may obscure relevant flow information. If required, increase Tissue transparency setting.

Color flow data may obscure other relevant color flow information (e.g. jet). If required adjust Flow transparency setting.

In some settings the volume rate can be less than 10 volumes per second. This may lead to small display mismatch between the color and tissue data. This is because of the rapid movement of structures (e.g. valves) compared to the time lag between the tissue and the color volume acquisitions. Tissue data should only be used as guidance for the localization of the flow data.

Real time multi beat 4D Color Flow acquisition

Real time gated 4D Color Flow acquisition is based on ECG gated sub-volume acquisitions of color flow data.



CAUTION

ECG gated acquisition may by nature contain artifacts. The triggering works by acquiring the whole tissue volume during the first heart beat, followed by several color sub-volumes that are stitched together. Consequently, the tissue volume is not updated for every heart beat, and only the color data may have stitching artifacts.

Artifacts may be caused by:

- Movements of the probe caused by the operator during acquisition.
- Movements of the patient during acquisition, including movements caused by respiration.
- Irregular heart rate during acquisition.

To validate the acquisition, perform a visual inspection in both the volume rendering and the elevation plane. Stitching artifacts are shown as visible transitions between the sub-volumes in the color flow data. The Multi-Slice mode is also well suited for evaluating the presence of stitching artifacts while in live acquisition (see page 6-11).

Real time multi beat 4D Color Flow acquisition (continued)

1. Connect the ECG device and make sure to obtain a stable ECG trace.
2. Select a 4D probe and a cardiac application.
3. While in 2D, press **Color**.
4. Press **4D** on the Control panel.
The 4D Color Flow Prepare mode is started.
5. You may adjust **Multi beat** to change the number of heart beats the acquisition should be based on. Select **Num Beats**.
6. Using the trackpad to adjust the position and size of the color ROI as necessary.
7. Press **4D** key or the **Update/Menu** key on the Control panel to start acquisition. The gated acquisition is started. Ask the patient to hold her/his breath at end expiration. Keep the probe steady and look for stitching artifacts in the color flow data in both the volume rendering and the elevation plane in the lower left window of the screen.
8. Press **Freeze**.
In Freeze, look for stitching artifacts in the color flow data in both the volume rendering and the elevation plane in the lower left window of the screen.
9. Rotate the volume to check the result. Use Cycle select to select the best heart cycle.
10. Press **Store**.

4D Zoom prepare acquisition (Color Flow)

See '4D Zoom prepare acquisition' on *page 6-14*.

HD color

HD Color is a 4D Color Flow visualization mode available by pressing **HD Color** while in 4D Color Flow mode. **HD Color** applies reflections and shadowing to the 4D Color Flow Volume to enhance the 3D depth perception when visualized on a 2D monitor. A transparency control, **HD Color Strength**, is available to visualize selectable degrees or strengths of turbulent blood flow within the transparent outline of the non-turbulent flow.

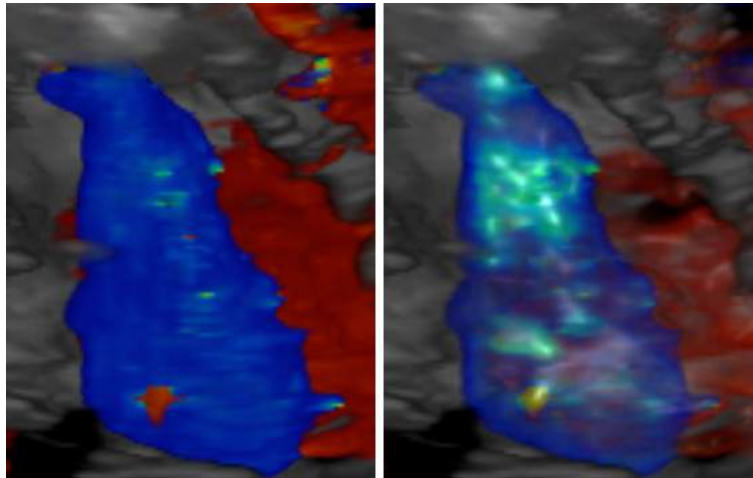


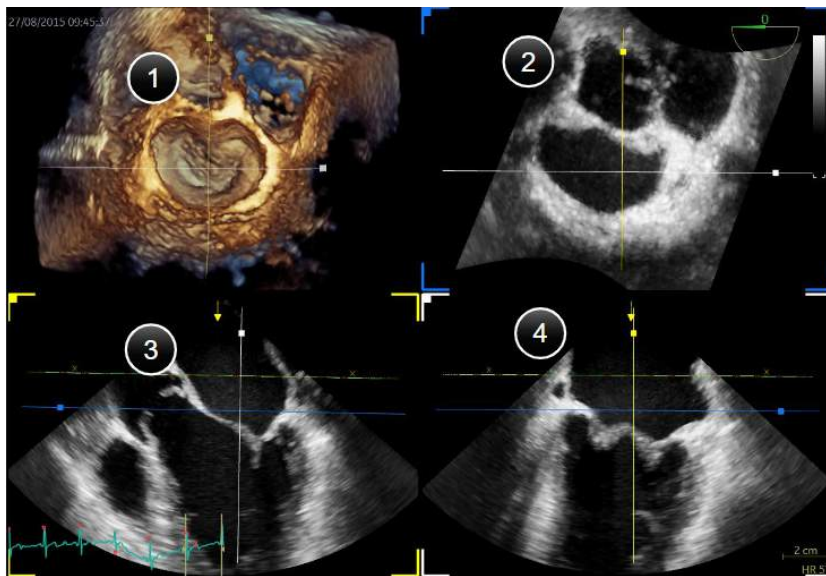
Figure 6-9. On the left: Conventional 4D Color Flow without HD Color, on the right: 4D Color Flow with HD Color enabled.

Flexi-Slice

The Flexi-Slice mode is used to extract 2D cut-planes from 4D data sets. The Flexi-Slice mode displays three perpendicular cut-planes and a volume rendering. The cut-planes can be rotated and translated independently of each other, or in combination (see page 6-30). Flexi-Slice mode is available from 4D and 4D Color Flow mode in live and replay.

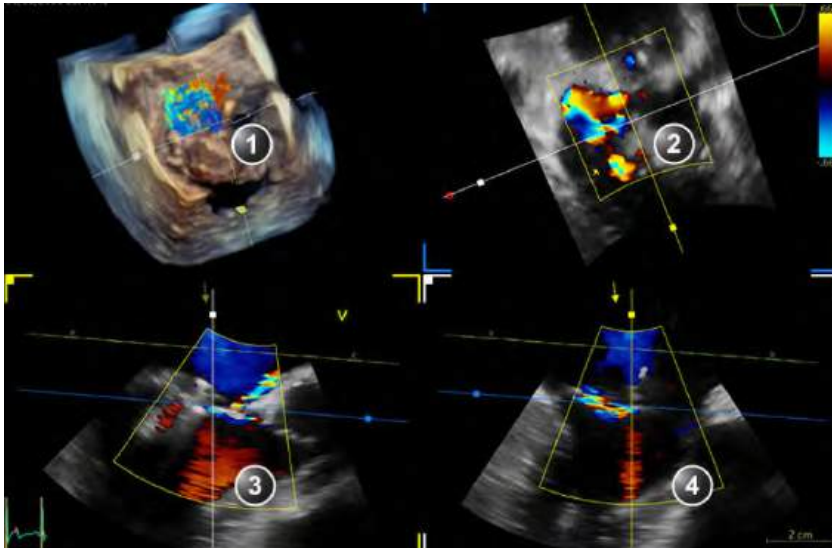
To start the Flexi-Slice mode press **Flexi-slice** while in 4D or 4D Color Flow mode.

Flexi-Slice mode screen



1. Volume rendering
2. Cut-plane 1 (blue)
3. Cut-plane 2 (yellow)
4. Cut-plane 3 (white)

Figure 6-10. The 4D screen (Flexi-Slice mode)

Flexi-Slice mode screen (Color flow)

1. Volume rendering
2. Cut-plane 1 (blue)
3. Cut-plane 2 (yellow)
4. Cut-plane 3 (white)

Figure 6-11. 4D Color Flow screen (Flexi-Slice mode)

Flexi-Slice preset layouts

In Flexi-slice mode, several cut-planes are displayed as well as their location and the location of the crop plane. At least one cut-plane is parallel to the crop plane. Several preset layouts are available to the user that can be selected on the side bar.

In Flexi-Slice, change trackpad mode to **Rot** to start interacting with the 3D rendering in the same way as Volume rendering mode. The trackpad will change the viewing angle of the rendering.

NOTE: On some layouts, two lines parallel to the crop plane are visible. These planes are used to obtain extra slices on the volumes. The views corresponding to these planes display distance values on the lower left corner. The reference plane shows "0mm", while the other shows the absolute distance between the current plane and the reference plane.

Basic operations

Rotating/Translating the view plane or crop plane

Rotation and translation can be performed in either Volume rendering or Flexi-Slice mode. Press **Flexi-Slice** to toggle between the two modes.

Volume rendering mode

In Volume rendering mode, rotation applies to the viewing direction onto the volume rendering. When **View Crop** on the side bar is selected, the viewing direction and the crop plane rotate together. When **View crop** is deselected rotation applies only to the viewing direction.

Translation applies to a crop plane into the volume.

1. Press **Set** to toggle between **Rotate** and **Translate**.

Rotation:

- Rotation with **View crop** selected: use the touchscreen to rotate the active crop plane together with the viewing direction. The viewing direction always coincides with the crop plane.
- Rotation with **View crop** deselected: use the touchscreen to rotate the viewing direction around the volume rendering. The crop plane does not rotate.

Translation:

- Use the trackpad to translate the crop plane into the volume.

The default position can be displayed again by pressing **Clear**.

Flexi-Slice mode

In Flexi-Slice mode each cut-plane may be rotated or translated independently using the trackpad:

1. Press Yellow, White or Green line on the touch screen to select the Reference plane.
The volume rendering is updated accordingly.
2. Place the cursor at one of the extremities of a cut-plane intersection line in one of the cut-planes. The cursor is changed to . Drag to rotate the cut-plane.
3. Place the cursor in the middle section of a cut-plane intersection line. The cursor is changed to . Drag to translate the cut-plane.
4. Place the cursor at the intersection between two cut-plane lines. the cursor is changed to . Both cut-planes are translated simultaneously.
5. Click on a point in the volume rendering to move the intersection of the two other cut-planes to that location.
 - If **Depth Mode** is turned on: the reference plane is also moved inside the volume rendering to the corresponding selected depth.
 - If **Depth Mode** is turned off: the reference plane is kept at the current depth.
6. Place the cursor at the outer area of one of the cut-planes. The cursor is changed to . Drag to rotate the cut-plane image. The cut-plane lines remain fixed.
7. Place the cursor in the inner area of one of the cut-planes. The cursor is changes to . Drag to pan the cut-plane image. The cut-plane lines remain fixed.

Zooming

1. Adjust the Zoom clockwise by pressing “+” on the operation panel.

The volume rendering is magnified.

4D Views

4D Views enables quick access to standard 2D and 4D views. 4D Views requires slice alignment before standard views can be selected.

4D Views is available in Freeze and replay.

- Press **4D Views** on the side bar.

The *Slice alignment* screen is displayed.

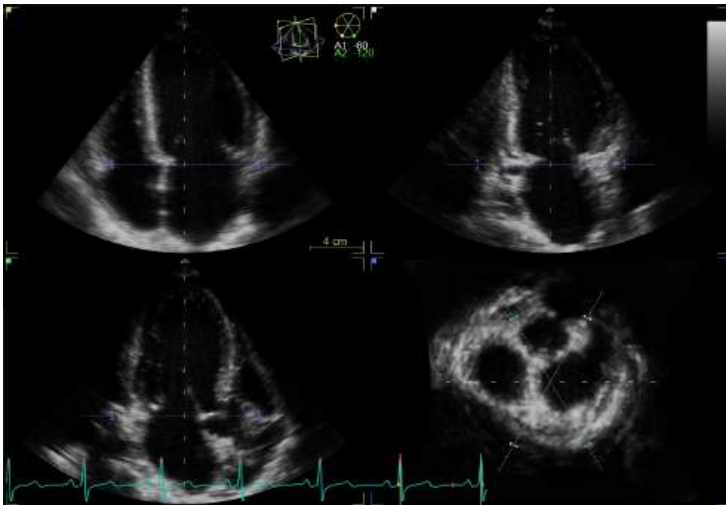


Figure 6-12. Slice alignment screen

Alignment - Transesophageal acquisition

1. Perform slice alignment using the slice alignment controls on the side bar or using the trackpad.

From the Trackpad, adjust as required:

- Place the cursor outside one of the extremities of the slice intersection lines in the short axis view. The cursor is changed to . Drag to rotate all views around the main axis.
- Place the cursor at one of the extremities of the 2 chamber slice intersection line (white) in the short axis view. The cursor is changed to . Drag to rotate the 2 chamber slice around the main axis.
- Place the cursor at one of the extremities of the Mid-esophageal (ME) long axis slice intersection line (green) in the short axis view. The cursor is changed to . Drag to rotate the ME long axis slice around the main axis.
- Place the cursor at one of the extremities of a slice intersection line in one of the long axis views. The cursor is changed to . Drag to tilt all slices around a perpendicular axis to the view.
- Place the cursor in the middle section of a slice intersection line in one of the long axis views. The cursor is changed to . Drag to pan all slices.
- Place the cursor on the blue intersection lines in one of the long axis views. The cursor is changed to . Drag to translate the short axis plane.

Alignment - Transesophageal acquisition (continued)

NOTE: Pressing Clear on the Touch panel will remove the alignment and display the original probe position or previously approved alignment.

- Press **Approve** when alignment is done.

NOTE: Pressing Delete on the Touch panel will remove any previously approved alignments and exit the Slice alignment function.

2. Select the desired standard view on the screen.

2-click cropping

2-click crop enables to quickly extract any views for visualization of 4D structures. Two crop planes are created by clicking twice in one of the 2D images or in the volume rendering.

1. Press **2 Click Crop** on the side bar.
2. Touch in one of the 2D views (or the volume rendering) to create the first crop plane.
3. Touch on a new location. The volume rendering is updated simultaneously showing the cropped view.
4. Press **Set** to create the second crop plane.

NOTE: *If desired repeat the procedure to create a new cropped view.*

5. Press **2 Click Crop** to go back to the *Volume rendering* screen.
6. To remove 2-click crop, press **Clear** on the Control panel.

Dual cropping

Dual Crop enables to quickly display the 4D data from opposite views using two renderings. To enable this visualization, two crop planes are created by clicking twice in one of the 2D slices or in the volume rendering.

1. Press **Dual Crop** on the Touch panel.
2. Place the cursor in one of the 2D slices (or the volume rendering) and press **Set** to create the first crop plane.
3. Move the cursor to a new location. The volume rendering is updated simultaneously.
4. Press **Set** to create the second crop plane and to enter Dual Crop visualization.
5. Press **Layout** to toggle dual crop layouts. The volume rendering can be freely rotated.
6. Press **Dual Crop** to go back to the *Volume rendering* screen.
7. To remove crop planes, press **Clear** on the Touch panel.

4D-Mode controls

	Update/Menu
4D, 4D Color	Depending on the situation: • Toggles between 4D Color Flow Prepare mode and 4D Color Flow acquisition. • Toggles between 4D/4D Color Flow Zoom mode and 4D/4D Color Zoom prepare mode.

	Trackpad
4D, 4D Color	The trackpad has multiple functions. The trackpad functions are organized in several functional groups. The function selected is displayed in the lower part of the screen. • Press Set to toggle between the trackpad functions within the active functional group. Groups with several functions are marked with a + symbol. • Press trackpad to toggle between the functional groups. The functions available are: Volume rendering mode: Group 1: • Rotate: rotates the viewing direction onto the volume rendering. The active crop plane is also rotated if View crop is selected on the side bar. • Translate: translates a crop plane into the volume rendering. Group 2: • Speed: adjusts cine replay speed. • Scroll: scrolls through a cineloop (in Freeze). Volume rendering, cropping mode: Group 1: • Translate: translates the current crop plane. • Rotate: • Rotates the viewing direction onto the volume rendering. • Rotates the crop plane if Rotate is selected on the operation panel. Flexi-Slice mode: Group 1: • Rotate: rotates the viewing direction onto the volume rendering. Group 2: • Adjust: rotates and translates the selected cut-plane or the data. Group 3: • Speed: adjusts cine replay speed • Scroll: scrolls through a cineloop (in Freeze)

	4D Gain (Active Gain)
4D, 4D Color	Affects the transparency of the volume rendering. Too much 4D Gain applied will take away structures, too little will leave opaque "Gray clouds" in the ventricle.

	Clear
4D, 4D Color	Sets the cut-planes and crop planes to the default position.

	Zoom (4D Zoom prepare)
4D, 4D Color	Enters 4D Zoom prepare acquisition: Enables 4D Zoom prepare acquisition displaying a biplane screen with an adjustable zoom ROI in the azimuth and elevation planes. After adjustment of the ROI, press 4D to acquire 4D data for the defined ROI (see page 6-14).
	Layout
4D, 4D Color	Toggles the display between different screen layouts.
	4D Zoom prepare
4D, 4D Color	4D Acquisition preset that enables to acquire real-time data of isolated structures at a higher frame rate than what can be obtained with a full volume acquisition.
	Medium / Large
4D, 4D Color	4D Acquisition presets: sets the volume size for the 4D acquisition. • Medium: medium size sector with top-down view, more suited for mitral valve acquisition. • Large: large sector more suited for acquisition of the complete LV.
	View Crop
4D, 4D Color	Crop mode where the view plane and the crop plane always coincide.
	Flip Crop
4D, 4D Color	Sets the crop plane so that the opposite volume is cropped and the viewing direction is flipped 180 degrees.
	2 Click Crop
4D, 4D Color	Crop mode where two parallel crop planes are applied in the volume rendering. The position and viewing direction are defined by clicking in two locations either in the 2D reference images or in the volume rendering. 2 click crop enables to quickly extract any views for visualization of 4D structures.
	Dual Crop
4D, 4D Color	Dual Crop enables to quickly display the 4D data from opposite views using two renderings. To enable this visualization, two crop planes are created by clicking twice in one of the 2D slices or in the volume rendering.
	Flexi-Slice
4D, 4D Color	Toggles the display between Volume rendering (Figure 6-1 on page 6-4) and Slice mode (Figure 6-10 on page 6-26).

	Multi Slice
4D, 4D Color	Enables simultaneous display of equidistant short axis views generated from a volume acquisition.

	Depth/Color maps
4D, 4D Color	• Adjusts the volume rendering color from a color map menu. • Depth color maps: these color maps use colors to improve the perception of depth. Selecting the Depth bronze/blue color map will display structures that are close to the view plane with a bronze color. Structures that are farther behind will be colored with a gray color, while the structures that are farthest behind will be colored in blue. Very bright colors are almost white, independent of the depth.

	Elevation tilt (Front/Back)
4D	Tilts the volume in the elevation plane and change the viewing direction accordingly.

	Laser Lines
4D, 4D Color	Enables the visualization of the 2D image locations in the volume rendering. The 2D image locations are shown as overlaying red or color coded lines following the surface in the volume rendering. The color of the laser lines (white or green) corresponds to the color coding used for the 2D images.

	Up/Down
4D, 4D Color	Flips the volume upside-down. Not available when alignment has been approved.

	Depth Mode
4D, 4D Color	In Flexi-Slice mode, affects the position of the reference plane in the volume rendering. • Depth Mode on: when clicking in the volume rendering the reference plane is moved inside the volume to the corresponding depth. • Depth Mode off: the reference plane is kept at the current depth.

	Volume size
4D	Controls simultaneously the azimuth and elevation widths. An increase generates a bigger volume with a lower volume rate. A decrease generates a smaller volume with a higher volume rate.

	Volume shape
4D	Adjusts the ratio between the elevation and azimuth widths. Changing the volume shape from default will increase the volume rate.

	Volume optimize
4D	Optimizes the volume rendering by adjusting several display controls simultaneously (e.g Shading, Smoothness... etc.).

	Num Beats
4D, 4D Color	Adjusts the number of heart beats the multi beat acquisition is based on.

	DDP (Data Dependent Processing)
4D, 4D Color	Performs temporal processing which reduces random noise without affecting the motion of significant tissue structures.

	Smoothness
4D, 4D Color	Affects continuity of structures and image noise in the volume rendering. Too much smoothness will blur the image, too little will leave too much noise.

	Shading
4D, 4D Color	Adjusts the shading effect on the volume rendering. Shading may improve three dimensional perception.

	Gamma
4D	Adjusts the brightness of midtone values. A higher gamma value produces an overall darker image, a lower gamma value a brighter image.

	Tissue Transparency
4D, 4D Color	Adjusts the display transparency of tissue data. An increase of Tissue Transparency may help bring out tissue structures or flow information behind obscuring tissue structures.

	Bird's View
4D, 4D Color	4D Acquisition preset displaying a small sector seen from the side.

	Back to 4D
4D, 4D Color	Start 4D scanning by restoring the last used 4D settings.

Multi-plane Mode

Multi-plane mode overview

Bi-plane and Tri-plane modes are available on the Vivid *iq* scanner with the 6VT-D probe.

Using Multi-plane mode



Figure 6-13. Bi-plane mode screen

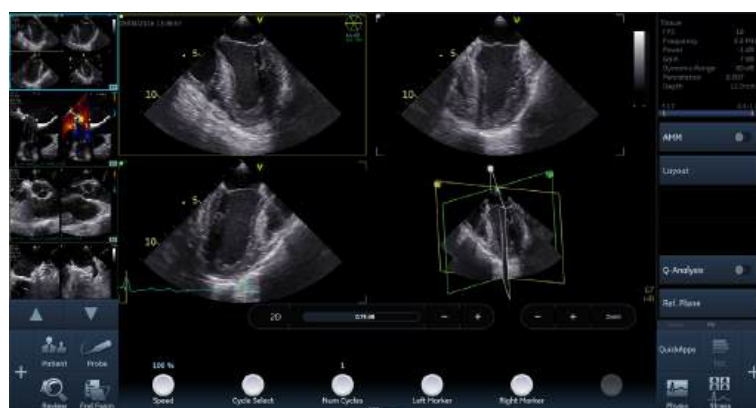


Figure 6-14. Tri-plane mode screen

Using Multi-plane mode (continued)

1. Select a 4D probe and a cardiac application.
2. Press **Multi D** on the control panel.
The *Bi-plane* screen is displayed.
3. Press **Tri-plane** or **Bi-plane** on the side bar to activate the corresponding mode.
4. Adjust the angle increment between the scan planes, or the overall rotation (see page 6-44).
5. If in Bi-plane mode, adjust the scan plane 2 tilt angle (see page 6-47).
6. To activate another scanning mode:
 - Press **Color** to activate CF mode.

NOTE: *To start 4D acquisition, select one of the 4D acquisition presets on the side bar (**Medium**, **Large** or **4D Zoom prepare**).*

7. Zoom in the structure of interest (see page 6-48).

NOTE: *Scan plane rotation or tilting cannot be done when in zoom mode.*

8. Press **Store** to save the acquisition.

Bi-plane prepare

Bi-plane prepare is a 4D scanning mode intended to be used for entering Bi-plane from within a 4D acquisition. The trackpad is used to position two cut-planes according to structures that are visualized in the volume rendering. Pressing **Bi-plane** on the side bar enters the Bi-plane acquisition mode, keeping the cut-planes shown in the 4D mode, but with higher resolution and frame rate.

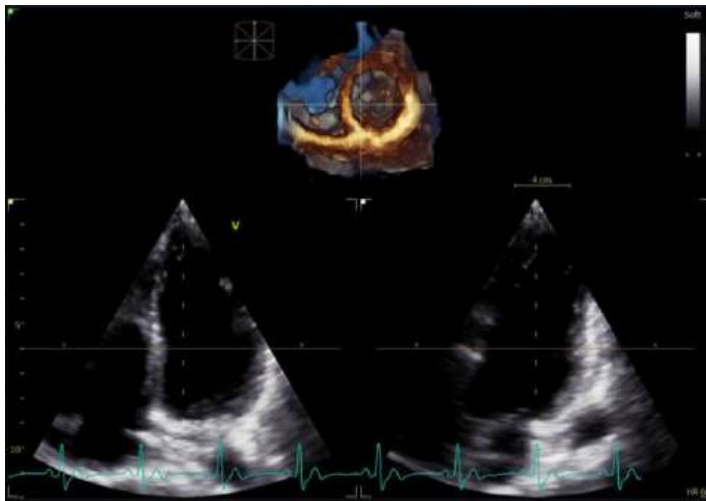


Figure 6-15. The Bi-plane prepare screen

- In 4D live:
 - Transesophageal acquisition: press **Bi-plane prepare** on the side bar.

The Bi-plane prepare screen is displayed showing two perpendicular cut-planes and a smaller volume rendering with a cross-hair defining the position of the cut-planes.

The crop-plane of the rendering is shown by dashed lines in the cut-planes.

Bi-plane prepare (continued)

- Using the trackpad, move the cross-hair in the volume rendering until the cut-planes of interest are displayed. Alternatively, adjust **Tilt** and **Rotate** rotary controls. Use the **Translate** rotary to adjust the position of the crop-plane.
- Press **Multi D** on the side bar to start high resolution and high frame rate bi-plane acquisition.
- Press **Store** to save the acquisition.

Basic operations

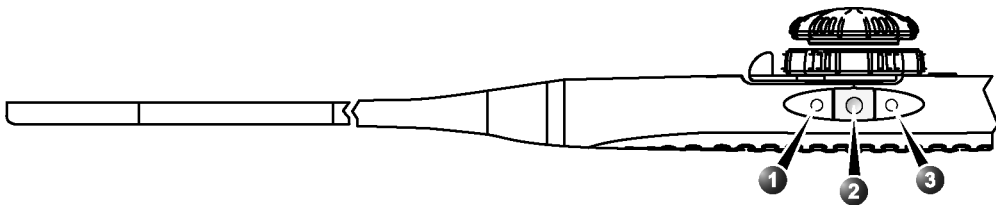
Scan plane rotation

Simultaneous scan plane rotation

Transesophageal acquisition

1. If using the default configuration for the buttons on the 6VT-D probe, use Buttons 1 and 3 to rotate all scan planes simultaneously (see Figure 6-16).

NOTE: To configure the 6VT-D probe buttons, see 'TEE probe (only for 6VT-D) and L4-20t-RS probe configuration' on page 5-96.



1. Button 1 (closest to the probe tip): counterclockwise scan plane rotation
2. Button 2: Image store
3. Button 3: clockwise scan plane rotation

Figure 6-16. 6VT-D default buttons configuration (Live mode)

Alternatively, adjust the **Rotate** rotary to rotate all scan planes simultaneously.

2. Press **Quick Rotate** to rotate all scan planes to pre-defined angles.

Single scan plane rotation

Scan plane 2 and 3 can be rotated separately. The rotation is done around the crossing line between the scan planes. Scan plane rotation is not available in zoom mode.

1. Press **Select** until the desired trackpad function is selected:
 - **Angle 1**: rotation of scan plane 2 (white)
 - **Angle 2**: rotation of scan plane 3 (green, Tri-plane only)
2. Use the trackpad to rotate the corresponding scan plane around the probe center axis.

NOTE: *Rotation of scan plane 2 and 3 can also be done using the **Angle 1** and **Angle 2** rotary buttons.*

3. In Bi-plane mode only, press **V-planes** to rotate scan plane 2, so that it has the same angle as scan plane 1. The scan plane 2 can then be tilted using the **Tilt** rotary or the trackpad (see below)
4. To reset the scan planes to the original default position, press **Clear**.

Single scan plane rotation

Scan plane 2 and 3 can be rotated separately. The rotation is done around the crossing line between the scan planes. Scan plane rotation is not available in zoom mode.

1. Press **Set** until the desired trackpad function is selected:
 - **Angle 1**: rotation of scan plane 2 (white)
 - **Angle 2**: rotation of scan plane 3 (green, Tri-plane only)
2. Use the touch pad to rotate the corresponding scan plane around the probe center axis.

NOTE: *Rotation of scan plane 2 and 3 can also be done using the **Angle 1** and **Angle 2** rotary buttons.*

3. In Bi-plane mode only, press **V-planes** to rotate scan plane 2, so that it has the same angle as scan plane 1. The scan plane 2 can then be tilted using the **Tilt** rotary or the trackpad (see below)
4. To reset the scan planes to the original default position, press **Clear**.

Tilting scan plane 2

In Bi-plane mode, the scan plane 2 can be tilted around the top of the scanning sector using the trackpad. Tilting is not available in zoom mode.

1. In Bi-plane mode, press **Set** until the trackpad function **Pos** is selected.
2. Use the trackpad to tilt the scan plane 2.

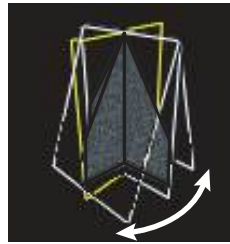


Figure 6-17. Tilting of scan plane 2 (Bi-plane mode)

3. To reset the scan planes to the original default position, press **Clear**.

Zooming

1. Adjust zoom on the operation panel.
All scan plane images are zoomed in. A *Navigation* window is displayed with a frame highlighting the zoomed area.
The zoomed area can be moved within the sector or resized.
1. In zoom mode, press **Set** to toggle the trackpad function to **Pos** and use the trackpad to freely move the zoomed area within the scan plane.
2. Press **Set** to toggle the trackpad function to **Size** and use the trackpad to adjust the size of the zoomed area (2D mode only).

Multi-plane mode controls

	Multi D
	Starts/exits Multi-plane mode.

	Trackpad
	The trackpad has multiple functions. The trackpad functions are organized in several functional groups. The function selected is displayed in the lower right corner of the screen. • Press Set to toggle between the trackpad functions within the active functional group. Groups with several functions are marked with a + symbol. • Press trackpad to toggle between the functional groups. The functions available are: Group 1 (Live): • Angle 1: adjusts the angle between the scan planes 2 (white) and scan plane 1 (yellow). Scan plane 2 is rotated around the crossing line between the scan planes. Scan plane 1 is fixed. • Angle 2: adjusts the angle between the scan planes 3 (green) and scan plane 1 (yellow). Scan plane 1 is fixed. Available in Tri-plane only. Group 1 (Zoom): • Pos: moves the zoom area. • Size: resizes the zoom area. Group 2 (Color): • Pos: moves the color sector. In Bi-plane CFM mode, if scan plane 1 (yellow) is selected as reference scan plane, both color sectors are moved. If scan plane 2 (white) is selected as reference scan plane its color sector is moved independently. In Tri-plane CFM mode, all ROI are moved at the same time. • Size: resizes the color ROI. All sectors are resized at the same time. Group 1 (Freeze/Replay): • Speed: adjusts cine replay speed. • Scroll: scrolls through a cineloop (in Freeze).

	Zoom
	Press + or - tab beside “Zoom” tab on the Shortcut Bar. An orientation preview showing the outlined magnified area is displayed in the upper right corner of the screen. The position and size of the magnified area are adjusted with the trackpad when in B mode. Press + or - tab beside “Zoom” tab on the Shortcut Bar. HR zoom concentrates the image processing to a magnified user selectable portion of the image, resulting in an improved image quality in the selected image portion. An orientation preview showing the outlined magnified area is displayed in the upper right corner of the screen. The position and size of the magnified area are adjusted with the trackpad.
	Clear
	Resets all scan planes to the default position.
	Layout
	• In Bi-plane mode, toggles the display between the default Bi-plane dual screen and a single screen showing the selected scan plane. • In Tri-plane mode, toggles the display between the default Tri-plane quad screen, a quad screen with enlarged <i>Geometric model</i> and a single screen showing the selected scan plane.
	Bi-plane / Tri-plane
	Toggles between Bi-plane and Tri-plane mode.
	Reference Plane
	Toggles the reference plane between the scan planes. The reference plane may also be selected using the trackpad.
	4D Zoom prepare
	Enables 4D Zoom prepare acquisition displaying a biplane screen with an adjustable zoom ROI in the azimuth and elevation planes. After adjustment of the ROI, press 4D to acquire 4D data for the defined ROI (see page 6-14).
	Right Invert
	In Transesophageal Bi-plane mode Live B-mode, CFM. • Invert: mirrors the image on the right hand side. Will turn off Auto if it is enabled. • Auto: automatically mirrors the image on the right hand side so that Angle 1 is always in the range 0 to 180 degrees, also when using probe buttons. Pressing Auto will override any mirroring of the right hand side image that has been set using Invert.

	Angle
	Toggles the position of scan plane 2 between the default position and a pre-defined angle relatively to scan plane 1.

	Angle 1 / Angle 2
	• Angle 1: adjusts the angle between the scan planes 2 (white) and scan plane 1 (yellow). Scan plane 2 is rotated around the crossing line between the scan planes. • Angle 2: adjusts the angle between the scan planes 3 (green) and scan plane 1 (yellow). Scan plane 3 is rotated around the crossing line between the scan planes.

	Quick Rotate
	Rotates all scan planes to pre-defined angles.

	Rotate
	Rotates all scan planes around the crossing line between the scan planes.

FlexiViews

Introduction

FlexiViews provides a quick access to standard or user-defined views when scanning with 4D TEE probes. This feature stores image geometry and a selected number of scanning parameters, such as 4D Gain and Multibeam.

Vivid *iq* with 4D option comes with a set of factory defined views. Users can create their own defined views as needed.

Storing FlexiViews while in zoom is limited to 4D modes and 4D Zoom Prepare.

FlexiViews can be managed on the fly according to Figure 6-18.

Press the *FlexiViews* tab and select any of the available FlexiViews. The name of the view is displayed in the button together with the scanning mode for that view. Factory default FlexiViews are identified with a "GE" mark on the top right corner of the button.

Introduction (continued)



- **Replace:** To replace an existing factory FlexiView. It is only possible to replace a FlexiView with a new setting working in the same scanning mode as predefined.
- **New:** To create a new user defined FlexiView. Press **New** and name the new FlexiView as desired.
- **Reset To Factory:** To reset a modified FlexiView to its predetermined factory settings. Press **Reset To Factory** and select the FlexiView that you want to restore to factory settings.
- **Reset All:** To restore all FlexiViews to the factory default values.
- **Configure:** To configure the order and visibility of the FlexiViews.
- **Delete:** To delete a user defined FlexiView. Press **Delete** and select the FlexiView to be deleted.
- **Lock:** To keep the FlexiViews tab open after selecting one of the available FlexiViews. If the Lock button is set to *OFF*, the Touch panel will return to the active imaging mode tab after selecting a FlexiView

Figure 6-18. The FlexiViews tab

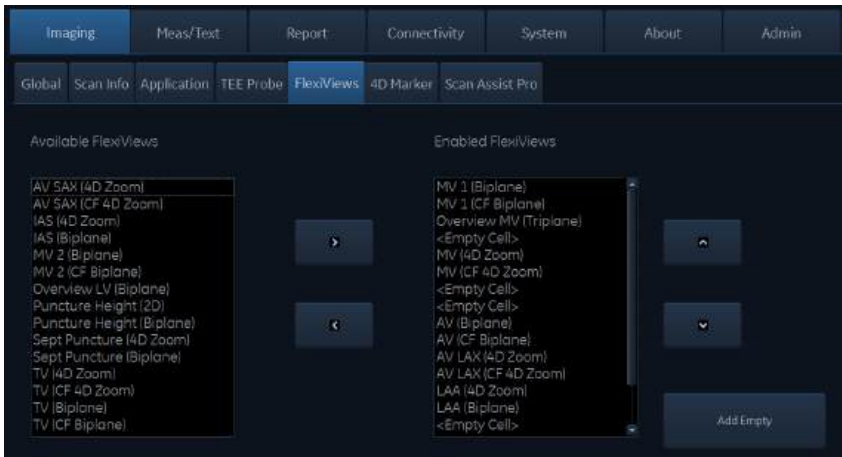
Introduction (continued)



WARNING

Displayed images may not accurately reflect the user-defined name of the selected FlexiView.

The **Configure** button opens the configuration screen which allows showing/hiding FlexiViews, and sorting the Enabled FlexiViews as described in Figure 6-19.



1. The arrows allow moving the FlexiViews from the complete available list to the *Enabled FlexiViews* that show the visible FlexiViews under the *FlexiViews* tab.
2. The arrows allow ordering the FlexiViews according to user preferences. The *Enabled FlexiViews* are divided in columns of 4 elements each. Empty cells may be added to customize the layout of the buttons within the *FlexiViews* tab.

Figure 6-19. FlexiViews configuration

Chapter 7

Stress Echo

This chapter describes:

‘Selection of a Stress Test Protocol Template’ on page 7-3

‘Image Acquisition’ on page 7-4

‘Stress Echo Analysis’ on page 7-23

‘Quantitative TVI Stress Echo Analysis’ on page 7-29

‘Editing/Creating a Stress Echo Protocol Template’ on page 7-38

‘Configuration’ on page 7-45.

Introduction

The ultrasound unit provides an integrated stress echo package, with the ability to perform image acquisition, review, image optimization, and wall segment scoring and reporting for a complete, efficient stress echo examination.

The stress package provides protocol templates for exercise, as well as pharmacological stress examinations. In addition to preset factory protocol templates, templates can be created or modified to suit users' needs. Users can define various quad screen review groups, in any order and combination, that will suit their normal review protocol. When reviewing stress examination images, the images are viewed at their original image quality, and different post-processing and zoom factors may be applied to the images under review for effective image optimization. The protocol template may be configured for Continuous capture. In addition to standard wall motion scoring analysis, the user can perform quantitative stress analysis based on tissue velocity information (TVI), see page 7-29.

A stress echo examination consists of three steps:

- Selection of a stress test protocol template (page 7-3)
- Image acquisition (page 7-4)
- Stress analysis (page 7-23)

Selection of a Stress Test Protocol Template

1. Press **Stress** on the Shortcut Bar.
The *Protocol* screen is displayed (see Figure 7-1) showing the default stress protocol for the current probe and application.
2. Turn freeze off or press **Begin/Cont** to initiate scanning using the current template.

To use another template, press **Template** and select the desired template from the template list. Turn freeze off or press **Begin/Cont** to initiate scanning.

NOTE:

To create or edit a template see page 7-38.



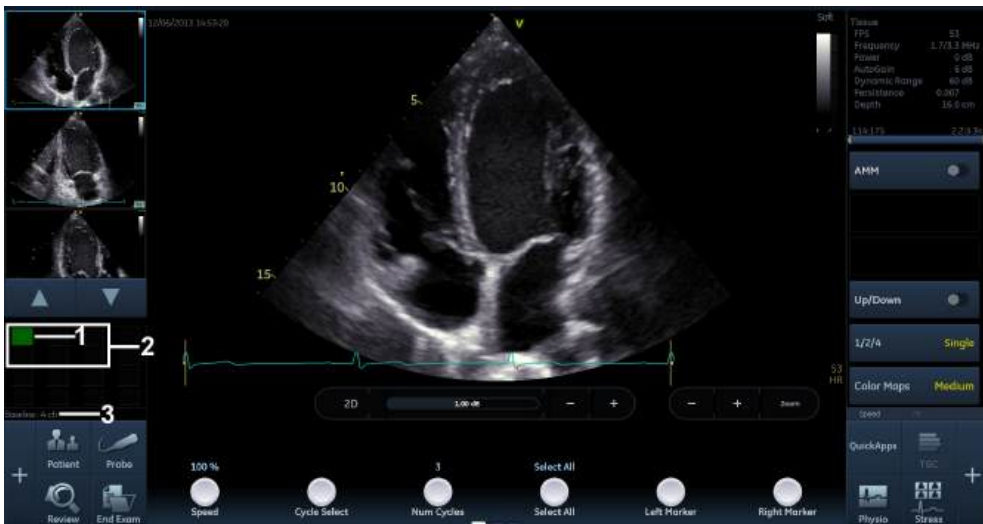
1. Projection selection
2. Current acquisition
3. Level selection
4. Group of views

Figure 7-1. The Protocol screen

Image Acquisition

Introduction

Images are acquired in a pre-defined order, according to the selected template. The highlighted cell (green) of the matrix, displayed in the *Clipboard* window indicates which view is currently being acquired (see Figure 7-2). The names of both the view and the level for the current cell is displayed on the top corner of the image area and under the template matrix.



1. Current view (Green cell)
2. Template matrix view and level
3. Current view, level and timers

Figure 7-2. The stress mode acquisition screen

Starting acquisition

1. Press **Begin/Cont** to initiate scanning.

NOTE: To use the Timer, see page 7-11.

2. Perform a scan that conforms with the view that is highlighted in the template matrix on the *Clipboard* window. If the selected template has the option **Smart Stress** turned on (see page 7-42), a subset of the image acquisition settings for each view in the baseline level will be stored and automatically reused in the corresponding views in the next levels.

NOTE: Smart Stress is turned on by default in factory templates.

3. Press **Store**.
 - If the actual stress level is configured to preview cineloop before storing, use the cineloop controls to select the most appropriate heart cycle and, if desired adjust the loop markers (see 'Cineloop' on page 4-28 for further information). Press **Store** to save the selected cineloop.
 - If the actual stress level is not configured to preview cineloop before storing, the system will automatically store the last cardiac cycles.

Starting acquisition (continued)



1. Current acquisition loop
2. Corresponding reference loop

Figure 7-3. Display of the Reference loop during acquisition

Starting acquisition (continued)

NOTE: *For further information on stress test configuration, see page 7-38.*

When storage of the cineloop is completed, the actual highlighted cell in the template matrix is filled with dark blue color indicating that the view has been acquired. After storing the loop, the system automatically highlights the next view in the matrix to be acquired.

Stress levels can be configured for side-by-side display/ comparison of the reference loop from baseline or previous level and the loop to acquire (see Figure 7-3).

4. Repeat previous steps until all required views are completed.

The template used can be configured so that analysis is automatically started, displaying the first protocol group. The wall segment scoring diagrams for each view is displayed in the *Parameters* window on the right side of the screen (see Figure 7-8 on page 7-26).

Protocol Pause function

During the stress acquisition it is possible to temporarily exit the protocol acquisition mode to acquire images in any mode outside the stress protocol.

1. To temporarily exit the protocol mode, press **Pause Stress** in the upper left corner.
2. Acquire the desired images outside the protocol.
3. Press **Resume Stress** in the upper left corner to restart the protocol acquisition mode and resume the stress acquisition.

Selecting a view during acquisition

A fixed protocol is provided for scanning, based on the selected template. The system automatically highlights the next view to be acquired in the template matrix, as images are stored. However, the order of scanning may be changed manually as follows.

Manual selection of a view during acquisition

1. Use trackpad or touch screen to highlight the cell that represents the view that is to be acquired.
The selected cell in the template matrix is highlighted in red, indicating non-default position and is blinking if it contains a previously stored acquisition.
2. Scan and save the selected loop as explained in the previous section.

After storage the system automatically highlights the next available view to be acquired.

Replacing an acquired image

1. Use trackpad to highlight the cell that represents the view that is to be replaced.
The selected cell in the template matrix is blinking red, indicating non-default position.
2. Scan and save the selected loop as explained in the previous section.
3. Select in the dialog window if you want to **Replace** or **Keep** the existing loop.
 - **Replace:** the original image is deleted from the examination and replaced by the acquired image.
 - **Keep:** the original image is replaced by the acquired image, but it is not deleted from the examination.

NOTE:

When selecting Keep, both the new and the old image will be associated with the current protocol cell and you may later perform Wall Motion Scoring for this level in the protocol using either the new or the old image. The new image may be opened from the protocol, while the old image may be opened manually from the clipboard.

After storage the system automatically highlights the next available view to be acquired.

Moving an acquired image

An Image can be moved from one cell to another during acquisition. There are two ways to move images.

Procedure 1

1. In the *Protocol* screen, press **Move image**.
2. Select the image to move using trackpad (source cell).
3. Select the destination cell using trackpad.

The image is moved from the source cell to the destination cell.

Procedure 2

1. In the *Protocol* screen, select the cell containing the image to move using trackpad (source cell).
2. Press and hold down **Set**.
3. With the **Set** key still depressed, using trackpad to select the destination cell.
4. Release the **Set** key.

The image is moved from the source cell to the destination cell.

If the destination cell contains an image, the images from the source and destination cells will be exchanged when moving an acquired image.

Timers

Two timers can be displayed in the *Stress mode acquisition* screen, beside the template matrix.

- **T1** displays the elapsed time from the start of the stress examination.
- **T2** starts when entering live scanning on the second stress level

Press Protocol T2 to stop/start the T2 timer. Timers restart always at zero.

The display of T1 and T2 is user-configurable (see page 7-38).

Continuous capture mode

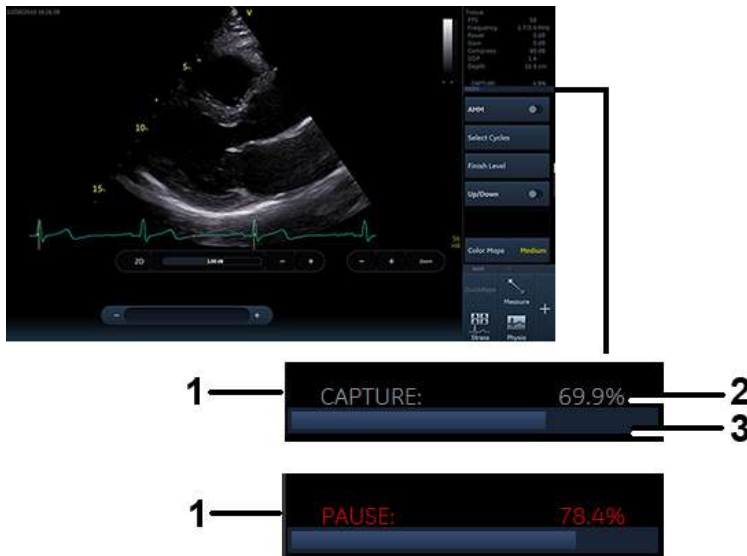
Continuous capture mode enables the user to perform acquisition continuously for several views at any level depending on the selected template configuration. Continuous capture consists of temporarily saving images acquired in a storage buffer. To enable best possible use of the limited storage buffer capacity, a Pause/Capture mode is provided, as opposed to the normal Freeze/Scan mode. The Pause mode enables scanning and live display on the screen, without any capture, thereby leaving the buffer available.

To run Continuous capture, the user has to select a template where this feature is activated (see page 7-38 about template configuration).

The buffer bar

When entering a cell with Continuous capture enabled, a *Buffer bar* is displayed in the *Info* window (Figure 7-4). The *Buffer bar* displays the following information:

- The scanning state:
 - **PAUSE**: live scanning without storing
 - **CAPTURE**: live scanning with storing to buffer
- The percentage of the buffer that is filled
- The buffer filling progression showed by a filling gauge



1. Scanning state
2. Percentage of filled buffer
3. Buffer gauge

Figure 7-4. The buffer bar in Continuous capture

Controlling the capture process

When entering a cell with Continuous capture enabled, the unit is automatically set in Pause mode.

1. Press **Store/Pause** to start image capture.
“Capture” is displayed in the buffer bar, the gauge starts filling and the percentage of filled memory buffer increases (Figure 7-4).
2. Press **Store/Pause** again to stop capture.
“Pause” is displayed in the buffer bar.

When 90% of the memory buffer is filled up, the text display in the buffer bar turns red.

The unit enters Freeze mode automatically once the buffer is full. The captured recording is stored on disk and the captured loops are displayed in the *Continuous capture selection* screen (see below).

Running Continuous capture

1. Do all your pre-stress acquisitions in the Cardiac application.
2. Press **Stress** on the Shortcut Bar to enter the stress echo mode.

The *Protocol* screen is displayed (Figure 7-1 on page 7-3).

NOTE: *The application **Exercise** should be used in order to get maximum continuous capture buffer.*

3. Press **Template**.
The template list is displayed.
4. Select the template **Exercise 2x4** or any user preset with continuous capture.
5. Press **Begin/Cont**.
6. Acquire the resting loops in all required views.
7. Once the last loop is acquired the system enters into a waiting mode where Continuous Capture is in pause state awaiting the patient to exercise.
8. When the patient has reached the maximum exercise and the user is ready to acquire the images, press **Store** or **Pause**. The Continuous capture acquisition is started.
9. Acquire all your views. You may pause the acquisition when moving the probe between parasternal and apical position.
The memory buffer gauge increases (Figure 7-4). When memory filling exceeds 90%, the percent number turns red.
The *Continuous capture selection* screen is displayed.
If the buffer is filled up the system will automatically display the *Continuous capture selection* screen.
Refer to the next section if additional image acquisition is necessary after the buffer is filled up.

Running Continuous capture (continued)

10. Press **Freeze** to finish.

11. Press **Select Cycles**.

The *Continuous capture selection* screen is displayed (see Figure 7-5 on page 7-20).

If the buffer is filled up the system will automatically display the *Continuous capture selection* screen.

Refer to the next section if additional image acquisition is necessary after the buffer is filled up.

12. Assign the cineloops to the views (see page 7-21).

The continuous capture acquisition was stored on disk before the *Continuous capture selection* screen was displayed. At end exam, a dialogue is displayed asking whether this file should be kept or not. To avoid unnecessary data storage, it is recommended to delete this file at end exam when the cycles have been selected and stored.

13. Press **Done** if you are finished selecting or want to do the selection later.

OR

Press **Select later** if you want to return to the scanning screen. If there are more rows in the protocol template, the active cell will move to the next row. To later select loops from the Continuous Capture, enter Protocol screen and click on the Continuous capture thumbnail in the lower left corner.

OR

Press **New capture** to start a new Continuous capture acquisition at this stress level.

14. Perform Analysis and scoring (see page 7-23).

Continuous capture with additional image acquisition

After acquiring Continuous capture, additional images can be stored to the clipboard before the patient's heart rate decreases toward recovery level. These additional images may be acquired with other scanning modes (using the same probe and application), before doing image assignment to the views. The following procedure applies if the Continuous Capture is on the final row:

1. Perform Continuous capture as described above (steps 1 to 10).
2. If the buffer is filled up: press **Select later**. Scanning is activated outside the stress protocol.
3. Perform the additional acquisition (e.g. Color flow, Doppler). Images will be stored outside the protocol.
4. In order to resume the stress echo exam and assign loops for the views from the Continuous capture buffer, press **Resume Stress**.
5. Select the **Continuous capture** in **Template Editor** screen, and press **OK**.
The *Continuous capture selection* screen is displayed.
6. Assign the cineloops to the views (see page 7-21).
7. Press **Done** when you are finished selecting.
8. Perform Analysis and scoring (see page 7-23).

Postponed image assignment

The assignment of the cineloops to the views can be done on a later stage on a stored Continuous capture acquisition.

1. Perform Continuous capture as described in 'Running Continuous capture' on *page 7-15* (steps 1 to 11).
2. When entering *Continuous capture selection* screen (step 11), the continuous capture acquisition is stored on disk before the *Continuous capture selection* screen is displayed. At end exam, a dialogue is displayed asking whether this file should be kept or not. To avoid unnecessary data storage, it is recommended to delete this file at end exam when the cycles have been selected and stored.
3. Re-open the examination if necessary.
4. Press **Resume Stress**.
The *Stress* screen is displayed.
5. Select the **Continuous capture** in **Template Editor** screen, and press **OK**.
The *Continuous capture selection* screen is displayed.
6. Assign the cineloops to the views (see *page 7-21*).
7. Press **Done** when finished.
8. Perform Analysis and scoring (see *page 7-23*).
9. When exiting this patient a dialogue window is displayed asking whether the remaining continuous capture images should be deleted.
 - Press **Yes** to delete the remaining continuous capture images
OR
 - Press **No** to keep the entire continuous capture acquisition.

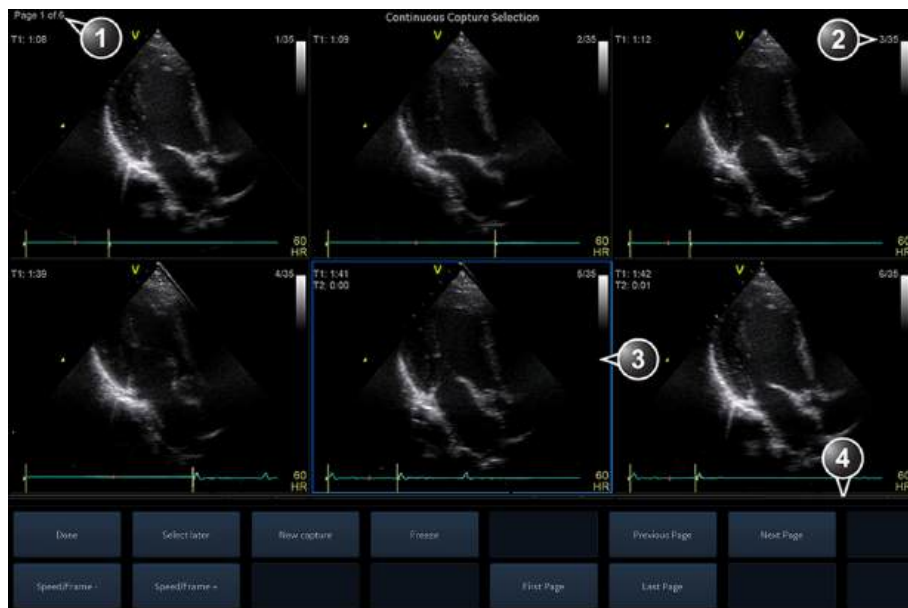
The normal procedure is to delete the remaining images as they take a lot of disk space.

New capture from the Continuous capture selection screen

1. Press **New Capture**.
The scanning screen is activated.
2. Press **Freeze** to start live acquisition.
3. Press **Store** to start capture.

Assigning and storing the loops

The cineloops captured in the buffer are assigned to the stress protocol views and stored from the *Continuous capture selection* screen (see Figure 7-5).



1. Press Next Page to display the next page.
2. Cycle number and total number of cycles
3. Highlighted loop
4. Buffer bar: to browse through the acquisition, select an area in the buffer bar to display the corresponding page or select the first, last, previous or next page buttons.

Figure 7-5. The Continuous capture selection screen

Assigning a cineloop to a view

1. Use trackpad to select the desired loop in order to assign it to a particular view of the stress template.
The frame of the loop is highlighted.
A pop-up menu is displayed with the view names of the template.
2. Select the required view name.
The name of the view is displayed in the loop window.
3. Repeat steps 1 to 2 to assign loops to the other views of the level.
4. Press **Done** when completed.

Assigning a cineloop to a view (continued)

NOTE: The continuous capture acquisition was stored on disk before the Continuous capture screen was displayed. At end exam, a dialogue is displayed asking whether this file should be kept or not. To avoid unnecessary data storage, it is recommended to delete this file at end exam if the cycles have been selected and stored.

1. Assigned loop
2. Highlighted loop
3. Already assigned view
4. Highlighted view

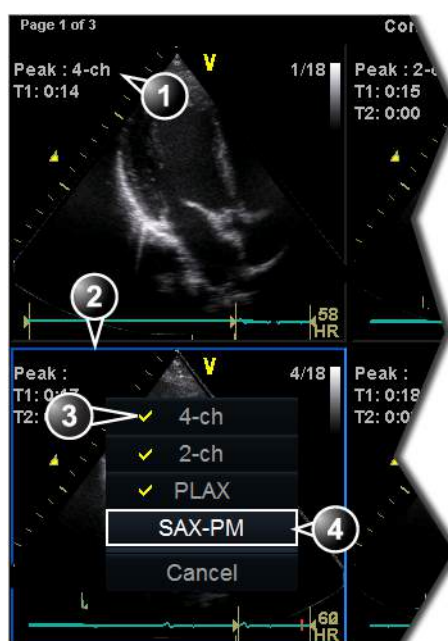


Figure 7-6. Loop assignment in Continuous capture

Stress Echo Analysis

Introduction

Stress Echo analysis consists of viewing previously saved loops and assigning scores to each cardiac segment, in order to quantify the function of the muscle, or wall motion.

Depending on the protocol configuration, the analysis stage can be started automatically after completion of the stress test or it can be started manually. In this case, the usual procedure consists of sequentially opening all image groups (if defined) and perform scoring from image to image.

The quad screen is the standard display for comparing heart cycles (Figure 7-8). The heart cycle loops in the display are synchronized to enable comparison. Each loop in the quad screen can be magnified, using the zoom control.

Image selection for analysis

Images can be selected manually or from a pre-defined group in the *Protocol* screen.

Selection of images from a group

If groups of images have been defined in the protocol template (page 7-44), the user can select a group of images for analysis and sequentially analyze all images from all groups from within the *Analysis* screen (Figure 7-8 on page 7-26).

1. In a stress examination, press **Stress**.
A preview of the acquisitions is displayed.
2. Use trackpad to move the cursor to a group in the *Group list*.
The frame of the images belonging to the group are highlighted.

NOTE: Pressing **Analyze** (while no images are selected in *Protocol* screen) on the touch screen will automatically open the first group of images in *Analyze* screen.

3. Select and open images in the *Analyze* screen (see page 7-26).

1. Select a Projection
2. Select an image
3. Select and open an Image group

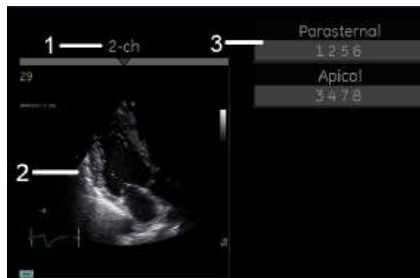


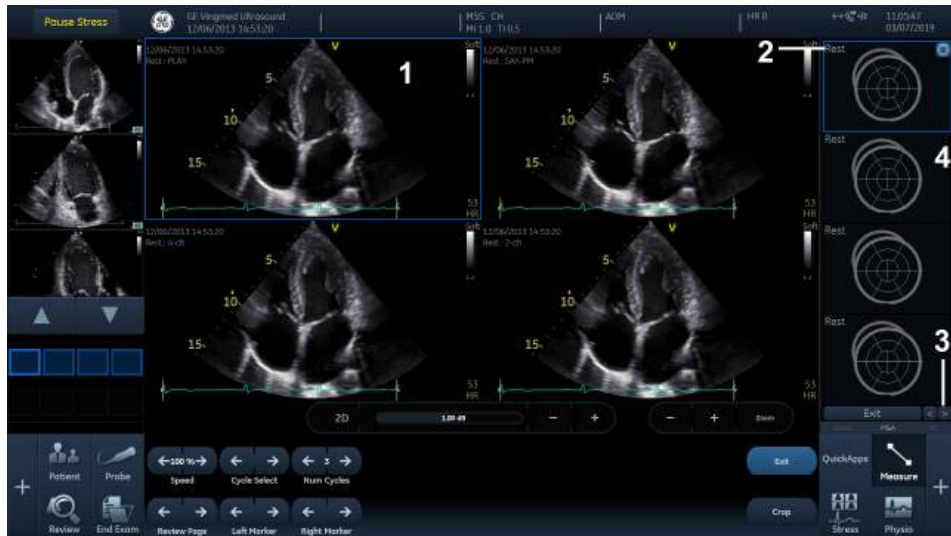
Figure 7-7. Image selection from the Protocol screen

Manual selection of images in the Protocol screen

1. In a stress examination, press **Stress**.
A preview of the acquisitions is displayed.
2. Select the first image.
The frame of the selected loop is highlighted.
3. Repeat steps 2 to select other images.
4. Press **Analyze** to open images in the *Analyze* screen (see page 7-26).

NOTE: *Alternative: Double click on the last selected image to open images.*

Wall motion scoring



1. Selected loop (highlighted frame)
2. Highlighted segment name (see pointer)
3. Change page or enter next image group
4. Display Bull's eye diagram

Figure 7-8. The stress echo analysis screen

Wall motion scoring (continued)

Wall motion scoring is used to evaluate wall motion in each cardiac segment. The left ventricle myocardium is divided into a number of segments (e.g. 16 or 18), and each segment is assigned a score based on visual evaluation/"eye-balling". The wall motion scoring results are linked to the stress level of the image being evaluated. This means that for instance when scoring a short axis projection and a long axis projection from the same stress level, then common segments with the same scoring value will be shown in the respective scoring diagrams.



CAUTION

The wall motion scoring result is assigned to the stress level of the image, but will not be updated if the image is moved to another stress level in the protocol at a later time. Images should be correctly placed in the protocol when performing wall motion scoring.

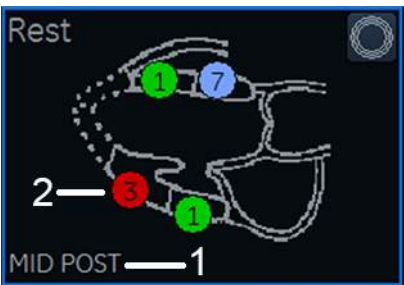
NOTE: *The number of segments (WMS segment model), the range of scoring values (WMS scoring legend) and the initial scoring value (WMS initial scoring) may be configured in Config/Meas Text/Advanced under the Cardiac M&A category.*

1. In the *Stress Echo Analysis* screen, select a segment in one of the scoring diagrams.
The *Score pop-up list* is displayed (see Figure 7-9).
2. Select a score.
The score is displayed in the relevant segment area in the diagram (see Figure 7-9).
3. Repeat steps 1 through 2 to score relevant segments.
4. Repeat steps 1 through 2 to score relevant segments on the new loops.

Wall motion scoring (continued)



1. Selected score



- 1. Highlighted segment name
- 2. Scored segment

Figure 7-9. Segment scoring

Quantitative TVI Stress Echo Analysis

Introduction



WARNING

QTVI Stress analysis is meant as a guide to wall motion scoring.

Diagnosis must not be based on results achieved by QTVI Stress analysis only.

The ultrasound unit provides a Quantitative TVI (QTVI) Stress analysis package based on Tissue velocity information (TVI). The TVI data is stored in a combined format with grey scale imaging during stress examination.

When selecting a template supporting TVI data acquisition, the ultrasound unit will automatically store TVI information, generally for the apical views of the stress examination.

The QTVI Stress analysis option currently applies only to Dobutamine stress-echo.

Wall Motion Scoring remains the basis for the diagnosis of CAD in stress echocardiography. QTVI Stress may be used as a guidance tool to check this interpretation.

The current version of QTVI Stress is based on the assessment of peak velocity at peak Dobutamine stress. The normal ranges have been validated in the “average” patient presenting for stress testing. The velocity cutoff values for the V_{peak} measurement will not work in the following cases:

Introduction (continued)

- Submaximal stress (<85% predicted max HR)
- Patients at extremes of age (<40 or >70)
- Previous myocardial infarction / revascularization
- Previous heart-failure / cardiomyopathy / hypertrophy / arrhythmia / aortic regurgitation

The velocity cutoff values are based on placing the sample volume at center of each cardiac segment at start of systole, the left ventricle myocardial segments are defined by the American Society of Echocardiography 16 segments model. However, the velocity cutoff model does not cover the apical segments (due to low velocities and segment orientation), (see note).

NOTE: *Velocity measurements in mid and basal segments of the myocardium will contain contributions from the apical region of the myocardium. E.g. if measured value in a mid segment is below the cutoff value for this segment then this might relate to a reduced function in the mid or apical region.*

Tissue Doppler does not have perfect site-specificity because of tethering by adjacent segments. Thus, although an ischemic segment has little thickening (and therefore could be expected to show low velocity), measured velocity may be influenced by local tethering, reflecting contraction in surrounding segments. Conversely, a normal segment may have its velocity reduced by an adjacent segment with reduced velocity. This tethering effect may decrease the sensitivity for single vessel disease, but nonetheless the sensitivity and specificity of the cut-offs are approximately 80% (see 'References' on *page 7-37*).

Introduction (continued)

Three different analysis tools based on TVI data are available:

- **'Vpeak measurement' on page 7-33**, enables the display of a tissue velocity trace for a selected region of a previously scored segment through the entire heart cycle. In addition Vpeak is color-coded on the 2D image. From the velocity trace, the user can estimate the peak systolic velocity (see 'References' on page 7-37).

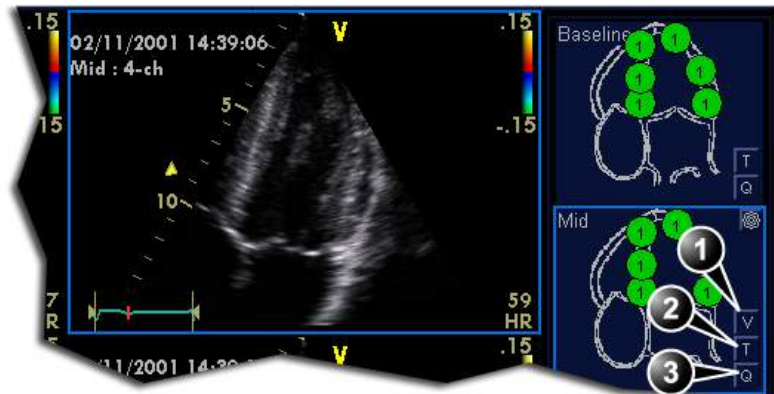
This tool is available in views from peak levels only and only when a segment has been scored in one of these views.

- **'Tissue Tracking' on page 7-36**, enables visualization of the systolic contraction of the heart by color-coding the myocardial displacement through the systole.
- **'Quantitative analysis' on page 7-37**, enables further quantitative analysis based on multiple tissue velocity traces.

The quantitative analysis is described in Chapter 8 on page 8-1.

Accessing QTVI Stress analysis tools

The three QTVI Stress analysis tools are entered by pressing a dedicated button on the scoring diagram (Figure 7-10) of the selected view. Only views with TVI data acquired will display QTVI Stress tools buttons on the respective diagrams.



1. Vpeak measurement (V-peak measurement is displayed in views from peak levels and only after scoring.)
2. Tissue Tracking
3. Quantitative analysis

Figure 7-10. QTVI Stress tools buttons

Vpeak measurement

This tool enables the user to generate a tissue velocity profile for a given wall segment through the entire heart cycle and display color-coded Vpeak in tissue.

From the velocity trace, the user can determine whether the systolic Vpeak is over or under a clinically determined velocity threshold (see 'References' on *page 7-37*) to confirm the wall motion scoring.



CAUTION

QTVI Stress can be used only in conjunction with wall motion scoring analysis, as a guiding tool.

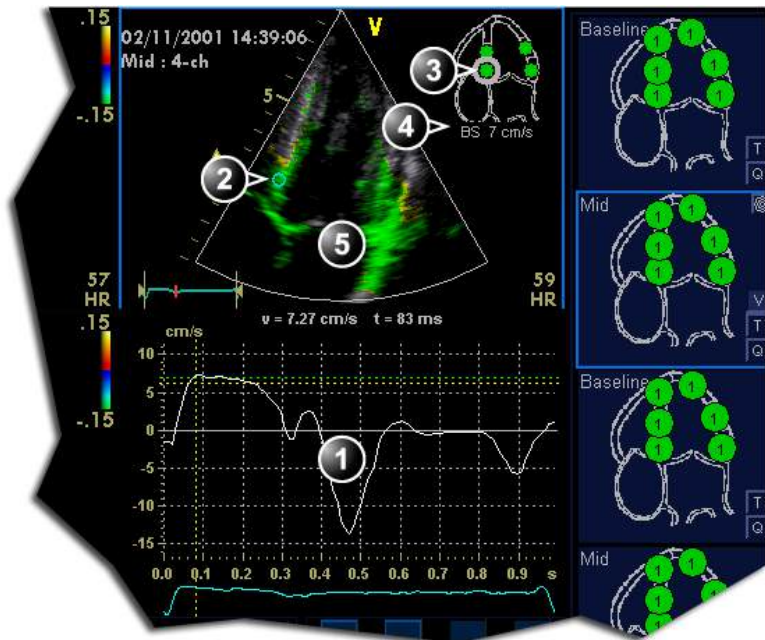
When activating QTVI Stress, the measurement *applies only to the currently highlighted segment* for the current level and projection view.

To display a Vpeak measurement

1. Perform segment scoring as described on page 7-26.
When performing scoring in a view from a peak level, the Vpeak measurement button (**V**) is displayed in the corresponding diagram.
2. In the *Scoring* diagram, press **V**.
The cursor is changed to sampling area and the scored peak views are updated showing:
 - A diagram with the current segment highlighted (scoring bullet with a ring) and the segment's velocity cutoff (Figure 7-11).
 - Color-coded velocity in tissue. The color-coding convention is as follow:
 - **Green**: Velocities above threshold value + 5%
 - **Yellow**: Velocities near threshold (+/- 5% interval)
 - **White**: Velocities below threshold value - 5%
 - A result window to display tissue velocity profile, shown when moving the sampling area in the view.
3. In the 2D sector, place the sampling point over the wall area corresponding to the current segment (shown as the highlighted segment in the diagram).
A tissue velocity profile for the actual segment is generated in the *Result* window (Figure 7-11).
4. Use **Segment Select** to analyze the other segments in the peak view,

Or
Select another scoring bullet in the diagram in one of the peak views.

To display a Vpeak measurement (continued)



1. Tissue velocity profile
2. Sampling point
3. Current segment
4. Vpeak threshold for current segment
5. Color-coded tissue velocity:

Color-coding (velocity thresholds and tissue):

- **Green:** velocities above threshold value
- **Yellow:** velocities near threshold (0 to -10% interval)
- **White:** velocities below threshold value - 10%

Figure 7-11. Vpeak QTVI Stress display

Turn-off the Vpeak measurement tool

1. Select the **V** button in the peak view scoring diagrams.

V-peak measurement interpretation

The systolic Vpeak in the tissue velocity profile is automatically detected and highlighted by a vertical bar (Figure 7-11). The automatically detected Vpeak should be visually verified by the user. In addition Vpeak thresholds are displayed as color-coded horizontal lines (Figure 7-11). These thresholds represent statistical guideline values for peak velocity at peak stress level (Dobutamine stress procedure) for the three apical views. Only threshold values for basal and mid-segments for each apical view are defined (see 'References' on *page 7-37*). The result is highlighted by a color-coding of the thresholds lines, the color-coding in the 2D image and the scoring bullet (Figure 7-11).

Tissue Tracking

Tissue Tracking calculates and color-codes the displacement in tissue over a given time interval. The displacement is found as the time integral (sum) of the tissue velocities during the given time interval. The color-coded displacements calculated in the myocardium are displayed as color overlay in the respective acquisition window.

By studying the color patterns generated in the different segments, the user can confirm the standard segmental wall motion scoring at peak levels.

To display Tissue Tracking

- Press **T** in one of the *Wall segment diagram* field (usually an apical view at peak level).

The Tissue Tracking color overlay is displayed in the *Acquisition* window.

Quantitative analysis

Quantitative analysis enables further analysis based on multiple tissue velocity traces. Quantitative analysis is performed using the Quantitative analysis package described in Chapter 8 on page 8-1.

To start quantitative analysis

- Press **Q** in one of the *Wall segment diagram* field (usually an apical view at peak level) to launch the Quantitative analysis package (page 9-1).

References

- **Application of Tissue Doppler to Interpretation of Dobutamine Echocardiography and Comparison With Quantitative Coronary Angiography.** Cain P, Baglin T, Case C, Spicer D, Short L. and Marwick T H. *Am. J. Cardiol.* 2001; 87: 525-531

Editing/Creating a Stress Echo Protocol Template

Introduction

The stress package provides protocol templates for exercise as well as pharmacological stress examinations. The user can create new templates or modify existing templates to suit the individual needs. Up to ten projections and fourteen stress levels can be created in a template.

Templates created may be temporary, used only during the current examination, or saved as new templates, for future use and reference.

Templates are edited/created from the *Template editor* screen.

Entering the Template editor screen

1. Press **Stress** on the Shortcut Bar to enter the stress echo mode.
2. Press **Template**.
The *Template* menu is displayed.
3. Select **Template Editor**.

The *Template editor* screen is displayed (see Figure 7-12).

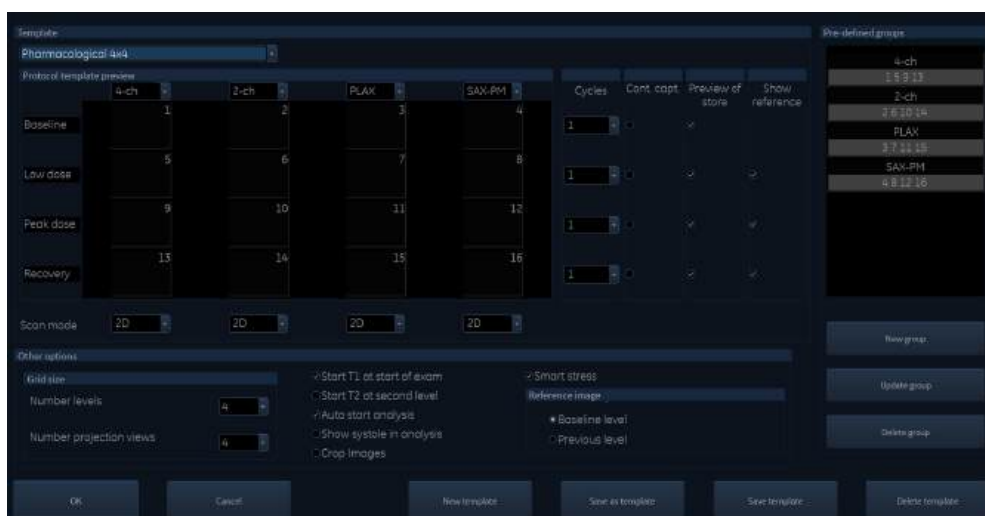


Figure 7-12. The Template editor screen

Editing/Creating a template

Selecting a base template to edit

1. From the *Template* drop-down menu on the upper left corner of the *Template editor* screen select a base template to edit.

NOTE: *Determine the required number of projections and levels you need and select the most appropriate foundation template.*

The selected template is displayed in the *Protocol template preview* field, showing the levels and projections and their labels.

Adding/deleting levels and projections

1. Enter the number of levels and projections in the *Grid size* field (see Figure 7-12).

The new grid size is displayed in the *Protocol template preview* field.

2. Press **New Template** to create a new template.

Or

Press **Save Template** to update the base template.

NOTE: *Factory templates cannot be changed.*

Scan mode selection

1. From the **Scan mode** drop-down menu, select a scan mode to be associated to the actual column (projection).

Display timer(s)

1. Check the box(es) to display timer(s) as specified (see Figure 7-12).

Start analysis automatically

1. Check **Auto start analysis** to display the Stress Echo Analysis screen when the last acquisition is performed.

Crop images

1. Check **Crop images** to enable display cropping of images recorded as part of the protocol.
Cropping can be turned off for individual cells of the protocol acquisition by using the **Crop**.

Smart stress

Check **Smart stress** to store a subset of the image acquisition settings (e.g. geometry, zoom, gain, compress, reject, power...etc) for each view in the protocol. Smart Stress enables to set image acquisition settings for each view at baseline level and automatically get the same image settings in the corresponding views in the next levels. If you want to use Smart stress in Continuous capture, you need to use the arrow buttons to indicate to the system when you are switching views.

Assigning new labels to levels and projections

1. Select a label from the *Label* drop-down menu or type a new label.

Configuring levels

The following options can be set up for each level:

Number of cycles to be stored in the cineloop

1. Enter the desired number in the *Cycles* field.

Up to four cycles/cineloop can be stored.

NOTE: Even if you store more than one cycle, while in analysis of the Stress echo images the system will by default only display the last cycle.

Continuous capture

1. Check **Continuous capture** if continuous image acquisition throughout the level is desired.

When Continuous capture is selected, preview of cineloop and reference display (see below) during acquisition are not possible.

Preview of store

1. Check **Preview of store** if review and adjustment of cineloops before storage is desired.

Show reference

1. Check **Show reference** if the display of the corresponding reference loop is desired during acquisition (dual screen mode).

Adding a group

1. In the *Protocol template preview* field select the cells to be part of the group.
2. In the *Pre-defined group* field, press **New group**.
A dialogue box is displayed asking the user to enter a name for the new group.
3. Enter the group name.
4. Press **OK**.

The new group is displayed in the *Pre-defined group* field.

Updating an existing group

1. In the *Pre-defined group* field, select the group to edit.
2. Either select (a) new cell(s) to add to the group or deselect (an) existing cell(s) to remove from the group.
3. Press **Update group** in the *Pre-defined group* field.
The display in the *Protocol template preview* field is updated accordingly.

Deleting a group

1. In the *Pre-defined group* field, select the group to delete.
2. Press **Delete group**.
The group is removed from the list in the *Pre-defined group* field.

Configuration

Introduction

Each application can have a default stress protocol defined.

- Select a probe and an application.
- Press **Config** on the Shortcut Bar and log on if required.
- Select **Imaging/Application**.
- In the *Application* sheet, select the desired stress protocol in the *Templates and Packages* field.

Chapter 8

Measurements and analysis

This chapter describes:

‘Assign and Measure modality’ on page 8-7

‘Measure and Assign modality’ on page 8-9

‘Measurements on protocol images’ on page 8-12

‘AI Auto Measure - Spectrum Recognition’ on page 8-13

‘Advanced cardiac measurements and analysis’ on page 8-18

‘4D/Multi-plane LV measurements and analysis’ on page 8-145

‘4D Auto MVQ’ on page 8-166

‘4D Auto AVQ (option)’ on page 8-177

‘Advanced vascular measurements and analysis’ on page 8-182

‘Pediatrics Calculations’ on page 8-191

'OB measurements and calculations' on page 8-196

'Measurement package configuration' on page 8-202

'Measurement result table' on page 8-235

'Worksheet' on page 8-236

'Measurement accuracy' on page 8-238.

Introduction

The ultrasound unit provides functionality for two measurement conventions:

- **Assign and Measure:** the user activates the **Measure** mode, selects and then performs a pre-labeled measurement.
 - The user is guided through the study: an auto-sequence functionality automatically selects the next measurement in a study.
 - The selected measurement is highlighted in the *Measurement* menu.
 - The performed measurement is indicated in the *Measurement* menu.

The studies and their parameters are user-configurable. The user can create its own studies containing the relevant measurements (see page 8-202).

- **Measure and Assign:** the user activates the **Measure** mode, then selects and performs a generic measurement. After completion, the user assigns a label to the measurement.

NOTE: *The system supports storing and recalling the measurements performed in an exam.*



CAUTION

Only assigned measurements are saved when ending the examination.

After doing measurements, the system automatically makes the calculations related to the measurements performed. Measurements and calculations are displayed in the *Measurements result* table (see page 8-235).

Assigned measurements and calculations are automatically gathered into a Worksheet and used to populate the patient report.

General recommendations about measurements

- When doing time-measurements in Doppler or M-Mode, it is recommended to freeze the 2D image during acquisition.
- Distance and area measurements should be done on greyscale 2D images or slice mode images if in 4D, not on color flow or TVI-based images. Similarly, in M-Mode, distance measurements should be done on greyscale M-mode images and not on color M-mode images. If doing Color M-Mode measurements of propagation of flow, please refer to your specific laboratory protocols.



WARNING

The X-Ray U/S coalignment may fail.

About Measurement results display

Be aware of the following:

- Measurement results display

By default the system always displays absolute values for parameters measured in Doppler. This means that values from above and below baseline will all be displayed as positive results.

For Cardiac this behavior cannot be changed. For non-Cardiac the Absolute Value setting can be turned off in **Config -> Meas/Text -> Advanced**, by setting the attribute **Absolute Value to Off**.

- Calculated parameters

For calculated parameters the system uses signed values in calculation formulas, and displays the absolute value of the result.

- When a parameter is measured several times the individual values for the parameter will be listed in the m1, m2... columns in the worksheet. The *Value* column in the worksheet will contain a derived value for the parameter, e.g. the average of the individual values (Figure 8-1).

When calculating formula derived parameters, the m1, m2... columns in the worksheet contain calculated values based on the individual input parameter values in the same column (Figure 8-1). The *Value* column contains calculated values based on the input parameter values in the *Value* column.

About Measurement results display (continued)

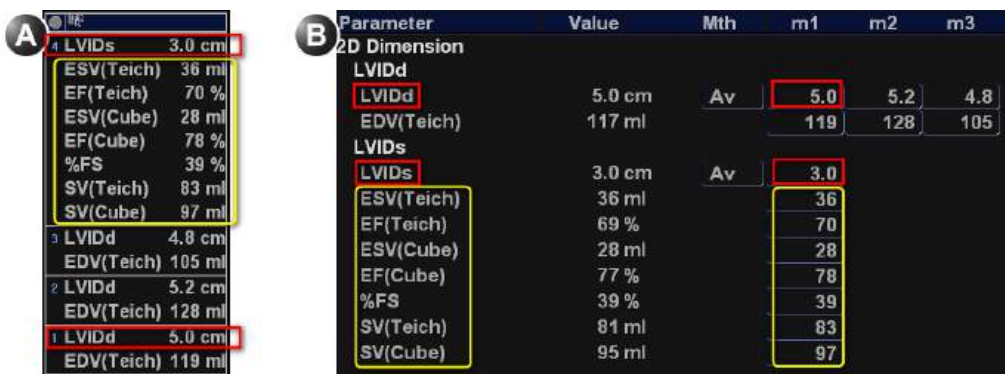


Figure 8-1. Measurement result window (A) and Worksheet (B)

The *Measurement result* window always displays values from the m1, m2... columns. It is therefore recommended to consult the worksheet to get an overview of measured and calculated parameters.

Assign and Measure modality

Overview



Figure 8-2. Example of a measurement study

1. Press **Measure** on the shortcut panel or control panel.

The *Measurement* menu is displayed, showing the measurement category for the current application (Figure 8-2).

To change Measurement category:

1. Select the heading in the *Measurement* menu and choose another category.

Overview (continued)

To perform measurements from a study:

1. Select the study (folder) in the *Measurement* menu.
The study folder is opened and the first measurement is selected.
2. Perform the measurement. Follow the instructions displayed on screen.

Make sure to follow the current medical practices when placing the specific points on the image.

If the folder is configured with auto-sequence measurement (see page 8-204), the next measurement in the study is pre-selected. To skip a pre-selected measurement, select another measurement.

Completed measurements are marked with a check mark.

Measure and Assign modality

Measurement Tool

1. Press **Measure** and select the measurement tool in the *Generic* folder in *Measurement* menu, for example: Caliper.



Figure 8-3. Measurement tools

2. Perform the measurement.
Make sure to follow the current medical practices when placing the specific points on the image.
3. To assign a label, select the measurement in the *Measurement result* table and select the required label.

Measurement Tool (continued)

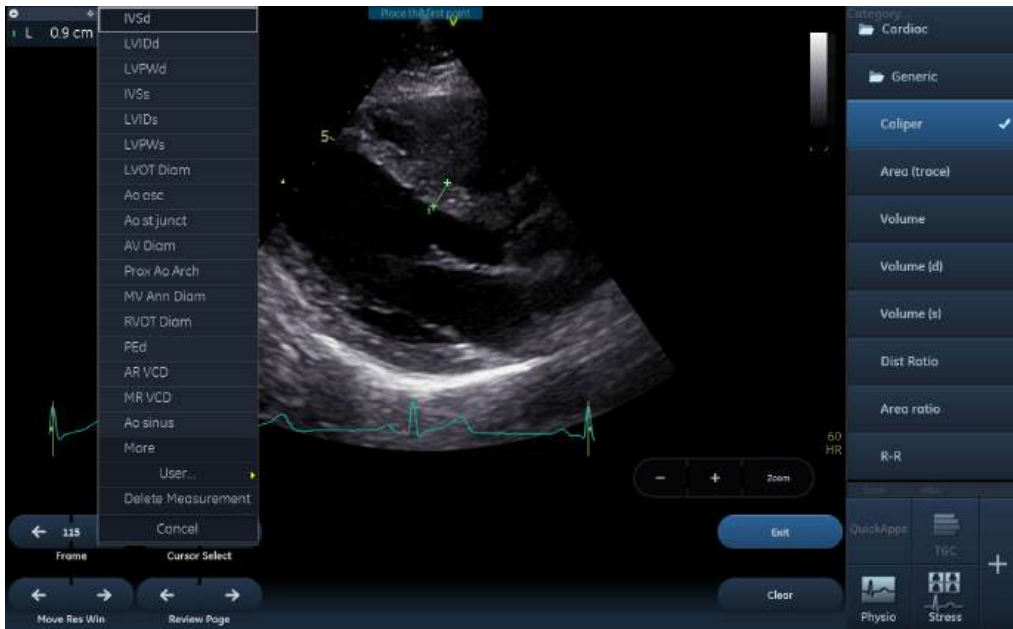


Figure 8-4. Assigning a label

Measurements on volume renderings

Distance and area measurements can be done on 4D volume renderings from a 4D acquisition.

1. Perform a distance or area measurement on a 4D acquisition by selecting either **Caliper (Crop plane)** or **Area (Crop plane)** measurement tool.



When measuring on a volume rendering, the measurement is actually performed on the displayed crop plane and the depth information is NOT taken into account.

Be aware that the Gain adjustment (2D and 4D Gain) may impact the display of the anatomical structures to measure.

Measurements on protocol images

When performing measurements on images acquired in a protocol, the measurement results will be associated with the protocol level of the image. Average values will be calculated for each protocol level.

For example you may measure LVOT Diam for images acquired outside protocol and for images on each level of an Exercise 2x4 protocol, leading to the following results in worksheet:

Parameter	Value	Method	m1	m2
LVOT Diam	1.0 cm	Average	1.1	0.9
LVOT Diam, Rest	1.1 cm	Average	1.0	1.2
LVOT Diam, Peak	1.2 cm	Average	1.2	



Measurement results associated with a stress level will not be updated if the image is moved to another stress level at a later time. Images should be correctly placed in the protocol before performing measurements.

AI Auto Measure - Spectrum Recognition

Introduction

AI Auto Measure - Spectrum Recognition provides semi-automatic AI based navigation through the Doppler part of the Measure menu. This workflow feature is activated by the **Freeze** button or the **Measure** button, depending on the configuration, when a Doppler spectrum is active on screen.

When a given class is recognized, and an associated measurement is enabled, this measurement will be invoked. If the measurement has associated Cardiac Auto Doppler functionality, this will be activated automatically, and tracing or points will be visible. If the default measurement is enabled but does not have an associated Cardiac Auto Doppler functionality, the appropriate folder will open.

The algorithm predicts the appropriate measurement for the spectrum based on a baseline shift up/down and the cursor location. If the default measurement is not enabled (in **Config>Meas/Text**), a supplementary measurement will, where available, be performed. A list of supported measurements is provided in Table 8-1.

NOTE: *AI Auto Measure - Spectrum Recognition does not perform any measurements, it only sends a command for the system to initiate a specific measurement. The measurement itself is either performed by Cardiac Auto Doppler (see 'Cardiac Auto Doppler' on page 8-130) or manually.*

Table 8-1: Supported measurements and classes

Network Class	Spectrum Class**	Default measurements	Additional measurements
Aortic Valve	Aortic Regurgitation (AR)***	AR Pressure Half time	AR Trace, AR Vmax
	Aortic Valve Outflow (AVO)	*AV Trace	*AV Vmax
	Aortic undecided (ARAVO)	None. Aortic folder opened. User has to select.	
	Left Ventricle Outflow Tract (LVOT)	*LVOT Trace	*LVOT Vmax

Table 8-1: Supported measurements and classes

Network Class	Spectrum Class**	Default measurements	Additional measurements
Mitral Valve	Mitral Regurgitation (MR)***	MR Trace	MR Vmax, MR dP/dT
	Mitral Valve Inflow (MVI) Trace	*MV Trace	
	Mitral undecided (MRMvtrace)	None.Mitral folder opened. User has to select.	
	Mitral Valve Inflow (MVI) Velocity	*MV E/A Velocity	MV E/A Ratio, MV E Vel, MV A Vel, MV DecT
Pulmonary Valve	Pulmonary Regurgitation (PR)***	PRend, Vmax	RAP
	Pulmonary Outflow (PVO)	*PV Trace	*PV Vmax
	Pulmonary undecided (PRPVO)	None.Pulmonary folder opened. User has to select.	
	Right Ventricle Outflow Tract (RVOT)	*RVOT Trace	*RVOT Vmax
Tricuspid Valve	Tricuspid Regurgitation (TR)***	*TR Vmax	TR Trace, TR dP/dT
	Tricuspid Valve Inflow (TVI) Velocity	TV E/A Vel	TV E Vel, TV A Vel, TV DecT
Pulmonary Vein	Pulmonary Vein (P Vein)	P Vein S	P Vein D, P Vein A, P Vein A Dur
Tissue Doppler	Lateral Wall - Left Ventricle	*LV E'	*E'
	Septal Wall	*Sep E'	*E'
	Lateral Wall - Right Ventricle	*RV S	
* Cardiac Auto Doppler - supported measurements (see 'Cardiac Auto Doppler' on page 8-130) ** AI Auto Measure - Spectrum Recognition - supported classes *** These labels refer to the intention to measure regurgitation through the given valve, however this does not imply the presence of regurgitation and thus does not correspond to a diagnosis.			

Introduction (continued)

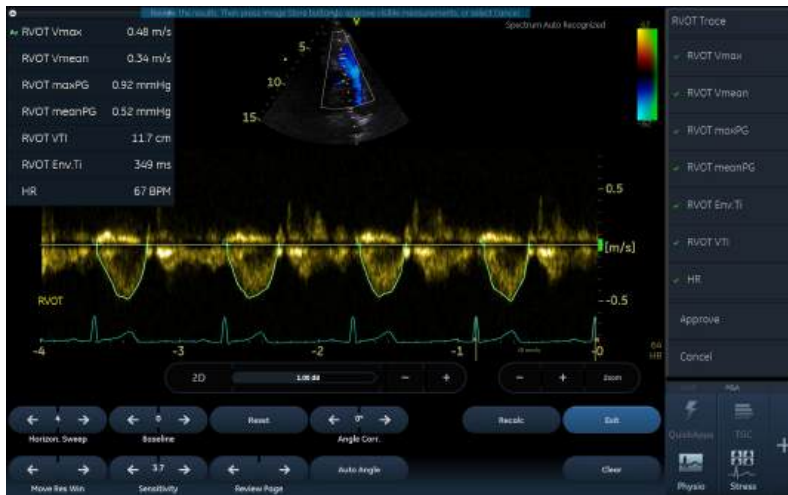


Figure 8-5. AI Auto Measure - Spectrum Recognition

The AI Auto Measure – Spectrum Recognition algorithm was trained, verified and validated on adult cardiac images. Algorithm was able to provide a classification in 93 % of cases and had accuracy of 98 % for the cases where classification was provided. The algorithm for AI Auto Measure - Spectrum Recognition will only consider the complete visible cardiac cycles on display when **Freeze/Measure** is pressed. Cycles that are incomplete or not visible will not be considered. Measurements for individual cycles can be excluded/approved on a cycle-by-cycle basis by hovering mouse pointer over each cycle, see 'Review and Approve' on [page 8-133](#).



WARNING

AI Auto Measure - Spectrum Recognition uses AI based computer algorithms to determine the spectrum type. There is an inherent risk that these algorithms may sometimes give suboptimal or incorrect results. Verify that semi-automatically selected measurements are appropriate for the displayed spectrum type before approving the measurements.

Configuration for AI Auto Measure - Spectrum Recognition

1. Go to **Config** and select the **Meas/Text** tab.
2. Select **Advanced**.
3. In the drop-down options of the M&A category, select **Cardiac**.
4. Set *Automated Doppler Measurements* to *On*.
5. Set *AI Auto Measure - Spectrum Recognition* to *On*.

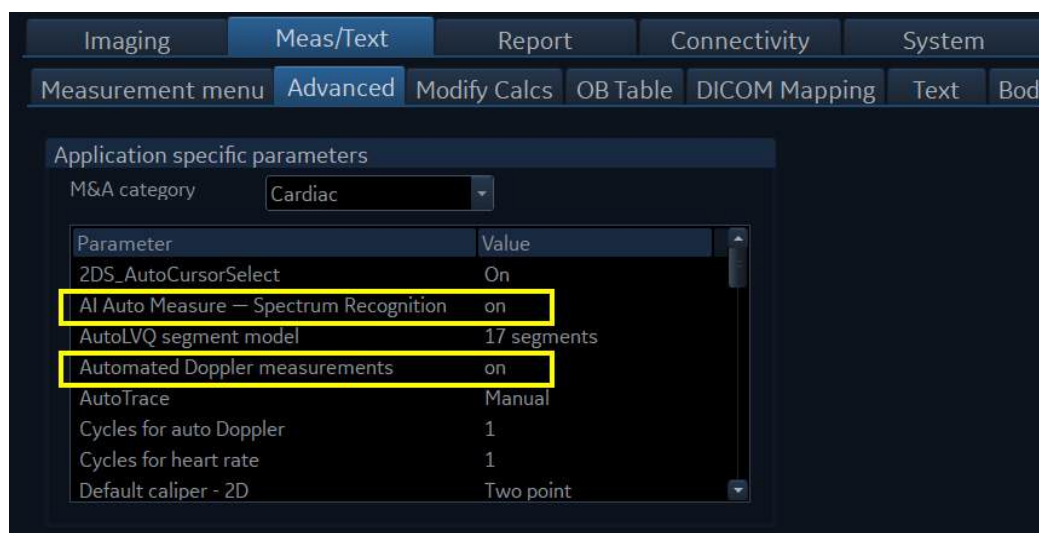


Figure 8-6. Enabling AI Auto Measure - Spectrum Recognition and Automated Doppler Measurements

Configuration for AI Auto Measure - Spectrum Recognition (continued)

6. Set *Start M&A on freeze PW* to *On*.

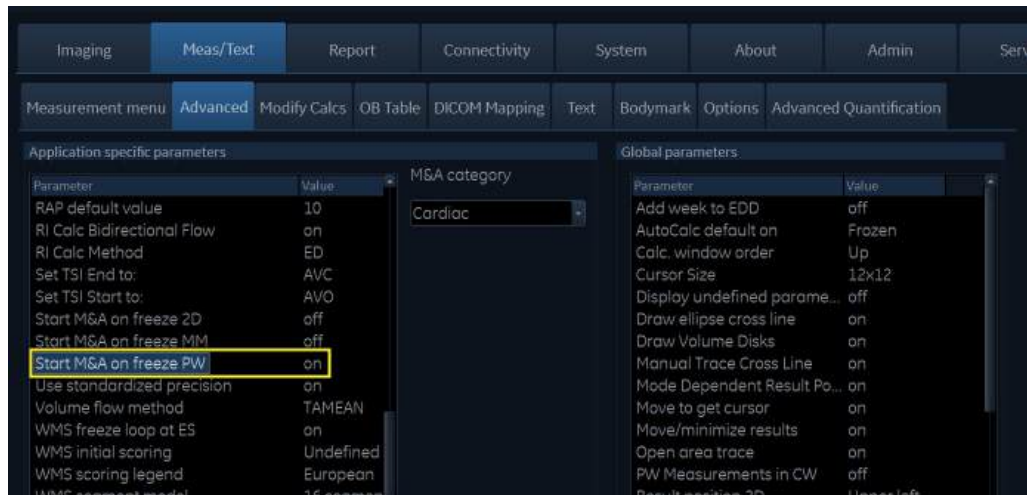


Figure 8-7. Enabling Start M&A on freeze PW

If *Start M&A on freeze PW* is set to *Off* when pressing **Freeze**, the preferred complete cycles must be on screen before pressing **Measure**.

Restrictions for AI Auto Measure - Spectrum Recognition

AI Auto Measure - Spectrum Recognition is only available under the M&A category *Cardiac* for Doppler Spectrums acquired with cardiac Adult TTE probes. Spectrum type with no associated auto measurements will open the measure menu at the suitable location for manual measurements. A list of supported spectrum classes is provided in Table 8-1.

Advanced cardiac measurements and analysis

Naming Format for Cardiac Measurements

When you make a measurement, you will select the abbreviation for the measurement. Most abbreviations are made using acronyms. The following table lists acronyms used for naming cardiac measurements.

Table 8-2: Cardiology Abbreviations

Acronym	Name
% STIVS	% Interventricular Shortening
A	Area
Acc	Acceleration
AccT	Flow Acceleration Time
ALS	Aortic Leaflet Separation
Ann	Annulus
Ao	Aorta
AR	Aortic Regurg
Asc	Ascending
ASD	Atrial Septal Defect
AV	Aortic Valve
AV Cusp	Aortic Valve Cusp Separation
AVA	Aortic Valve Area
AV-A	Aortic Valve Area by Continuity Equation
BSA	Body Surface Area
CI	Cardiac Index
CO	Cardiac Output
d	Diastolic

Table 8-2: Cardiology Abbreviations (Continued)

Acronym	Name
D	Diameter
Dec	Deceleration
DecT	Deceleration Time
Desc	Descending
Dur	Duration
EdV	End Diastolic Volume
EF	Ejection Fraction
EPSS	E-Point-to-Septum Separation
EsV	End Systolic Volume
ET	Ejection Time
FS	Fractional Shortening
FV	Flow Volume
FVI	Flow Velocity Integral
HR	Heart Rate
IVRT	IsoVolumetric Relaxation Time
IVS	Interventricular Septum
L	Length
LA	Left Atrium
LAA	Left Atrium Area
LAD	Left Atrium Diameter
LPA	Left Pulmonary Artery
LV	Left Ventricle
LVA	Left Ventricular Area
LVID	Left Ventricle Internal Diameter
LVL	Left Ventricle Length
LVM	Left Ventricular Mass
LVPW	Left Ventricle Posterior Wall
ML	Medial to Lateral
MPA	Main Pulmonary Artery
MR	Mitral Regurgitation

Table 8-2: Cardiology Abbreviations (Continued)

Acronym	Name
MV	Mitral Valve
MVcf	Mean Velocity Circumferential Fiber Shortening
MVO	Mitral Valve Orifice
OT	Outflow Tract
P	Papillary Muscles
PA	Pulmonary Artery
PAP	Pulmonary Artery Pressure
PDA	Patent Ductus Arteriosis
PEP	Pre-Ejection Period
PFO	Patent Foramen Ovale
PG	Pressure Gradient
PHT	Pressure Half Time
PI	Pulmonary Insufficiency
PISA	Proximal Isovelocity Surface Area
PR	Pulmonic Regurgitation
PV	Pulmonic Valve
PV-A	Pulmonic Valve Area by Continuity Equation
PVein	Pulmonary Vein
PW	Posterior Wall
Qp	Pulmonic Flow or CO
Qs	Systemic Flow or CO
RA	Right Atrium
RAA	Right Atrium Area
Rad	Radius
RAD	Right Atrium Diameter
RPA	Right Pulmonary Artery
RV	Right Ventricle
RVA	Right Ventricle Area
RVAW	Right Ventricle Anterior Wall
RVD	Right Ventricle Diameter

Table 8-2: Cardiology Abbreviations (Continued)

Acronym	Name
RVID	Right Ventricle Internal Diameter
RVL	Right Ventricle Length
RVOT	Right Ventricle Outflow Tract
s	Systolic
SI	Stroke Index
ST	Shortening
SV	Stroke Volume
SVI	Stroke Volume Index
T	Time
TA	Tricuspid Annulus
TAML	Tricuspid Annulus Medial to Lateral
TR	Tricuspid Regurgitation
TV	Tricuspid Valve
TVA	Tricuspid Valve Area
Vcf	Velocity Circumferential Fiber Shortening
Vel	Velocity
VET	Valve Ejection Time
Vmax	Maximum Velocity
Vmean	Mean Velocity
VSD	Ventricular Septal Defect
VTI	Velocity Time Integral

Event timing measurements

Event timing enables the time measurement for opening and closure of the Aortic and Mitral valves, as referred to the automatically detected QRS marker, which normally is on the rising slope of the R-wave.

Event timing can be performed on a Doppler spectrum or an M-Mode acquisition showing the corresponding valves. The procedure is similar in both modes. In addition event timing can be done on traces in Q Analysis. The measurements are shown as dashed lines in the *Analysis* window and *Anatomical M-Mode* window in Q Analysis.

The measurements can be used as default start and end times for TSI.

1. Generate the spectrum or M-Mode image to be measured.
2. Press **Freeze** to stop the cineloop.
3. Press **Measure** on the Shortcut Panel or control panel.
4. Select **Event Timing** in the *Measurement* menu.

The following event timing measurements are available (with the first measurement on the list selected):

- **AVO**: Aortic Valve Opening
- **AVC**: Aortic Valve Closure
- **MVO**: Mitral Valve Opening
- **MVC**: Mitral Valve Closure

5. Use trackpad to place the cursor to the corresponding point on the spectrum for the selected measurement.
6. Touch on the trackpad to anchor the point.

The event timing measurement (ms) is displayed in the *Measurement result* table.

When an event timing measurement is performed, the QRS markers are displayed on the ECG trace and correct QRS marker position should be verified before the Event Timing measurements are performed.

TSI Measurements

Introduction

TSI (Tissue Synchronization Imaging) calculates and color-codes the time from detected QRS to a detected event, typically the time to peak systolic velocity.

Each sample in the TSI image represents the time to the maximum velocity within the chosen TSI search interval from TSI Start to TSI End (page 5-31).

There are two automatic TSI time to peak measurement tools:

- **Generic TSI Time to peak measurement:** displays the TSI value at the location point set by the user.
- **Segmental TSI Time to peak measurement:** measures the time to peak velocity in specific wall segments and gets automatically calculated TSI indexes based on these measurements. The measurements may be presented in a color coded Bull's eye diagram.

Alternatively, time to peak measurement can be done in Q Analysis by manually measuring the time between the QRS marker and the peak velocity on the velocity trace.

Generic Time to peak measurement

1. Acquire a TSI apical loop.
2. Press **Measure**.
3. In the *Measurement* menu, select **Generic** and **Time to peak** (see Figure 8-8).

The TSI loop freezes at the TSI end frame.

4. Place a point in the middle of a basal or mid-level myocardial segment in the TSI image.

The Time to peak and Peak velocity values for the segment are displayed in the *Measurement result* window.

NOTE:

To judge the quality of your data at the measuring point in the 2D image the TSI trace may be used (see 'TSI trace' on page 8-25). See also the Caution text on page 8-29.

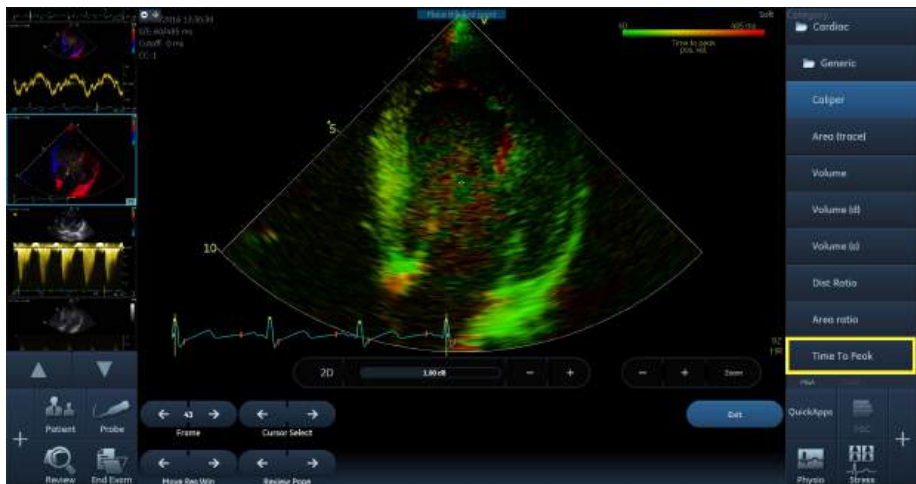
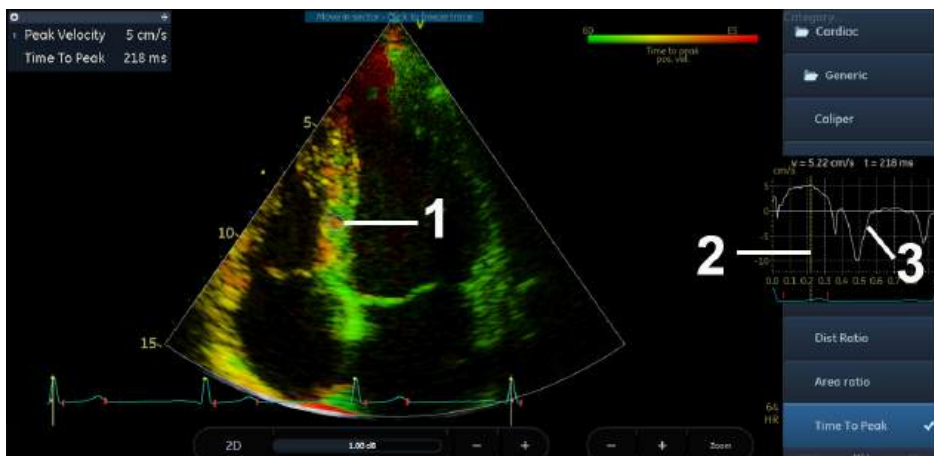


Figure 8-8. TSI Generic Time to peak measurement screen

TSI trace

The TSI Time to peak measurement can be verified and eventually manually changed from the TSI trace.

1. Double click on the measurement point.
The ROI and the corresponding TSI curve are displayed (see Figure 8-9).
2. Press **Set** to anchor the ROI and trace.
3. If required, select a new peak location in the trace.
4. Click in the acquisition window to exit the TSI trace.



1. TSI ROI
2. TSI trace
3. TSI Time to peak marker

Figure 8-9. TSI trace

Segment Time to peak measurements

1. Acquire TSI loops from all three apical views.
2. Press **Measure** and select the **TSI time** study.
The TSI loop freezes at the TSI end frame.
The first measurement in the study is automatically selected (see Figure 8-10).
3. Place a point in the middle of the corresponding segment in the TSI image.
The Time to peak value for the segment is displayed in the *Measurement result* window.
4. Perform a measurement for all basal and mid-level segments in all three apical views.
In addition to the Time to peak value for each segment, the following TSI indexes are calculated:
 - *Septal lateral delay*: difference in Time to peak velocity in the basal lateral wall and basal septum.
 - *Septal posterior delay*: difference in Time to peak velocity in the basal posterior wall and the basal antero-septum.
 - *Basal seg. max diff.*: difference between the maximum and minimum time to peak measurements in the six basal segments. Requires at least four of the six basal segment measurements.
 - *Basal standard deviation*: the standard deviation of the time to peak measurements in the six basal segments. Requires at least four of the six basal segment measurements.

Segment Time to peak measurements (continued)

- *All seg. max diff.:* difference between the maximum and minimum time to peak measurements in all the measured basal and mid level segments. Requires at least eight of the twelve segmental measurements.
- *All segments standard deviation:* the standard deviation of the time to peak measurements in all measured basal and mid level segments. Requires at least eight of the twelve segmental measurements.

The TSI indexes indicate degrees of asynchrony in time to peak velocity.

5. Select **TSI Bull's eye report** in the *Measurement* menu.

The measurements are displayed in a color coded bull's eye diagram together with a list of the calculated TSI indexes.

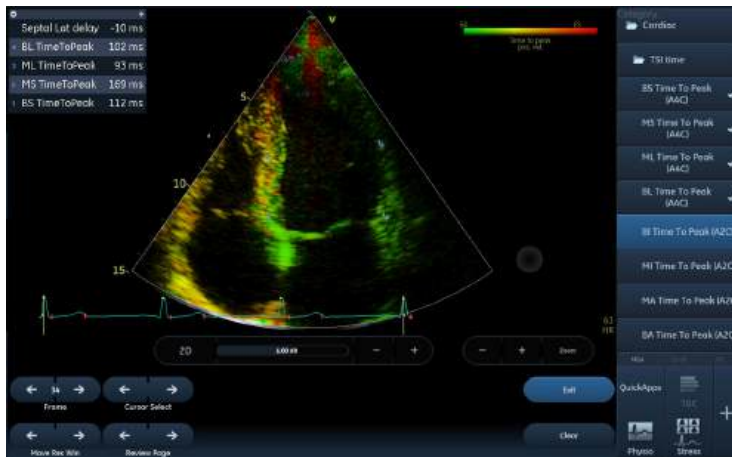


Figure 8-10. Segment Time to peak measurements screen

Time to peak measurement in Q Analysis

1. From a TSI apical loop, press **Q Analysis** on the side bar.
2. Place a sample area in a myocardial segment.
A velocity trace is displayed in the *Analysis* window (see Figure 8-11).
3. Press **Measure**.
4. In the *Measurement* menu, select **Generic** and **Time**.
5. In the *Analysis* window, measure the time from the yellow QRS marker to the peak velocity of the velocity trace.



1. Time measurement tool
2. Sample area
3. QRS marker
4. Time to peak measurement

Figure 8-11. Manual TSI Time to peak measurement in Q Analysis

NOTE: *It is possible to do a Generic or a Segment Time to peak measurement from within Q Analysis and compare the result with a manual Time to peak measurement.*

Time to peak measurement in Q Analysis (continued)



CAUTION

The Time to peak measurement in Q Analysis may differ from the TSI Time to peak measurements due to the following considerations:

- The TSI Time to peak measurements find the maximum velocity only within the TSI search interval. If the desired peak on the velocity trace is outside the TSI search interval, the TSI Time to peak measurements will return a different result than the manual Time to peak measurement.
- If the maximum velocity is at one of the ends of the TSI search interval, the TSI time to peak measurements return the time of the end of the TSI search interval. In some cases the falling flank of an iso-volumic contraction peak at the time of TSI Start or the rising flank of a post-systolic contraction peak at the time of TSI End may be detected. In a manual measurement the time to a peak within the TSI search interval with a lower velocity than the velocity at the end of the interval may be measured instead. The color map *TSI Trace* may be used to identify regions in the image where the peak detection is near the ends of the TSI search interval. The TSI Trace tool should be used to verify TSI measurements in the identified regions.
- If there are two or more peaks of comparable velocity within the TSI search interval, or a poor signal quality, the TSI Time to peak measurements may return the time to a different peak than what a manual method would do. Typically in these situations, the TSI image will show a wide range of colors over a small spatial region.

Automated Function Imaging(AFI)

Automated Function Imaging (AFI) is a decision support tool for global and regional assessment of the systolic function of the left ventricle (LV), right ventricle (RV), and left atrium (LA). AFI calculates the myocardial tissue deformation based on feature tracking on 2D grey scale loops.

Content in this section:

- 'AFI on the Left Ventricle(AFI 3.0, Easy AFI LV)' on *page 8-31*
- 'AFI on the Right Ventricle(RV)' on *page 8-74*
- 'AFI on the Left Atrium' on *page 8-96*

AFI on the Left Ventricle (AFI 3.0, Easy AFI LV)

AFI is performed on the standard TTE apical views, apical long-axis (APLAX), 4-chamber (A4CH) and 2-chamber (A2CH), as well as on the standard mid-esophageal views acquired with a TEE probe.

Before starting AFI on the LV

- [‘Data Requirements’ on page 8-32](#)
- [‘Views’ on page 8-32](#)
- [‘Recommended Probes’ on page 8-33](#)
- [‘Image Characteristics’ on page 8-33](#)
- [‘Acquisition’ on page 8-34](#)
- [‘Sequential acquisition’ on page 8-34](#)
- [‘Enabling/Disabling automatic TTE view recognition’ on page 8-35](#)
- [‘Heart rate and cycles’ on page 8-36](#)
- [‘Configuring the tool’ on page 8-36](#)
- [‘Configurable workflow controls’ on page 8-37](#)
- [‘Configurable analysis settings’ on page 8-38](#)
- [‘Strain reference layer’ on page 8-39](#)

Data Requirements

Data types

All AFI analyses are available on raw data, which also is the recommended data format for all AFI processing.

Analysis on multi-frame DICOM files is only possible for AFI on LV. The DICOM files must have a calibration region.

One click workflow (available with Easy AFI LV option only) is only available for AFI LV analysis on Adult TTE raw data images.

When running AFI on DICOM multiframe data, it is advised to optimize the acquisition to provide well visible speckle patterns in the tissue.

Views

Automated Function Imaging of the Left Ventricle can be performed on one or three of the standard views.

If a complete analysis of all three views is performed, the result is presented as a Bull's Eye display showing color-coded and numerical values for peak systolic longitudinal strain, PSS (Peak Systolic Strain), TTP (Time To Peak global longitudinal strain) and traces.

If the analysis of one view alone is performed, the result is presented as a *Quad* layout, with two screens to evaluate the ROI and tracking, a strain curves graph and a Color Anatomical M-Mode (CMM).

Recommended Probes

Table 8-3: Recommended probes - AFI on LV

Application	Probes
Cardiac	6VT-D, 6Tc-RS, M5Sc-RS, 3Sc-RS
Pediatric	6S-RS, 12S-RS, 9T-RS

NOTE: *AFI 3.0 is only recommended for the probes in Table 8-3. Easy AFI LV is only available for adult TTE. The measurement accuracies of the longitudinal strain values reported in 'Measurement accuracy' on page 8-238 are verified with these probes.*



CAUTION

AFI LV is only recommended for the probes in Table 8-3. The measurement accuracies of the longitudinal strain values reported in 'Measurement accuracy' on page 8-238 are verified with these probes.

Image Characteristics

- A frame rate higher than 40 frames per second is recommended. Lower frame rates are accepted by the tool (37 fps for raw data and 30 fps for DICOM). Higher frame rates will benefit the workflow by making it easier to achieve satisfactory speckle tracking. A higher frame rate is recommended for high heart rates.
- The entire myocardium should be visible.
- A depth range that includes the entire heart chamber of interest (LV) should be used.
- Acquisitions must be made without the use of contrast agents.

Acquisition

Create an exam, connect the ECG device and make sure to obtain a stable ECG trace.

The apical views may be acquired sequentially in 2D mode, or simultaneously in Tri-plane mode.

Sequential acquisition

Acquire 2D grey scale cineloops of an APLAX, 4CH and 2CH view.

NOTE: *It is recommended to acquire all three apical views sequentially to get similar heart rate in all views.*

If TTE view recognition is enabled during the acquisition and the views are successfully recognized by the AI, the detected view label is saved in the file during Image Store.

Enabling/Disabling automatic TTE view recognition

Automatic view recognition is enabled by default for TTE acquisition. Uncheck the **Enable View Recognition** check-box to disable automatic view recognition (press **Config**, select **Imaging** and then the **Global** tab), as illustrated in Figure 8-12. Similarly, check the **Enable View Recognition** check-box to enable automatic view recognition.

NOTE: Automatic view recognition is only supported for 2D TTE using adult Cardiac presets.

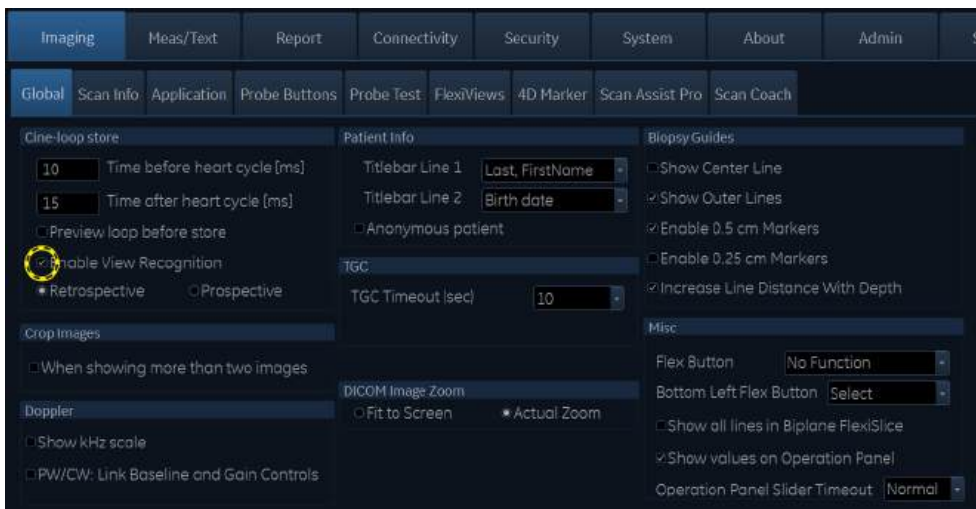


Figure 8-12. Artificial intelligence (AI)-based 2D view recognition

Heart rate and cycles

- Heart rate variability between the recordings should not exceed 30%.
- If the acquisition has more than one heart cycle, the analysis will by default be done on the second to last heart cycle.
- The system should be configured to store 100 ms before and after each heart cycle.

Configuring the tool

It is possible to configure some of the AFI controls and analysis settings.

To access the configuration menu, press **Config** on the shortcut bar, select the category **Meas/Text**, and the **Advanced Quantification** subgroup.

Select **AFI** to configure the AFI tool designed for analysis on the Left Ventricle.

Configurable workflow controls

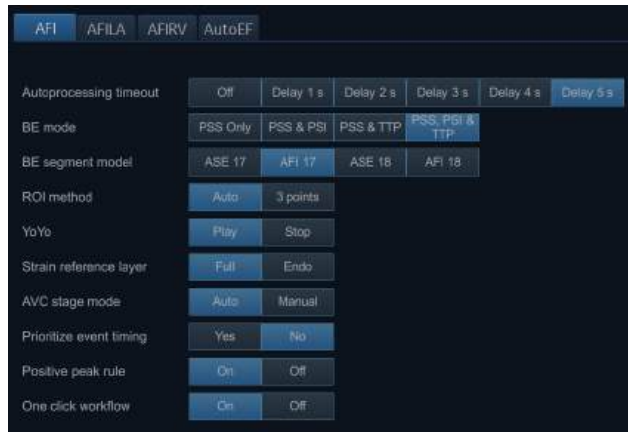


Figure 8-13. AFI configuration

- *Autoprocessing timeout* - The time the operator must keep the trackpad still before tracking automatically starts.
- *BE Mode* - Colormaps that shall be available for the Bull's Eye, refer to 'Bull's eye colormaps' on [page 8-67](#).
- *ROI Method* - Select fully automatic or 3-Click ROI as default tool.
- *YoYo* - When adjusting the ROI, select whether a limited number of frames around the selected ROI frame should be looped back and forth to ease ROI adjustment.
- *AVC Stage mode* - Select whether to always open the AVC Selection stage. If Auto is selected, upon analysis of the APLAX view, the user is taken to the Results stage after the ROI stage. "Auto" AVC or Event timing will be used by default. It will still be possible for the user to re-visit the AVC Selection stage to edit the chosen AVC.

Configurable workflow controls (continued)

- *Prioritize event timing* - Select Yes to use Event Timing values for AVC if there are some in the current exam. Meanwhile, AVC Stage mode is on *Auto*.
- *Positive Peak Rule* - If *On*, then a positive strain value will be shown if the maximum positive peak exceeds 30% of the maximum negative peak, resulting in a blue segment in the bull's eye. If *Off*, then the negative strain value will be shown regardless of the size of the positive peak.
- *One click workflow* (available with Easy AFI LV option only)- If *Off*, then processing stops for user input for each view. If *On*, then processing will attempt to proceed automatically through all views and present the user with the aggregated results of all views. One click workflow is only available for Adult TTE raw data images. If for some reason one click workflow is attempted but cannot be performed, the system will revert back to the manual step-by-step workflow.

Configurable analysis settings

- *BE Segment model* - Select the preferred Bull's Eye (BE) standard (ASE/AFI, 17/18 segment models).
- *Strain reference layer* - Select whether the strain values shall be calculated based on endocardial or full wall tracking.

Strain reference layer

The tool supports calculation of strain parameters based on either endocardial deformation or myocardial/full wall deformation.



CAUTION

Measurements based on endocardial and myocardial analysis are not comparable.

- Endocardial deformation is assessed by performing analysis of the endocardial part of the ROI trace. Measurements derived from endocardial deformation are suffixed Endo, such as for instance GPeakSysSL(Avg)_Endo
- Myocardial/full wall deformation is assessed by performing analysis of the whole ROI trace. Measurements derived from myocardial deformation are suffixed Full, such as for instance GPeakSysSL(Avg)_Full

NOTE: *If attempting to reprocess an analysis using a different reference layer a warning will be shown informing that the values in the analysis will change.*

Go back to the beginning, see: [‘AFI on the Left Ventricle\(AFI 3.0, Easy AFI LV\)’ on page 8-31](#)

Starting AFI on LV

- 'Starting AFI on raw data' on *page 8-41*
- 'Starting AFI on DICOM data' on *page 8-42*
- 'Navigating the tool' on *page 8-43*
- 'AFI on the APLAX view' on *page 8-45*
- 'AFI on A4CH and A2CH views' on *page 8-49*
- 'Tracking' on *page 8-51*
- 'ROI adjustment' on *page 8-52*
- 'General ROI remarks' on *page 8-53*
- 'To adjust the ROI' on *page 8-53*
- 'To create a new ROI' on *page 8-55*
- 'Guidelines for optimal ROI placing' on *page 8-57*
- 'Event timing' on *page 8-59*
- 'AVC timing adjustment (APLAX only)' on *page 8-60*
- 'Inspecting the results' on *page 8-61*
- 'Peak detection' on *page 8-62*
- 'Completed analysis results' on *page 8-65*
- 'Bull's eye standards' on *page 8-66*
- 'Bull's eye colormaps' on *page 8-67*
- 'Exiting AFI on LV' on *page 8-65*

Starting AFI on raw data

1. Open the exam for which you want to perform AFI analysis and select one of the apical images you would like to use for the analysis.
2. Press **Measure** on the shortcut bar and select the **AFI** study.

If the images are acquired with a transthoracic probe, the system will try to identify a triplet of apical views suitable for the analysis. If a triplet is identified, a message will be displayed in the lower part of the screen "AFI starting with images selected by AI" and the tool will start up in the *Define ROI stage* with one of the selected views. Or, if feasible and one click enabled, the tool will proceed to the results stage showing results from all the three views. The selected triplet is highlighted in the clipboard, with a thicker border around the current view being analyzed.

If the identification of a suitable triplet failed, or if the probe is a transesophageal probe, the tool will start up in the *Select View stage*.

NOTE: *Automatic identification of the suitable triplets is based on view recognitions stored in the files (during Image Store), clipboard location, frame rate and heart rate proximities. The View Recognition algorithm was trained, verified and validated on adult resting cardiac TTE images. Algorithm was able to provide a classification in 98 % of cases and for these cases had accuracy of 99 %.*

Starting AFI on DICOM data

1. Open an exam to perform the AFI analysis on and select the DICOM multi-frame image of a suitable apical view.
2. Press **Measure** on the shortcut bar and select the **AFI** study.

NOTE: *DICOM files do not usually provide the complete ECG trace as usable data. It is present on the image; and will be displayed as part of the image data. However, if the DICOM file contains R-wave information (DICOM tag 0018, 6060 "R Wave Time Vector"), the AFI tool will automatically detect cycles in a multicycle acquisition. See Figure 8-11 for an illustration of the ECG on AFI analysis of DICOM files with and without the DICOM tag. It is still possible to perform AFI on DICOM data without a defined "R Wave Time Vector", but a single cycle must be identified in the view stage of the tool. To do so, drag the vertical bars marking the cycle boundary on the ECG trace to frames that correspond to the cycle you wish to perform the analysis on.*



Figure 8-14. ECG representation in AFI when performed on DICOM data. If the required tag was found, cycle starts will be displayed as yellow dots on the ECG line.

Navigating the tool

If one click workflow is enabled (available with Easy AFI LV option only), the tool will proceed automatically to the result screen which shows the results for all views combined. However, by clicking on any view in the result screen (see), the tool will provide navigation as described in this section. One click operation is only available for AFI LV for Adult TTE raw data images.

Perform the analysis by following an on-screen guided workflow (see Figure 8-15).

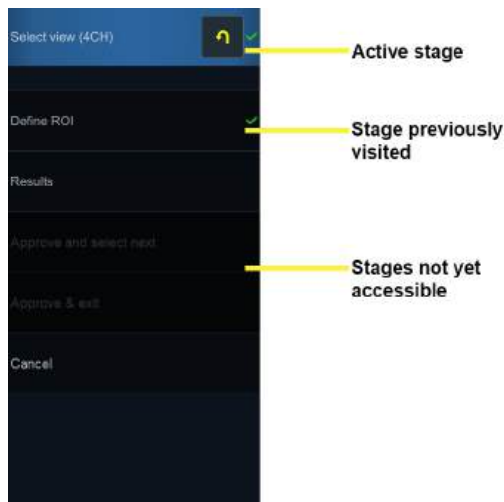


Figure 8-15. A typical AFI workflow menu

The *Workflow* menu (or stage menu) is located on the right side of the tool. It contains a set of stages the user should visit sequentially. It is possible to re-visit already viewed stages. Click on their title to navigate to any available stage. Stages that are not accessible given the tool's state are greyed out.

The stages of an AFI analysis on the left ventricle are:

- *Select View* - where the user indicates to the tool which view will be analyzed (skipped for images acquired with automatic TTE view recognition).
- *Define ROI* - where the user draws the ROI where speckle tracking will take place.
- *Set AVC (APLAX only)* - where the user defines the AVC time when processing the APLAX view.
- *Results* - where the user examines the results of the analysis.

Navigating the tool (continued)

Most stages require interaction with the user, and hints on what is expected are given on the operation panel (see Figure 8-16).

- If a stage is labeled , the stage is complete and nothing more needs to be done in that tool stage.
- Click the  (reset) button to reset the stage and clear all user-entered information in that stage.



Figure 8-16. AFI Workflow menu

When available, press **Approve and select next** to return to the *Select View* stage and perform the analysis for a new view.

When available, press **Approve & Exit** to approve the analysis and store the reviewed measurements to worksheet. See 'Measurements available after complete analysis' on *page 8-71* for the list of stored measurements after performing AFI of the LV.

At any time, click **Cancel** to exit the tool without saving any analysis.

AFI on the APLAX view

Automatically annotated TTE data

1. When in Define ROI stage:

Verify that the view annotation shown to the upper left of the screen is correct. If it is not, either:

- Click the **Select View** stage button to reannotate to the correct view and proceed analyzing that image.
- Click on an **APLAX** image in the clipboard. This will discard analysis of the current loop and replace it with the one selected from clipboard. The tool will start in the Select view stage where it should be annotated as APLAX.

Pay attention to the left/right orientation of the image by comparing the LV wall names with a visual inspection of the image. If the image orientation is wrong:

- go back to the *Select View* stage.
- press **Left-Right Flip**.
- verify the view by annotating it as *APLAX* again.

NOTE: *You may alternatively exit AFI, invert the image and start AFI again.*

2. An automatic ROI is generated when entering the Define ROI stage. The ROI may be edited by clicking and dragging on the endocardial and epicardial contours. See 'ROI adjustment' on page 8-83 for more information.

NOTE: *If AFI is performed on pediatric exams with 9T-RS/12S-RS or 6S-RS, the automatic ROI is disabled. See section about 3-click ROI in 'To create a new ROI' on page 8-55.*

Automatically annotated TTE data (continued)

3. When satisfied with the ROI, either stop moving the cursor and wait for automatic processing to start or click on the **Process** button, **Results** for A4CH/A2CH, or **Set AVC** for APLAX. Now the system performs feature tracking to get a temporal ROI trace. On completion, it proceeds to the next stage.
4. (APLAX only) After the ROI edit stage, the system enters the Set AVC stage. Select one of the AVC setting strategies to verify AVC time. See 'Event timing' on *page 8-90*. On completion, the AFI tool now proceeds to the Results stage.
5. The AFI tool is now displaying the *Results* stage in a *Quad layout*. Now the tracking quality must be inspected and verified. The tracked ROI is divided into segments. The tracking quality for each segment is automatically evaluated and applied to reject segments for which the tracking is assumed to be not reliable. Segments that have been rejected do not have values in the segmental result ROI to the lower left in the *Quad* view, but instead shows an X. The strain trace (upper right), Curved Anatomic M-mode section (lower right) and parametric overlay on the dynamic ROI (upper left) are disabled for rejected segments. By clicking on a segment in the segmental result ROI it is possible to override the automatic quality assessment to either show or hide segmental values. The tracking for each segment must be visually controlled and validated as described below.

Automatically annotated TTE data (continued)

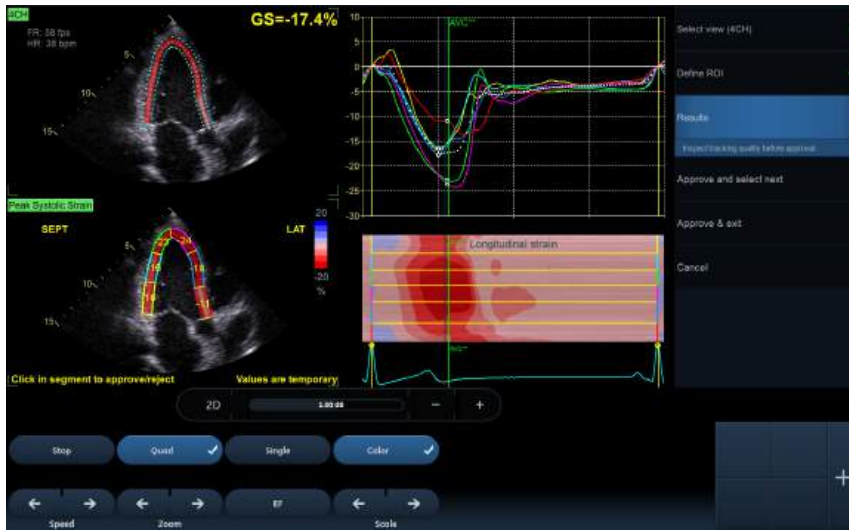


Figure 8-17. Results stage in Quad layout

Once the tracking quality has been controlled for all segments, you may choose to click:

- **Reprocess** - To completely reprocess the view currently being reviewed. This will take the user back to "Define ROI" stage of the workflow.
- **Approve and Select Next** - To proceed analyzing the next view in order to achieve a complete Bull's eye.
- **Approve and Exit** - To exit the tool and store performed measurements. No segmental strain results are stored in this case.

NOTE: *In case of a multi-cycle recording, the system automatically launches the second to last cycle for analysis. If during analysis, the operator wants to switch to another cycle, that is possible by entering the Select View stage and change cycle using the Cycle button. Also, the CineStart and CineEnd markers may be adjusted by clicking and dragging the markers on the ECG for precise edition of the selected cycle.*

TTE data without view recognition or TEE data

The workflow for data without view recognition is very similar to the workflow with view recognition. The differences are:

- The first stage when launching the tool, will be the *Select View* stage. The user should then:
 - Perform any Left-Right flip corrections.
 - Select Cycle and adjust Cine markers as appropriate.
 - Annotate the view by clicking one of the view labeling buttons (**A4CH**, **A2CH**, **APLAX**).
- When clicking **Approve and Select Next**, the tool will proceed to the *Select View* stage, and the operator has to manually select the next view to process from the clipboard.

NOTE: If AFI is performed on TEE exams, the automatic ROI is disabled. See section about 3-click ROI in 'Creating a new manual ROI' on page 8-55.

AFI on A4CH and A2CH views

The procedure for AFI on Apical 4-chamber and 2-chamber views is similar to the one used in the APLAX view.

TTE data acquired with View Recognition

Perform the steps 1, 2, 3, and 5 from the APLAX procedure, but make sure the view is correctly annotated as *A4CH/A2CH* and that wall names in the *ROI Adjustment* stage are as expected.

Perform the tracking validation (page 8-123) and, optionally, ROI adjustment (page 8-51) procedures.



If the APLAX view was not analyzed first, the strain values displayed in the Quad screen for the A4CH/A2CH are labeled temporary and may be different after APLAX have been analyzed. The reason for this is that for the A4CH and A2CH views, the AVC time is automatically set based on strain curve peaks (Auto mode). If the user, during APLAX analysis, selects to use Event Timing or manually sets the AVC time, the globally applied AVC time will become different, causing segmental results to change.



If AVC mode is set to Auto, the final value of AVC time is not available before all three views have been analyzed. Thus, strain values displayed in Quad screen of the two views analyzed first are labeled temporary. The reason for this is that the Auto-AVC calculation derived from all three views is most accurate and may be different from the intermediate AVC calculations used for each view.

EF by AFI

The AFI tool also provides EF values which fully correspond to the values provided by the dedicated AutoEF tool. In the AFI result screens, the green endocardial border corresponds to the contours used for the EF calculation. Thus, users should be reviewing correctness of these contours (and EF values displayed on screen) before approval. If further details on EF are needed, clicking the EF button will provide the same information as within the AutoEF tool.

NOTE: *If both A4CH and A2CH have been analyzed, the system also calculates biplane Simpson EF, SV, CO and volumes.*

NOTE: *The EF values (including volume values) provided by running the AFI tool will appear in the Worksheet, Report and in DicomSR in exactly the same way as EF values provided by running the dedicated AutoEF tool. If first AutoEF is performed and then AFI, there will be two instances of the EF values in the Worksheet.*

Tracking

The accuracy of the measurements provided by AFI rely on good tracking quality.



WARNING

Poor tracking quality may lead to incorrect measurement results. The tracking for each segment must be visually controlled and validated.

Poor tracking quality could result from a variety of causes. The most common causes for bad tracking are:

- Erroneous placement of the basal points when defining the ROI. If the basal points are placed too far from the annular region, the ROI segments at the annular base will not move together with the underlying 2D image throughout the entire heartbeat.
- Erroneous placement of the apex when defining the ROI. The point should be placed so that the resulting ROI covers mainly the myocardium. If the apex point is placed too high, the ROI will mainly cover the epicardium, resulting in poor tracking.
- Too narrow ROI width. Narrowing the ROI too much will result in poor tracking due to lack of tissue data in the ROI.
- Too much clutter. Images with too much static clutter will result in poor tracking.

Tracking (continued)

Inspect each segment and make sure that the center line is moving together with the underlying 2D image. Use the various results layouts to examine the tracking quality (e.g. Quad layout).

The following can help examining the tracking quality:

- Turn off the color overlay by clicking **Color** button.
- Reduce playback speed by using the **Speed** slider (or the rotary on the touch panel).
- Use the Single layout to get a larger view of the dynamic mesh (especially in difficult cases).

If the tracking needs to be improved for some segments, the user can modify the ROI or create a new ROI.

ROI adjustment

Automatic ROI based on AI segmentation (available with Easy AFI LV option only) is only available for adult TTE raw cardiac images and only when the appropriate options are enabled. This algorithm was trained, verified and validated on adult TTE cardiac raw data images. Accuracy of running with Automatic AI ROI is reported in 'Measurement accuracy' on page 8-238 as "accuracy w/o editing".

If the automatic ROI is not optimal (resulting in poor tracking), the user can either adjust the ROI or create a new ROI as described below.

General ROI remarks

The calculations performed on the tracked ROI aim to find the longitudinal deformation along the cardiac muscle from base to apex. For an AFI analysis on the Left Ventricle, these calculations assume the ventricle to have a horse-shoe shape.



If the ROI does not have a horse-shoe shape, the calculated measurements may not be accurate.

To adjust the ROI

The following adjustments can be done in the Define ROI stage:

- Adjust *ROI width* by clicking the **ROI Width** slider (or use the touch panel rotary).
- Click-and-drag (or click, move the mouse, click to release) on the endocardial part of the ROI. Endocardial editing edits the whole ROI (Figure 8-18, upper part).
- Click-and-drag (or click, move the mouse, click to release) the anchor points on the epicardial ROI (highlighted in red on mouse hovering). Epicardial editing edits the epicardial part only (Figure 8-18, lower part).

A pictogram in the upper right corner of the screen indicates the core feature of a good ROI for the current view the user is analyzing

To adjust the ROI (continued)

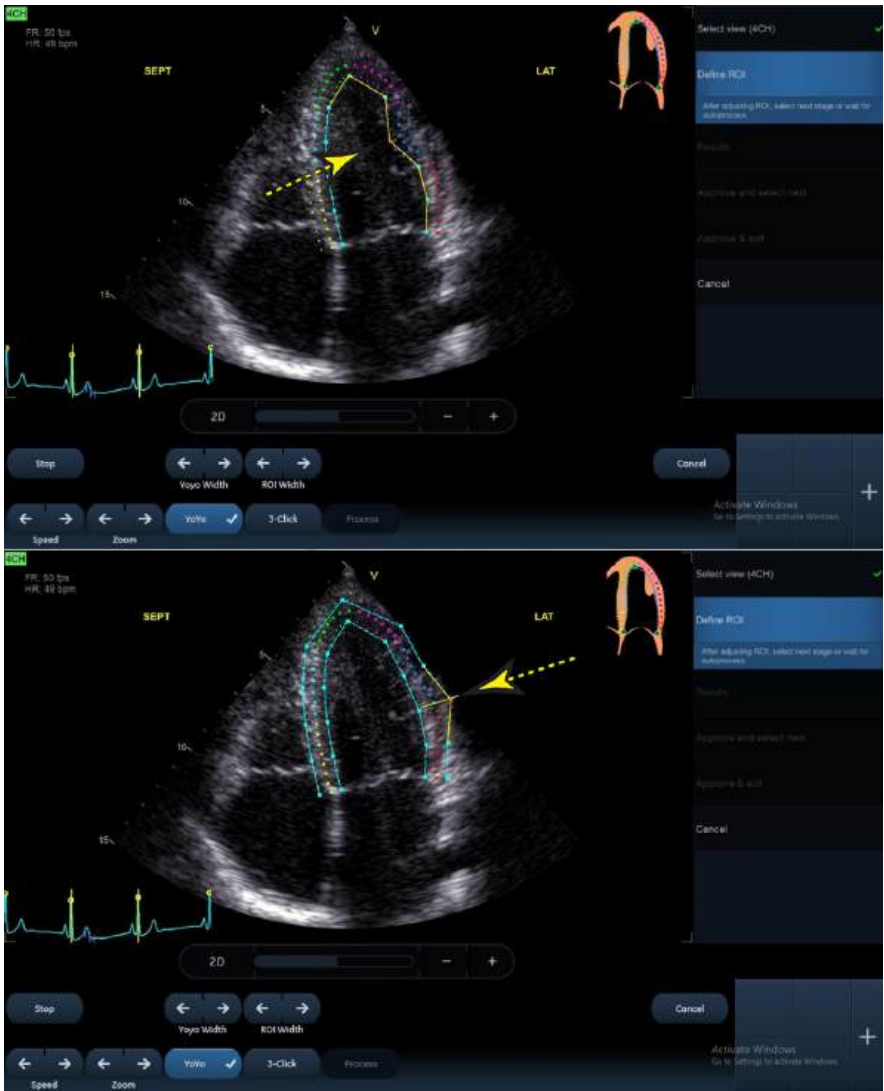


Figure 8-18. ROI Editing Options

To create a new ROI

Selecting the correct frame

The system automatically displays a frame where the endocardial border is usually visible. To use another frame, while in *Define ROI* stage, pause the playback by pressing **Stop**. Then, use the **Frame** slider to select a different frame for ROI definition.

Creating a new automatic ROI

To create a new automatic ROI, click the **Reset** stage symbol . This relaunches the automatic segmentation.

Creating a new manual ROI

Sometimes, the automatic ROI may fail to capture the correct ROI. In this case, a 3-Point ROI alternative is provided. To generate a ROI by this method, when in *Define ROI* stage, click on the **3-Click** button. The AFI tool will now prompt to place 3 landmarks. Take care to place the landmarks in the correct location according to the hints displayed close to the mouse pointer.

NOTE: *The 3-Point ROI is the default ROI method for TEE data and Pediatric exams with raw data.*

When the third landmark is placed, a ROI is generated and can optionally be edited as for the automatic ROI (Figure 8-19).

NOTE: *If the ROI needs to be adjusted, make sure to make the changes immediately after the ROI is displayed, before the auto processing of the ROI begins.*

NOTE: *Auto processing of the ROI will start after a given time delay that is configurable (from **Config**).*

NOTE: *The YoYo function is turned on to help find the correct location of the landmarks.*

Creating a new manual ROI (continued)

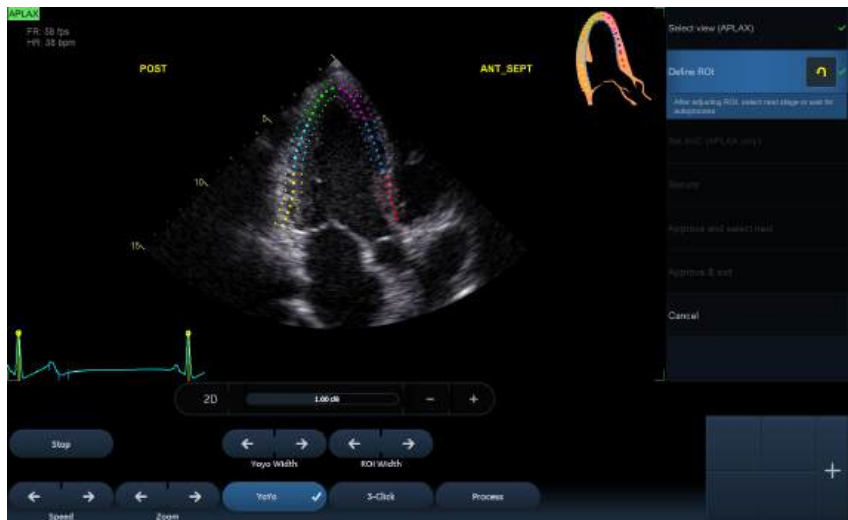
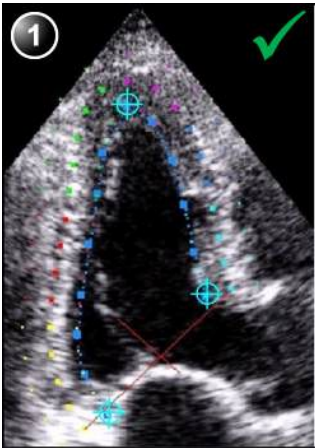
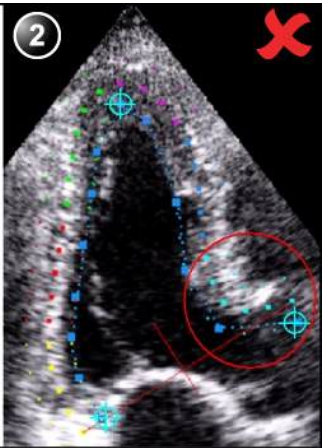
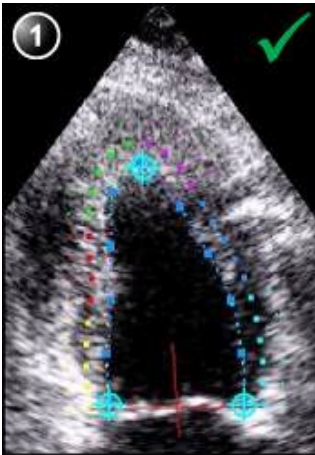


Figure 8-19. Defining a ROI

Guidelines for optimal ROI placing

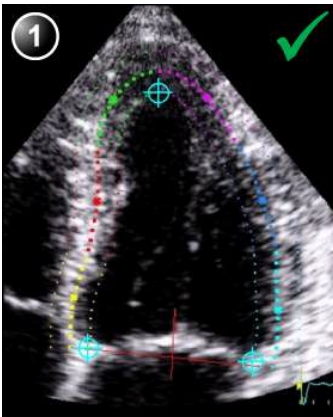
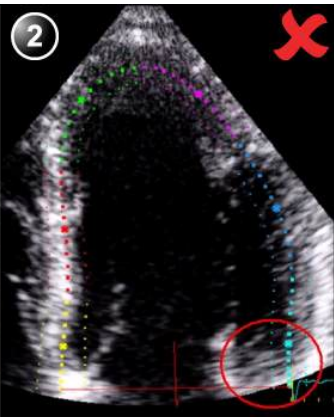
Correct ROI definition is crucial to get good tracking. By not following the ROI definition guidelines, the tool accuracy may be reduced. See use cases below for common pitfalls.

Tip: Make sure to follow the recommendations when placing the three points (see below).

Base	Correct	Wrong
1. Correct position of the base points. 2. The ROI extends into the aortic tract.	1  An echocardiogram image showing a correct base ROI. Three cyan crosshair markers are placed on the left ventricular wall. A dashed line connects the two lower markers, and a red 'X' is drawn over it, indicating that the ROI should not extend into the aortic tract. A green checkmark is in the top right corner.	2  An echocardiogram image showing an incorrect base ROI. The ROI extends into the aortic tract, which is circled in red. A red 'X' is in the top right corner.
Apex	Correct	Wrong
1. Correct position of the Apex point. 2. The apex point is placed too high. The ROI is extending beyond the epicardium.	1  An echocardiogram image showing a correct apex ROI. Three cyan crosshair markers are placed on the left ventricular wall. A dashed line connects the two lower markers, and a red 'X' is drawn over it, indicating that the ROI should not extend into the aortic tract. A green checkmark is in the top right corner.	2  An echocardiogram image showing an incorrect apex ROI. The apex point is placed too high, and the ROI extends beyond the epicardium. A red 'X' is in the top right corner.

Apex	Correct	Wrong
1. Correct position of the Apex point. 2. The upper right border of the ROI is way too much into the chamber cavity.	1	2

Bulges	Correct	Wrong
1. Correct ROI. 2. ROI should not be bulging or follow the papillary muscle. To edit the ROI, see 'ROI adjustment' on page 8-52.	1	2

General	Correct	Wrong
The left ventricle must be visible through the entire cycle. 1. End systole frame: the entire left ventricle is displayed. 2. End diastole frame: the annulus is not displayed.	 Figure 1: AFI frame showing the left ventricle fully visible. A green checkmark indicates this is the correct setup.	 Figure 2: AFI frame showing the left ventricle partially obscured. A red X indicates this is incorrect.

Event timing

Timing information may be crucial to accurate diagnosis. The most important event timing (Refer to 'Event timing measurements' on *page 8-22*) is the aortic valve closure (AVC), since it is part of the definition of the end systolic strain parameter.

Determination of the AVC timing by the system is as follows, depending on the situation

- If event timing is not available, an automatic AVC estimate is used, determined by the temporal contraction of all LV segments (Strain curves).
- From the APLAX view, the user can adjust the estimated AVC timing. The adjusted AVC timing will then be used in the other apical views when running AFI on these views.

AVC timing adjustment (APLAX only)

After tracking is performed, the system enters the Set AVC stage. The following options for AVC settings are provided:

- *Auto*: AVC is set automatically based on the ROI tracking using the time of peak negative strain.
- *Event timing*: AVC is taken from the event timing measurements.

NOTE: *This option is only available if the operator performed event timing measurement prior to running AFI, see page 8-18. If 'AVC stage mode' is configured to be automatic (see 'Configurable workflow controls' on page 8-37 for more information), this stage will be skipped and the tool will proceed to the Results stage.*

- *Manual*: Use the provided frame sliders and locate the AVC time manually before approving with the **Manual** button.

Inspecting the results

After completed tracking, the system displays the Quad screen layout for tracking validation and inspection of results for the currently processed view.

The screen contains the following result displays:

- **Tracked ROI:** A dynamic display of the tracked ROI to be used for tracking validation. The tracked ROI has a texture overlay indicating strain values according to the colormap. The overlay may be turned off/on by clicking the **Color** button.

NOTE: *Rejected segments will not have texture overlay.*

- **Segmental result ROI:** A static display indicating the peak strain value per segment. Rejected segments are displayed with an X instead of a value. Clicking a segment changes its rejection status (See 'Tracking' on page 8-51 for more information.)
- **Strain traces:** A static display indicating the segmental and global strain traces with time. The peak values are indicated.

NOTE: *The peak values can be adjusted by clicking and dragging the peak markers with the mouse.*



CAUTION

Segments and peak detection should be checked to make sure that non-physiological traces are excluded in the calculation of indices.

- **Curved anatomic M-mode:** A static display indicating a curved anatomic M-mode along the center of the ROI. The M-mode has a parametric overlay indicating peak strain values.

NOTE: *Rejected segments will not have texture overlay.*

NOTE: *The Segmental result ROI, Strain traces and Curved anatomic M-mode are using color codes to link the different segments.*

Peak detection

The peak systolic strain detection for each segment can be verified and manually adjusted as required. To adjust the peak detection:

1. Press **BE+Traces**. The *Bull's Eye and Traces* screen is displayed (see Figure 8-22).
2. To change the peak marker position on a curve:
 - Click on the peak marker (square point) on one of the curves, move the peak marker to a new position and click again to fix the point.
 - Place the cursor on a segment in the Bull's Eye. The corresponding curve is highlighted. Click on the segment to select the corresponding peak marker and move it to a new position.

The peak type is determined by the selected color map (systolic for PSS, global for PSI and TTP). The position of the AVC marker can also be checked in the Bull's Eye and Traces screen. If needed, the APLAX view should be reprocessed to change the AVC time.

When using one click workflow, several automatically processed elements should be inspected before approval. These items can be visually inspected from the result screen (see xxx).

Peak detection (continued)

What to inspect?	How to inspect?	How to edit if wrong?
View and wall names are correct	Check that the three looping B-mode images correspond to the respective view labels as visible in the top left corner of each image and the wall names as visible at each side of the ultrasound sector.	If view label is wrong: Double click on the B-mode which is not corresponding to the view label. Then click the Select View stage in the menu and select a new image from clipboard. If wall names are Left-Right flipped: Double click the relevant B-mode, then click Select View and Left-Right Flip .
Tracking is correct (and thus implicitly the ROI is correct)	For each of the three looping B-mode images, check that the tracked ROI corresponds to the underlying motion as visible in the B-mode. See XX for details on evaluating tracking.	Double click on the B-mode with bad tracking. Adjust the ROI. Then click Process or wait for auto process. If tracking of a segment cannot be improved by adjusting the ROI, click on the segment to reject it.
EF	Inspect the EF values as visible above the Bull's eye and to the right of 4CH and 2CH views and compare with the LV motion. Also inspect the green endocardial contours (which are used for the EF calculation). To inspect volume values and/or the EF ED/EF ES frames specifically, click Review Item - EF . This will provide the same information as when running the dedicated AutoEF tool.	If ED or ES frames are wrong, click the Review Item - EF button and edit the frames using the available controls as described for AutoEF. If the EF is wrong due to the tracking being wrong, follow the above process for fixing the tracking/ROI delineation.
AVC	Inspect the green AVC mark on ECG of the APLAX view and compare with aortic valve closure as visible in the B-mode. Use Speed, Zoom, Stop , and Frame controls if necessary.	If AVC is wrong, click the Edit AVC button visible on the APLAX view. Click Set AVC-Manual and position AVC at the correct time point according to the valve closure as visible in the image.

Peak detection (continued)

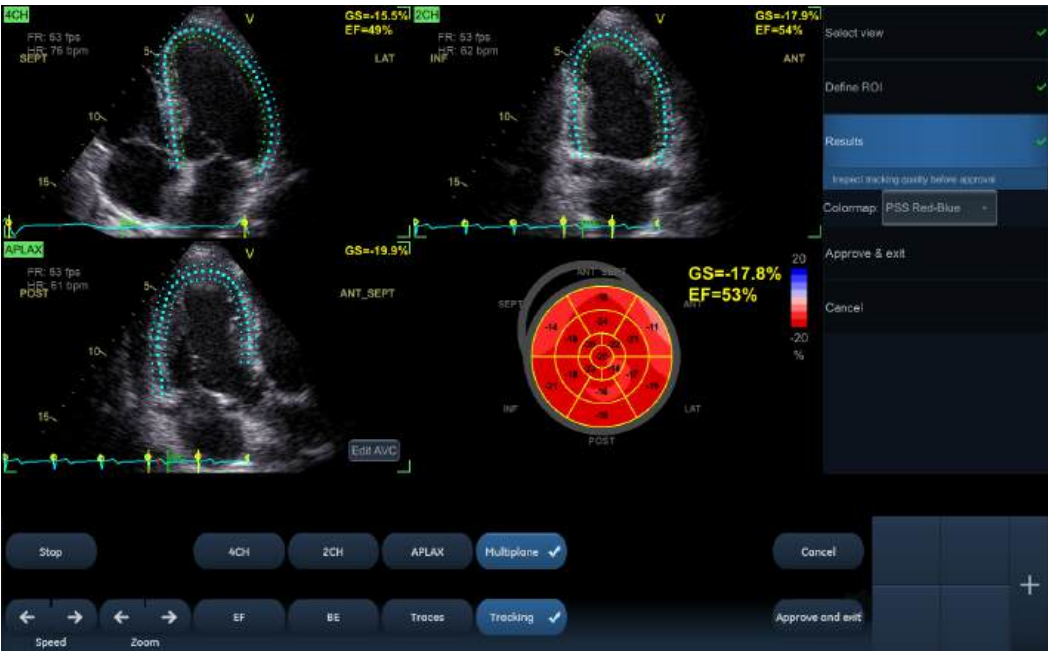


Figure 8-20. AFI result screen

Exiting AFI on LV

When in the Results stage the operator may click the **Approve and Exit** button. The behavior depends on the number of views analyzed:

- If all three views were analyzed the tool will go to the Bull's eye only layout and prompt the operator whether the results should be stored. If **Yes** is selected, measurements are transferred to the worksheet, and a result file with a screenshot of the Bull's Eye will be generated. See also the section 'Reprocessing Data' on *page 8-69*.
- If only one or two views were analyzed, the tool will enter the Quad layout of the most recently processed view and prompt the operator whether the results should be stored. If **Yes** is selected, measurements are transferred to the worksheet and a result file with a screenshot of the Quad screen is generated. See also the section 'Reprocessing Data' on *page 8-69*.

Completed analysis results

When all three apical views have been analyzed, the result screen provides three new Layouts to inspect global function.

- *BE Only*: Bull's eye presentation with segmental full wall Peak systolic strain color coding and segmental Peak systolic strain values.
- *BE + traces*: In addition to the Bull's eye, also displays the strain traces for all three views. In this view, it is possible to correct trace peaks by clicking and dragging peak markers or clicking the corresponding segment in the Bull's eye (Figure 8-18).
- *BE + Review*: In addition to the Bull's eye, also displays the cineloops for all three views.

Bull's eye standards

The Bull's eye can be configured to display either 18 or 17 segments using either the AFI or the ASE standard (from **Config**, refer to 'Configurable workflow controls' on *page 8-37*). Consult the Vivid *iq* Reference Manual for more information regarding Bull's Eye segmentation formats.



CAUTION

If reprocessing a file with a different Bull's Eye standard, the segmental values will change. The system will warn the operator if attempting to reanalyze a stored loop with a different Bull's eye standard.

Bull's eye colormaps

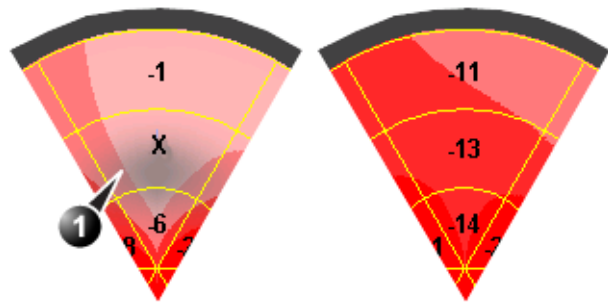
The tool provides a set of different colormaps for the Bull's Eye. The different colormaps are available from the *Colormap* dropdown menu in the *Result stage* menu.

The system can be configured to display other color maps (**Config**, refer to 'Configurable workflow controls' on page 8-37). The following colormaps are available:

- *PSS Red-Blue*: Peak systolic strain in a red-blue color coding.
- *PSS-Green-Yellow-Red*: Peak systolic strain in a green-yellow-red color coding.
- *PSI*: Post Systolic Index (PSI) color coding and segmental PSI values in the Bull's eye
- *TTP*: Time-to-peak strain (TTP) color coding and segmental TTP values in the Bull's eye

NOTE: *PSI and TTP color maps are based on the global peaks (as supposed to systolic peaks).*

Rejected segments in the Bull's Eye are identified by the peak values being replaced by a X, and that the segment is greyed out in the colorimetric display, see Figure 8-21.



1. Segment with tracking quality scored as Not acceptable (X).

Figure 8-21. Colorimetric display

After completing AFI on LV

- 'About the results' on *page 8-69*
- 'Reprocessing Data' on *page 8-69*
- 'Incomplete analysis (AFI on LV with not all 3 views)' on *page 8-70*
- 'Complete analysis (3 views)' on *page 8-70*
- 'Measurements available after complete analysis' on *page 8-71*

About the results

Be aware of the following:

- Clinical assessments should be made based on both color and segmental full wall Peak systolic strain values.
- No values shown in any *Result* screen will be transferred to the Worksheet unless either **Approve and Exit** or **Approve and select next** is pressed.
- All results shown (curves, colors, and values) are based on drift compensated values. Any strain drifting is linearly compensated throughout the cycle. If the drift compensation in a given segment is too high, the segment is automatically rejected.
- If more than one segment is rejected, the Global Strain value is not calculated.

Reprocessing Data

The data from one or several views from a saved AFI analysis may be reprocessed.

NOTE: When doing reprocessing, if the operator chooses to store the results, the results will be treated as new analysis with new measurements in the worksheet and a new thumbnail in the clipboard.

Incomplete analysis (AFI on LV with not all 3 views)

1. Double-click on the thumbnail showing the AFI Quad screen result layout. Depending on the number of views analyzed, either a dual or a quad screen is displayed, showing the last Quad view result screen and the cineloops processed in that analysis.
2. Launch **AFI**. The tool will proceed to the *Results* stage of the last analyzed view. The user may choose to reprocess the views already analyzed or to complete the analysis by processing the missing view(s).

Complete analysis (3 views)

1. Double-click on the thumbnail showing the AFI Bull's Eye layout. A quad screen is displayed, showing the Bull's Eye and the 3 cineloops processed in that analysis.
2. Launch **AFI**. The tool will proceed to the final *Results* stage. The user may choose to reprocess the views already analyzed or even replace earlier processed views.

NOTE: *A result file can only be reprocessed with the same AFI tool as it was originally processed. It is not possible to reprocess an AFI on LV result file with any other tool of the Vivid suite.*

Measurements available after complete analysis

The following parameters are also available after completed analysis:

- Global Strain (GS) values for all three apical views. In a given view the Global Strain (GS), also called Global Longitudinal Peak Strain (GLPS), is defined as the percentage of maximal contraction over the whole cardiac cycle of the entire myocardial wall relative to its end diastolic length.
- Average Global Strain value from all three apical views.
Global strain per view is not the average of the 6 segmental values. It is calculated as if the whole ventricular view is one large segment, from base to base. If more than two segments are rejected, no global view strain is shown.
The global strain for the left ventricle is calculated as the arithmetic average of the three global view strain values.
- AVC measurement (either automatic, event timing measurement or manual, see page 8-59).
- PSD: Peak Strain Dispersion is an index that displays variability in time-to-peak (TTP) longitudinal strain. The index is the standard deviation of the TTP strain (of all segments) over the whole cycle. The TTP bulls-eye is useful in association with PSD as the color scheme uses green color to indicate normal contraction with a peak around AVC, blue color to indicate early contraction, and yellow to red color to indicate late contraction.

Measurements available after complete analysis (continued)



CAUTION

Rejection of non-physiological traces and correct peak detection (see 'Inspecting the results' on [page 8-61](#)) is particularly important when using the TTP color map, as wrong peaks will influence the PSD index significantly. Peaks detected in very early systole and late diastole should be checked, and traces rejected if they are considered non-physiological.

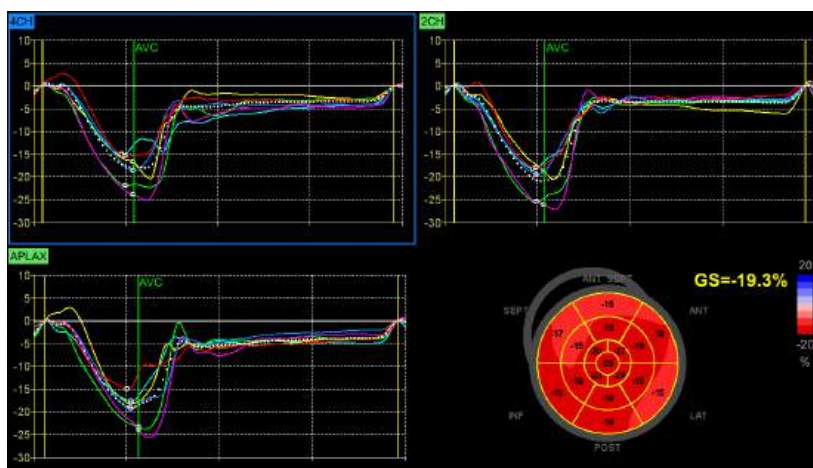


Figure 8-22. Bull's Eye and Traces screen

EF Layout

The results screen for A4CH and A2CH views also has an AutoEF layout. In this layout, the system presents automatically generated end systolic and end diastolic traces used to calculate ejection fraction (EF), stroke volume (SV), cardiac output (CO), as well as volumes. See 'AutoEF measurements for the Left Ventricle (AutoEF 3.0, Easy AutoEF)' on [page 8-117](#) for details.

NOTE: *If both A4CH and A2CH have been analyzed, the system also calculates biplane Simpson EF, SV, CO and volumes.*

NOTE: *If the user does not open the AutoEF layout while processing each view, the AutoEF measurements generated in the AFI tool will not be considered as validated by the user. Therefore, they will not appear in the result screen nor be transferred to the Worksheet.*

Go back to the beginning, see: '[AFI on the Left Ventricle\(AFI 3.0, Easy AFI LV\)](#)' on [page 8-31](#)

AFI on the Right Ventricle(RV)

Automated Functional Imaging of the Right Ventricle should be performed on a RV focused view. It is important that the free-wall (FW) is well visible throughout the heart cycle.

Before starting AFI on the RV

- [‘Data Requirements’ on page 8-75](#)
- [‘Views’ on page 8-75](#)
- [‘Recommended Probes \(raw data only\)’ on page 8-75](#)
- [‘Image settings’ on page 8-76](#)
- [‘Acquisition’ on page 8-76](#)
- [‘Heart rate and cycles’ on page 8-76](#)
- [‘Configuring the tool’ on page 8-76](#)
- [‘Configurable workflow controls’ on page 8-77](#)
- [‘Configurable analysis settings’ on page 8-77](#)
- [‘Strain reference layer’ on page 8-77](#)

Data Requirements

Data types

AFI of the RV is only available for raw data.

Views

AFI of the RV should be performed on RV focused apical 4-chamber (A4CH) images.

Recommended Probes (raw data only)

Table 8-4: Recommended probes - AFI on RV

Application	Probes
Cardiac	M5Sc-RS, 3Sc-RS
Pediatric	6S-RS, 12S-RS



CAUTION

AFI is only recommended for the probes in Table 8-4. The measurement accuracies of the longitudinal strain values reported in 'Measurement accuracy' on *page 8-238* are verified with these probes.

Image settings

- A frame rate higher than 40 frames per second is recommended. Lower frame rates are accepted by the tool (37 fps for raw data and 30 fps for DICOM). Higher frame rates will benefit the workflow by making it easier to achieve satisfactory speckle tracking. A higher frame rate is recommended for high heart rates.
- The entire myocardium should be visible.
- A depth range that includes the entire heart chamber of interest (RV) should be used.
- Acquisitions must be made without the use of contrast agents.

Acquisition

Create an exam, connect the ECG device and make sure to obtain a stable ECG trace.

Heart rate and cycles

- If the acquisition has more than one heart cycle, the analysis will by default be done on the second to last heart cycle.
- The system should be configured to store 100 ms before and after each heart cycle.

Configuring the tool

It is possible to configure some of the AFI controls and analysis settings.

To access the configuration menu, press **Config** on the shortcut bar, select the category **Meas/Text**, and the **Advanced Quantification** subgroup.

Select **AFI RV** to configure the AFI tool designed for analysis on the Right Ventricle.

Configurable workflow controls

- *Autoprocessing timeout* - The time the operator must keep the trackpad still before tracking automatically starts.
- *YoYo* - When adjusting the ROI, select whether a limited number of frames around the selected ROI frame should be looped back and forth to ease ROI adjustment.

Configurable analysis settings

- *Strain reference layer* - Select whether the strain values shall be calculated based on endocardial or full wall tracking.

Strain reference layer

The tool supports calculation of strain parameters based on either endocardial deformation or myocardial/full wall deformation.



CAUTION

Measurements based on endocardial and myocardial analysis are not comparable.

- Endocardial deformation is assessed by performing analysis of the endocardial part of the ROI trace. Measurements derived from endocardial deformation are suffixed Endo.
- Myocardial/full wall deformation is assessed by performing analysis of the whole ROI trace. Measurements derived from myocardial deformation are suffixed Full.

NOTE: *If attempting to reprocess an analysis using a different reference layer a warning will be shown informing that the values in the analysis will change.*

Go back to the beginning, see: '[AFI on the Right Ventricle\(RV\)](#)' on [page 8-74](#)

Starting AFI on RV

- 'Starting AFI on RV' on *page 8-79*
- 'Navigating the tool' on *page 8-79*
- 'Tracking' on *page 8-81*
- 'ROI segments' on *page 8-83*
- 'ROI adjustment' on *page 8-83*
- 'General ROI remarks' on *page 8-84*
- 'To adjust the ROI' on *page 8-84*
- 'To create a new ROI' on *page 8-86*
 - 'Selecting the correct frame' on *page 8-86*
 - 'Creating a new ROI' on *page 8-86*
- 'Guidelines for optimal ROI placing' on *page 8-88*
- 'Event timing' on *page 8-90*
- 'Inspecting the results' on *page 8-91*
- 'Peak detection' on *page 8-92*
- 'Exiting AFI on RV' on *page 8-92*

Starting AFI on RV

1. Open the exam for which you want to perform AFI on RV analysis and select the A4CH image you would like to use for the analysis.
2. Press **Measure** on the Control Panel and select **AFI RV**. The tool will launch in the *Define ROI* stage with the selected view. Use the **Cycle** slider to select the heart cycle to perform the analysis on (if more than one is available).

Navigating the tool

Perform the analysis by following an on-screen guided workflow (see Figure 8-23).

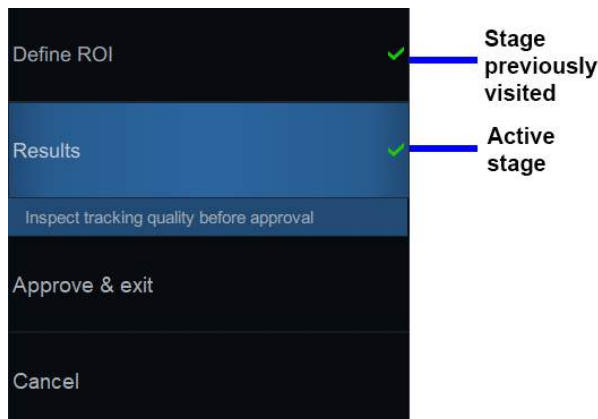


Figure 8-23. A typical AFI workflow menu

The *Workflow* menu (or stage menu) is located on the right side of the tool. It contains a set of stages the user should visit sequentially. It is possible to re-visit already viewed stages. Click on their title to navigate to any available stage. Stages that are not accessible given the tool's state are greyed out.

Navigating the tool (continued)

The stages of an AFI analysis on the right ventricle are:

- Define ROI - where the user draws the ROI where speckle tracking will take place.
- Results - where the user examines the results of the analysis.

Most stages require interaction with the user, and hints on what is expected are given on the operation panel (see Figure 8-24).

- If a stage is labeled , the stage is complete and nothing more needs to be done in that tool stage.
- Click the  (reset) button to reset the stage and clear all user-entered information in that stage.



Figure 8-24. AFI Workflow menu

When available, press **Approve & Exit** to approve the analysis and store the reviewed measurements to worksheet. See 'Measurements available after complete analysis' on *page 8-95* for the list of stored measurements after performing AFI of the RV.

At any time, click **Cancel** to exit the tool without saving any analysis.

Tracking

The accuracy of the measurements provided by AFI rely on good tracking quality.



Poor tracking quality may lead to incorrect measurement results. The tracking for each segment must be visually controlled and validated.

Poor tracking quality could result from a variety of causes. The most common causes for bad tracking are:

- Erroneous placement of the basal points when defining the ROI. If the basal points are placed too far from the annular region, the ROI segments at the annular base will not move together with the underlying 2D image throughout the entire heartbeat.
- Erroneous placement of the apex when defining the ROI. The point should be placed so that the resulting ROI covers mainly the myocardium. If the apex point is placed too high, the ROI will mainly cover the epicardium, resulting in poor tracking.
- Too narrow ROI width. Narrowing the ROI too much will result in poor tracking due to lack of tissue data in the ROI.
- Too much clutter. Images with too much static clutter will result in poor tracking.

Tracking (continued)

Inspect each segment and make sure that the center line is moving together with the underlying 2D image. Use the various results layouts to examine the tracking quality (e.g. Quad layout).

The following can help examining the tracking quality:

- Turn off the color overlay by clicking **Color** button.
- Reduce playback speed by using the **Speed** slider (or the rotary on the touch panel).
- Use the *Single* layout to get a larger view of the dynamic mesh (especially in difficult cases).

If the tracking needs to be improved for some segments, the user can modify the ROI or create a new ROI.

ROI segments

The ROI used in AFI RV includes both the intraventricular septum and the right ventricle Free Wall (FW).

For each of these walls, strain is calculated in three segments: base, mid and apex (see Figure 8-25)



Figure 8-25. Segments on AFI on RV ROI

ROI adjustment

If the automatic ROI is not optimal (resulting in poor tracking), the user can either adjust the ROI or create a new ROI as described below.

General ROI remarks

The calculations performed on the tracked ROI aim to find the longitudinal deformation along the cardiac muscle from base to apex. For an AFI analysis of the Right Ventricle, these calculations assume the ventricle to show a hinge at the apex.



WARNING

If the ROI does not have a hinge in the apex, the calculated measurements may not be accurate.

To adjust the ROI

The following adjustments can be done in the Define ROI stage:

- Adjust ROI width by clicking the **ROI Width** slider (or use the Touch Panel rotary).
- Click-and-drag (or click, move the mouse, click to release) on the endocardial part of the ROI. Endocardial editing edits the whole ROI (Figure 8-26, upper part).
- Click-and-drag (or click, move the mouse, click to release) the anchor points on the epicardial ROI (highlighted in red on mouse hovering). Epicardial editing edits the epicardial part only (Figure 8-26, lower part).

A pictogram in the upper right corner of the screen indicates the core feature of a good ROI for the current view the user is analyzing.

To adjust the ROI (continued)



Figure 8-26. ROI Editing Options

To create a new ROI

Selecting the correct frame

The system automatically displays a frame where the endocardial border is usually visible. To use another frame, while in *Define ROI* stage, pause the playback by pressing **Stop**. Then, use the **Frame** slider to select a different frame for ROI definition.

Creating a new ROI

While in *Define ROI* stage, use the **Reset**  button to remove the previous ROI.

The AFI tool will now prompt to place 3 landmarks. Take care to place the landmarks in the correct location according to the hints displayed close to the mouse pointer.



CAUTION

Faulty landmark selection may cause segment values to be swapped in the final results.

When the third landmark is placed, a ROI is generated and can optionally be edited (Figure 8-27).

NOTE: *If the ROI needs to be adjusted, make sure to make the changes immediately after the ROI is displayed, before the auto processing of the ROI begins.*

NOTE: *Auto processing of the ROI will start after a given time delay that is configurable (from **Config**).*

NOTE: *The YoYo function is turned on to help find the correct location of the landmarks.*

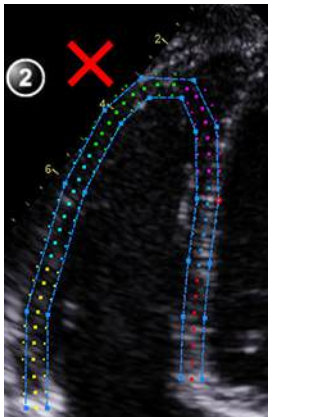
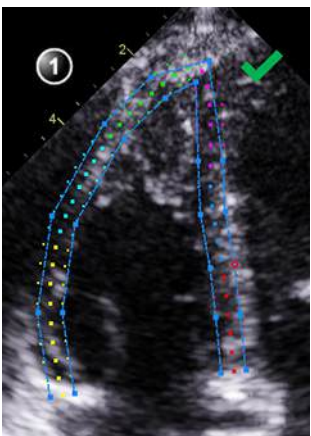
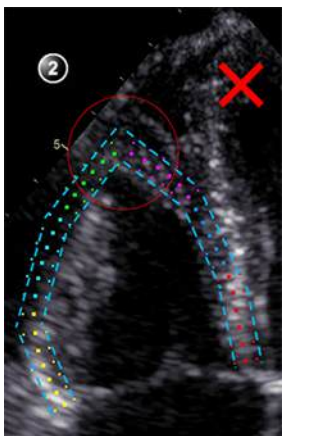


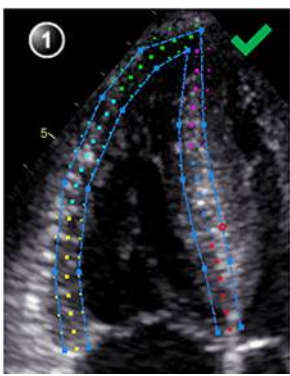
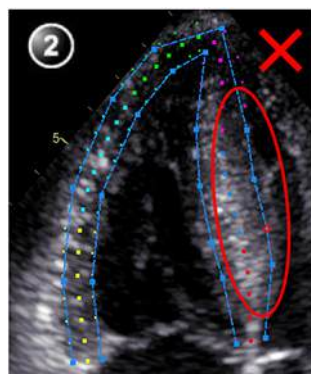
Guidelines for optimal ROI placing

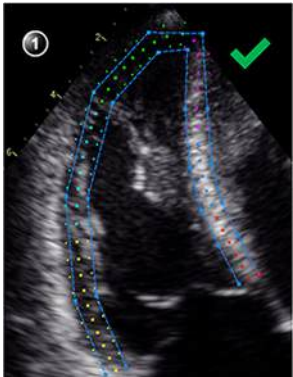
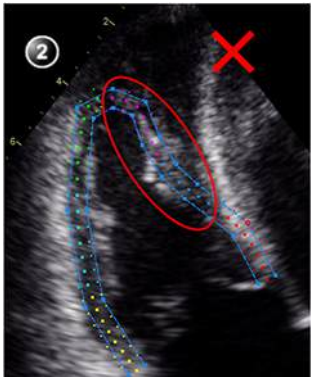
Please refer to the current official recommendations on Right Ventricle strain analysis on 2D images for state-of-the-art ROI placement guidelines. Unless current guidelines state otherwise, it is not recommended to include the whole interventricular septum in the AFI RV ROI. Instead, the ROI width in the interventricular septum should be kept similar to that of the free wall.

Correct ROI definition is crucial to get good tracking. By not following the ROI definition guidelines, the tool accuracy may be reduced. See use cases below for common pitfalls.

Base	Correct	Wrong
1. Correct position of the base points, at the tricuspid leaflet insertion level. 2. The ROI goes to the level of the mitral annulus.		
1. Correct position of the base point. 2. The ROI is curved at base level.		

Apex	Correct	Wrong
1. Correct shape at apex. 2. The ROI does not show a sharp angle at apex.	 An echocardiogram image showing a correctly defined ROI for the apex. The ROI is a blue dashed line following the contour of the heart wall. A green checkmark is in the top left corner. A circled '1' is in the top left corner.	 An echocardiogram image showing an incorrect ROI for the apex. The ROI is a blue dashed line that does not follow the contour of the heart wall. A red X is in the top left corner. A circled '2' is in the top left corner.
1. Correct placement of apex. 2. The apex is too low.	 An echocardiogram image showing the correct placement of the apex. The ROI is a blue dashed line following the contour of the heart wall. A green checkmark is in the top right corner. A circled '1' is in the top left corner.	 An echocardiogram image showing an incorrect placement of the apex. The ROI is a blue dashed line that is too low. A red X is in the top right corner. A circled '2' is in the top left corner.

Septum	Correct	Wrong
1. Correct septum ROI. 2. The ROI includes the left ventricular part of the septum.	 An echocardiogram image showing a correct septum ROI. The ROI is a blue dashed line following the contour of the septum. A green checkmark is in the top right corner. A circled '1' is in the top left corner.	 An echocardiogram image showing an incorrect septum ROI. The ROI is a blue dashed line that includes the left ventricular part of the septum. A red X is in the top right corner. A circled '2' is in the top left corner.

Bulges	Correct	Wrong
1. Correct ROI. 2. ROI should not be bulging or follow the papillary muscle (to edit ROI, see 'ROI adjustment' on page 8-83.)		

Event timing

The peak strain measured on the Right Ventricle is measured between the start of the cycle and the Pulmonic Valve Closure (PVC) time.

If PVC has been measured in the current exam using Event Timing (refer to 'Event timing measurements' on page 8-22), the AFI RV tool will use this value to determine the time range in which the peak systolic strains have to be found.

Unselect the **Event Timing** button to use PVC calculated from the tracking results (see Figure 8-28). In this case, PVC will be calculated based on the time of the peak negative strain.



Figure 8-28. Event Timing button

Inspecting the results

After completed tracking, the system displays the *Quad* screen layout for tracking validation and inspection of results for the currently processed view.

The screen contains the following result displays:

- *Tracked ROI*: A dynamic display of the tracked ROI to be used for tracking validation. The tracked ROI has a texture overlay indicating strain values according to the colormap. The overlay may be turned off/on by clicking the **Color** button.

NOTE: *Rejected segments will not have texture overlay.*

- *Segmental result ROI*: A static display indicating the peak strain value per segment. Rejected segments are displayed with an X instead of a value. Clicking a segment changes its rejection status (See 'Tracking' on *page 8-81*.)
- *Strain traces*: A static display indicating the segmental and global strain traces with time. The peak values are indicated.

NOTE: *The peak values can be adjusted by clicking and dragging the peak markers with the mouse.*



CAUTION

Segments and peak detection should be checked to make sure that non-physiological traces are excluded in the calculation of indices.

- *Curved anatomic M-Mode*: A static display indicating a curved anatomic M-mode along the center of the ROI. The M-mode has a parametric overlay indicating peak strain values.

NOTE: *Rejected segments will not have texture overlay.*

NOTE: *The Segmental result ROI, Strain traces and Curved anatomic M-mode are using color codes to link the different segments.*

Peak detection

The peak systolic strain detection for each segment can be verified and manually adjusted as required. To adjust the peak detection:

1. Go to *Results* stage. The quadrant view is displayed.
2. To change the peak marker position on a curve, click on the peak marker (square point) on one of the curves, move the peak marker to a new position and click again to fix the point.

The peak type is determined by the selected color map (systolic for PSS, global for PSI and TTP). The position of the PVC can also be checked on the curves graph.

Exiting AFI on RV

When in the Results stage, the operator may click the **Approve and Exit** button. The tool will prompt the operator whether the results should be stored. If **Yes** is selected, measurements are transferred to the worksheet, and a result file with a screenshot of the Results stage will be generated. See 'Reprocessing Data' on *page 8-95*.

Go back to the beginning, see: '[AFI on the Right Ventricle\(RV\)](#)' on *page 8-74*

After completing AFI on RV

- 'Completed analysis results' on *page 8-94*
- 'About the results' on *page 8-94*
- 'Reprocessing Data' on *page 8-95*
- 'Measurements available after complete analysis' on *page 8-95*

Completed analysis results

A completed AFI analysis on the right ventricle is a single view analysis that can be stored in a result file.

Relevant strain data can be observed at the *Results* stage screen.

Peak systolic strain values per segment can be observed on the lower left quadrant, inside the ROI mesh.

Strain values per segment during the chosen analyzed cycle can be observed on the graph on the upper right quadrant. It is also visible on the color anatomical M-Mode (CMM) on the lower right quadrant.

Global values are displayed as text on the lower left quadrant.

About the results

Be aware of the following:

- All results shown (curves, colors, and values) are based on drift compensated values. Any strain drifting is linearly compensated throughout the cycle. If the drift compensation in a given segment is too high, the segment is automatically rejected.
- No values shown in any Result screen will be transferred to the Worksheet unless **Approve & Exit** is pressed.
- If more than one segment is rejected, the Global Strain is not calculated.
- If more than one segment of the Free Wall is rejected, the Free Wall Strain is not calculated.

Reprocessing Data

The data from a saved AFI analysis on the RV may be reprocessed.

NOTE: *When doing reprocessing, if the operator chooses to store the results, the results will be treated as new analysis with new measurements in the worksheet and a new thumbnail in the clipboard.*

1. Double-click on the thumbnail showing the AFI RV Results stage.
2. Launch **AFI RV**. The tool will proceed to the *Results* stage. You may choose to reprocess the view already analyzed, after the ROI or segments' approval.

NOTE: *A result file can only be reprocessed with the same AFI tool as it was originally processed. It is not possible to reprocess an AFI on RV result file with any other tool of the Vivid suite.*

Measurements available after complete analysis

After a complete analysis has been performed, the following measurements can be transferred to the worksheet:

- Tricuspid Annular Plane Systolic Excursion (TAPSE)
- Global Peak strain on the entire Right Ventricle wall is defined as the percentage of maximal contraction over the whole cardiac cycle of the entire myocardial wall, relative to its end diastolic length
- Global Peak Systolic strain on the Right Ventricle Freewall is defined as the percentage of maximal contraction of the right ventricle free wall, relative to its end diastolic length
- The peak systolic strains calculated on each of the segments

Go back to the beginning, see: '[AFI on the Right Ventricle\(RV\)](#)' on [page 8-74](#)

AFI on the Left Atrium

Automated Functional Imaging of the Left Atrium should be performed on a LA focused 4-Chamber and 2-Chamber view. It is important to avoid foreshortening of the LA chamber.

Before starting AFI on the LA

- [‘Data Requirements’ on page 8-97](#)
- [‘Views’ on page 8-97](#)
- [‘Recommended Probes \(raw data only\)’ on page 8-97](#)
- [‘Image settings’ on page 8-98](#)
- [‘Heart rate and cycles’ on page 8-98](#)
- [‘Configuring the tool’ on page 8-99](#)
- [‘Configurable workflow controls’ on page 8-99](#)

Data Requirements

Data types

Automated Function Imaging of the Left Atrium is only available for raw data.

Views

AFI of the LA should be performed on LA focused apical 4-chamber (A4CH) and apical 2-chamber images.

Recommended Probes (raw data only)

Table 8-5: Recommended probes - AFI on LA

Application	Probes
Cardiac	M5Sc-RS, 3Sc-RS
Pediatric	6S-RS, 12S-RS



CAUTION

AFI on LA is only recommended for the probes in Table 8-5. The measurement accuracies of the longitudinal strain values reported in 'Measurement accuracy' on *page 8-238* are verified with these probes.

Image settings

- A frame rate higher than 40 frames per second is recommended. Lower frame rates are accepted by the tool (37 fps for raw data and 30 fps for DICOM). Higher frame rates will benefit the workflow by making it easier to achieve satisfactory speckle tracking. A higher frame rate is recommended for high heart rates.
- The entire left atrium should be visible. Measurements are not reliable if images are foreshortened.
- A depth range that includes the entire heart chamber of interest (LA) should be used.
- Acquisitions must be made without the use of contrast agents.

Acquisition

Create an exam, connect the ECG device and make sure to obtain a stable ECG trace.

Heart rate and cycles

- If the acquisition has more than one heart cycle, the analysis will by default be done on the second to last heart cycle unless a different cycle was selected before starting AFI.
- The system should be configured to store 100ms before and after each heart cycle.

Configuring the tool

It is possible to configure some of the AFI controls and analysis settings.

To access the configuration menu, press **Config** on the shortcut bar, select the category **Meas/Text**, and the **Advanced Quantification** subgroup.

Select **AFI LA** to configure the AFI tool designed for analysis on the Left Atrium.

Configurable workflow controls

- *Autoprocessing timeout* - The time the operator must keep the trackpad still before tracking automatically starts.
- *YoYo* - When adjusting the ROI, select whether a limited number of frames around the selected ROI frame should be looped back and forth to ease ROI adjustment.
- *EF reminder* - Select Yes to be reminded to visit the EF layout on A4CH and A2CH views analysis. Visiting the EF layout is mandatory to obtain EF values in Worksheet while using AFI for the analysis of the Left Atrium.

Go back to the beginning, see: '[AFI on the Left Atrium](#)' on [page 8-96](#)

Starting AFI on LA

- 'Starting AFI on LA' on *page 8-101*
- 'Navigating the tool' on *page 8-102*
- 'Tracking' on *page 8-104*
- 'ROI adjustment' on *page 8-106*
- 'General ROI remarks' on *page 8-106*
- 'To adjust the ROI' on *page 8-106*
- 'To create a new ROI' on *page 8-108*
- 'Selecting the correct frame' on *page 8-108*
- 'Creating a new ROI' on *page 8-108*
- 'Guidelines for optimal ROI placing' on *page 8-110*
- 'Inspecting the results' on *page 8-111*
- 'PreA time' on *page 8-112*
- 'Emptying fraction layout' on *page 8-112*
- 'Exiting AFI on LA' on *page 8-113*

Starting AFI on LA

1. Open the exam for which you want to perform AFI LA analysis and select one of the apical LA focused image to use for the analysis.
- Press **Measure** on the Control Panel and select **AFI LA**. The tool will launch in the Select View stage. If more than one heart cycle is available, use the **Cycle** slider to select which heart cycle to perform the analysis on.

Navigating the tool

Perform the analysis by following an on-screen guided workflow (see Figure 8-23).

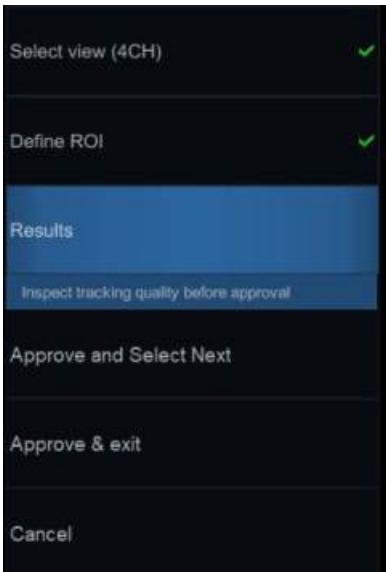


Figure 8-29. A typical AFI LA workflow menu

Navigating the tool (continued)

The workflow menu (or stage menu) is located on the right side of the tool. It contains a set of stages the user should visit sequentially. It is possible to re-visit already viewed stages. Click on their title to navigate to any available stage. Stages that are not accessible given the tool's state are greyed out.

The stages of an AFI analysis of the left atrium are:

- Select View - where the user indicates to the tool which view will be analyzed.
- Define ROI - Where the ROI is drawn, speckle tracking will take place.
- Results - Examination of the analysis' results.

Most stages require interaction with the user, and hints on what is expected are given on the operation panel.

- If a stage is labeled  , the stage is complete and nothing more needs to be done in that tool stage.
- Click the  (reset) button to reset the stage and clear all user-entered information in that stage.

When available, press **Approve and select next** to return to the Select view stage and perform the analysis for a new view.

When available, press **Approve and Exit** to approve the analysis and store the reviewed measurements to worksheet. See 'Measurements available after complete analysis' on *page 8-116* for the list of stored measurements after performing AFI of the LA.

At any time, click **Cancel** to exit the tool without saving any analysis.

Tracking

The accuracy of the measurements provided by AFI rely on good tracking quality.



Poor tracking quality may lead to incorrect measurement results.

Poor tracking quality could result from a variety of causes. The most common causes are:

- Erroneous placement of the basal points when defining the ROI. If the basal points are placed too far from the annular region, the ROI segments at the annular base will not move together with the underlying 2D image throughout the entire heartbeat.
- Erroneous placement of the atrial roof when defining the ROI. The point should be placed so that the resulting ROI covers mainly the myocardium. If the atrial roof point is placed too deep, the ROI will mainly cover the epicardium, resulting in poor tracking.
- Too narrow ROI width. Narrowing the ROI width too much will result in poor tracking due to lack of tissue data in the ROI.

Tracking (continued)

Inspect tracking ROI closely and make sure that the center line in each region is moving together with the underlying 2D image. Use the various results layouts to examine the tracking quality (e.g. Single layout).

The following can help examining the tracking quality:

- Turn off the color overlay by clicking on the **Color** button.
- Reduce playback speed by using the **Speed** slider (or the rotary on the Touch Panel).
- Use the *Single layout* to get a larger view of the dynamic mesh (especially in difficult cases).

If the tracking needs to be improved for some regions, the user can modify the ROI or create a new ROI.

ROI adjustment

If the ROI is not optimal (resulting in poor tracking), the user can either adjust the ROI or create a new ROI as described below.

General ROI remarks

The calculations performed on the tracked ROI aim to find the longitudinal deformation along the cardiac muscle from base to atrial roof. For an AFI analysis of the Left Atrium, these calculations assume the atrium to have a horse-shoe shape.



CAUTION

If the ROI does not have a horse-shoe shape, the calculated measurements may not be accurate.

To adjust the ROI

The following actions can be done in the Define ROI stage:

- Adjust the ROI width by clicking the **ROI Width** slider (or use the Touch Panel rotary).
- Click-and-drag (or click, move the mouse, click to release) on the endocardial part of the ROI. Endocardial editing edits the whole ROI (see Figure 8-26, upper part).
- Click-and-drag (or click, move the mouse, click to release) the anchor points on the epicardial ROI (highlighted in red on mouse hovering). Epicardial editing edits the epicardial part only (see Figure 8-26, lower part).

A pictogram in the upper right corner of the screen indicates the core feature of a good ROI for the current view the user is analyzing.

To adjust the ROI (continued)

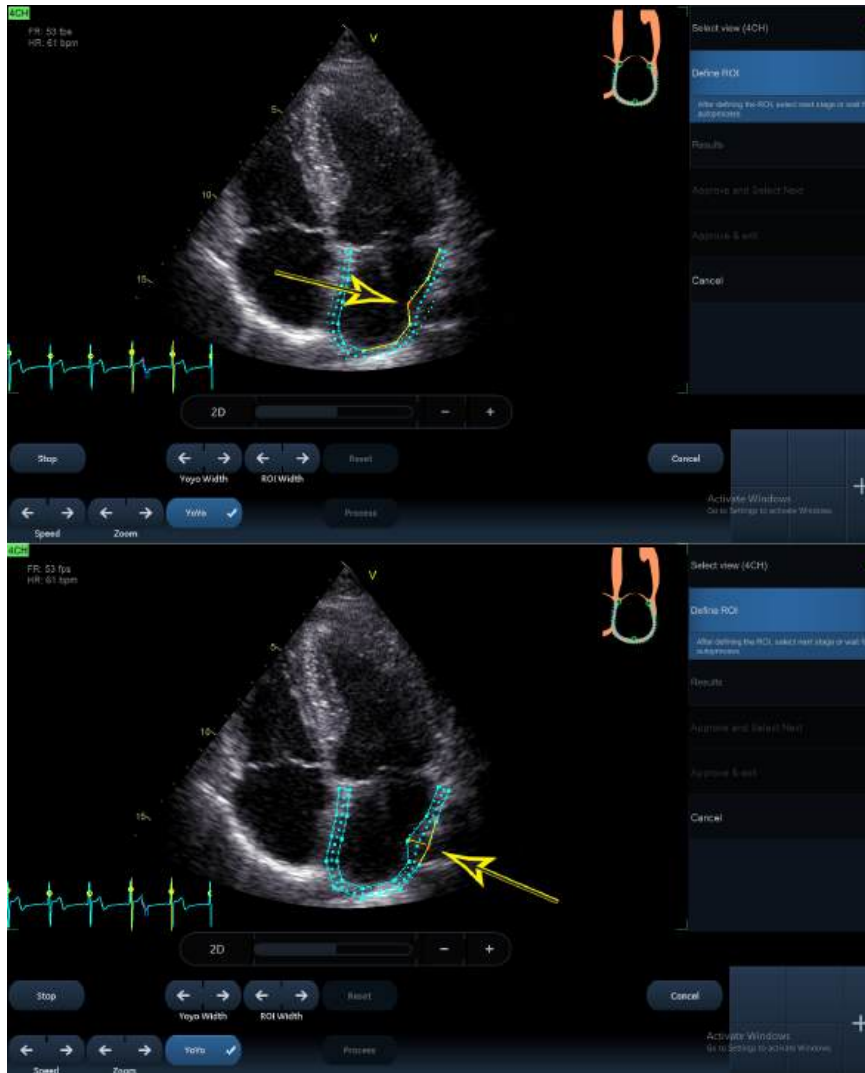


Figure 8-30. ROI editing options

To create a new ROI

Selecting the correct frame

The system automatically displays a frame where the endocardial border is usually visible. To use another frame, while in *Define ROI* stage, pause the playback by pressing **Stop**. Use the **Frame** slider (or rotary on the Touch Panel) to select a different frame for ROI definition.

Creating a new ROI

While in *Define ROI* stage, use the **Reset**  button to remove the previous ROI.

The AFI tool will now prompt to place three landmarks. Take care to place the landmarks in the correct location according to the hints displayed close to the mouse pointer.

When the third landmark is placed, a ROI is generated and can optionally be edited (Figure 8-27).

NOTE: *If the ROI needs to be adjusted, make sure to make the changes immediately after the ROI is displayed, before the auto processing of the ROI begins.*

NOTE: *Auto processing of the ROI will start after a given time delay that is configurable (from **Config**).*

NOTE: *The YoYo function is turned on to help find the correct location of the landmarks.*

Creating a new ROI (continued)

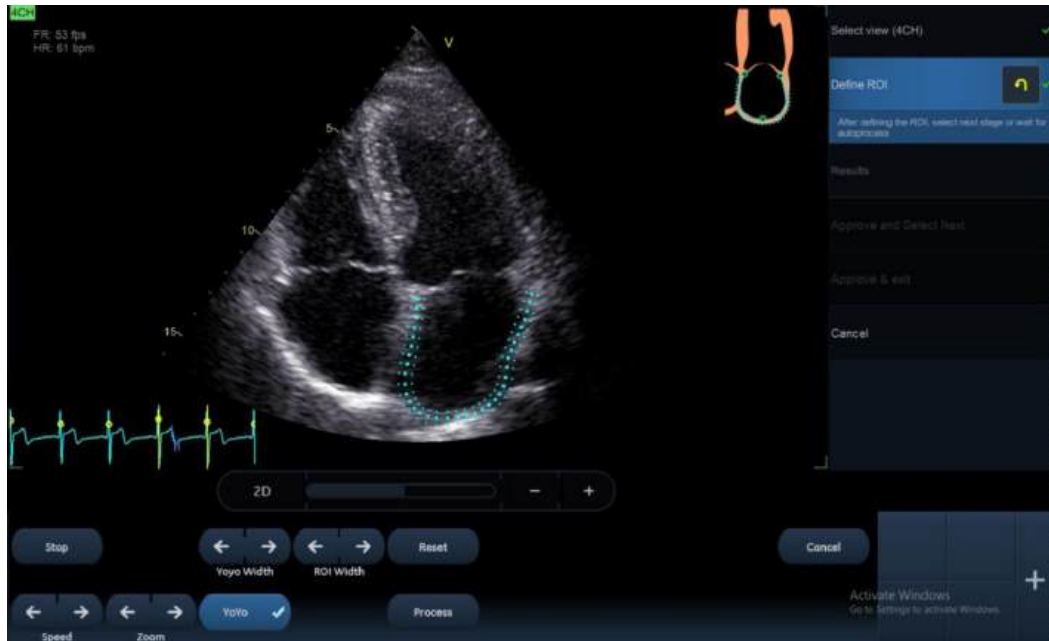
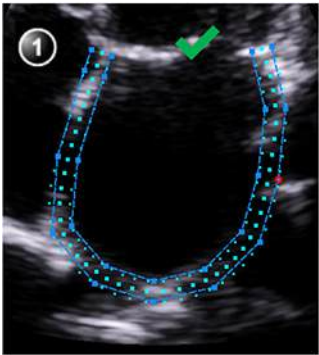
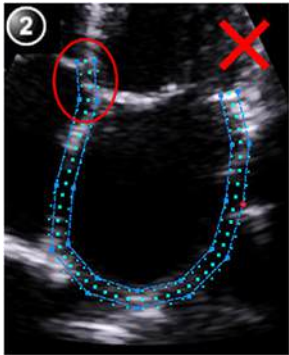
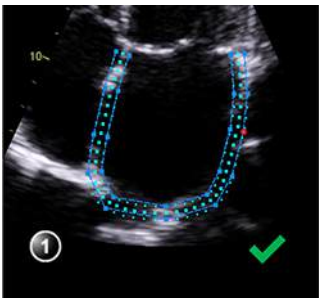


Figure 8-31. Defining a ROI

Guidelines for optimal ROI placing

Correct ROI definition is crucial to get good tracking. By not following the ROI definition guidelines, the tool accuracy may be reduced. See use cases below for common pitfalls.

Base	Correct	Wrong
1. ROI should be bounded by mitral valve plane from top. 2. ROI goes above mitral valve plane.		

Apex	Correct	Wrong
1. Correct shape in atrial roof. 2. ROI is too sharp in atrial roof.		

Inspecting the results

After completed tracking, the system presents a dynamic display of tracked ROI for tracking validation and results inspection.

The screen contains the following result displays:

- Tracked ROI: A dynamic display of the tracked ROI to be used for tracking validation. The tracked ROI has a texture overlay indicating stretching with blue and contraction with red color. The overlay may be turned off/on by clicking the Color button.
- Strain trace: A static display indication the global strain trace with time.
- Measurements: Left atrium strain values during three phases of LA cycle: Reservoir strain (S_R), Conduit strain (S_CD) and contractile strain (S_CT), as well as the max LA volume for the processed view. Maximum LA volume for 4CH and 2CH views are displayed with LAVmax 4CH and LAVmax 2CH respectively.

NOTE: *Clicking S_R, S_CD or S_CT from Measurement menu show corresponding (time, strain) pair on the strain trace with a red double arrow.*

NOTE: *Zero strain reference can be set either at R-wave (default) or P-wave. This can be configured on the stage menu by selecting R-wave or P-wave button under Strain reference.*

NOTE: *After completing processing the second view, the system displays the Biplane layout by default which contains the tracked ROI and strain trace for each view.*

PreA time

PreA or the time before start of left atrium contraction is automatically calculated based on LA volume curve over entire LA cycle. However, user can edit this time by pressing Stop button and use frame slider to select the desired frame time as PreA and then press Set PreA button. This is also possible by dragging PreA marker on ECG curve. Setting new PreA time updates PreA dependent LA measurement: S_CD, S_CT and LAVPreA.

Emptying fraction layout

The results screen for each view also has an Emptying Fraction (EF) layout. In this layout, the system presents automatically generated traces of the LA endocardium at minimum and maximum volume times used to calculate LA emptying fraction (LAEF), LA emptying volume (LAEV), maximum LA volume (LAVmax), minimum LA volume and LA volume at PreA time (LAVpreA).

NOTE: *Maximum and minimum volume time are calculated in proximity of LV end systolic and end diastolic frame times respectively.*

NOTE: *If the user does not open the EF layout while processing each view, the EF measurements generated in the AFI tool will not be considered as validated by the user. Therefore, they will not be transferred to the Worksheet.*

Exiting AFI on LA

When in the Results stage, the operator may click the **Approve and Exist** button. The behavior depends on the number of views analyzed:

- If only one was analyzed, the tool will enter the *Trace* layout of the processed view and prompt the operator whether the results should be stored. If **Yes** is selected, measurements are transferred to worksheet and a result file with a screenshot of the *Trace* screen is generated. See also the section 'Reprocessing Data' on *page 8-116*.
- If both views were analyzed, the tool will go to the *Biplane* layout and prompt the operator whether the result should be stored. If **Yes** is selected, measurements are transferred to worksheet and a result file with a screenshot of the *Biplane* screen is generated. See also the section 'Reprocessing Data' on *page 8-116*.

Go back to the beginning, see: '[AFI on the Left Atrium](#)' on *page 8-96*

After completing AFI on LA

- 'Completed analysis results' on *page 8-115*
- 'About the results' on *page 8-115*
- 'Reprocessing Data' on *page 8-116*
- 'Measurements available after complete analysis' on *page 8-116*

Completed analysis results

A completed AFI analysis on the left atrium is a two-view analysis that can be stored in a result file.

Relevant left atrium strain data at each phase of LA cycle can be observed at the *Results* stage screen.

Emptying fraction and all relevant volumes are displayed in the *Measurement* table.

About the results

Be aware of the following:

- All results shown (curve, and values) are based on a drift compensated strain curve. Any strain drifting is linearly compensated throughout the cycle. If the drift compensation is too high, a warning message is shown to the user.
- No values shown in any Result screen will be transferred to the Worksheet unless **Approve and select next** and finally, **Approve & Exit** is pressed.

Reprocessing Data

The data from a saved AFI analysis on the LA may be reprocessed.

NOTE: *When doing reprocessing, if the operator chooses to store the results, the results will be treated as a new analysis with new measurements in the worksheet and a new thumbnail in the clipboard.*

- Double-click on the thumbnail showing the AFI LA Results stage.
- Launch **AFI LA**. The tool will proceed to the Results stage. You may choose to reprocess the view already analyzed or alter the ROI.

NOTE: *A result file can only be reprocessed with the same AFI tool as it was originally processed. It is not possible to reprocess an AFI on LA result file with any other tool of the Vivid suite.*

Measurements available after complete analysis

All strain measurements are calculated as differences of two measurements on the strain curve, where the strain curve is defined as percentage contraction of the entire myocardial wall relative to the length at either the R-wave or P-wave. After a complete analysis has been performed, the following measurements can be transferred to the worksheet:

- R-wave and P-wave referenced left atrium strain values at reservoir phase for each view. Defined as the difference of strain values at end and onset of the reservoir phase.
- R-wave and P-wave referenced left atrium strain values at conduit phase for each view. Defined as the difference of strain values at end and onset of the conduit phase.
- R-wave and P-wave referenced left atrium strain values at contractile phase for each view. Defined as the difference of strain values at end and onset of the contractile phase.
- Left atrium emptying fraction and volume for each view.
- Minimum and maximum left atrium volumes for each view as well as volume at PreA time.

Go back to the beginning, see: [‘AFI on the Left Atrium’ on page 8-96](#)

AutoEF measurements for the Left Ventricle (AutoEF 3.0, Easy AutoEF)

Automated Ejection Fraction (AutoEF) is a semi-automatic measurement tool used for measurement of the global EF (Ejection fraction). The AutoEF tool is used as an optional decision support tool.

The AutoEF tool is derived from a 2D speckle tracking algorithm, which tracks and calculates the myocardial tissue deformation based on feature tracking on 2D grey scale loops.

AutoEF is performed on either one or both apical 4-chamber or 2-chamber views, in any order.

The result is presented as Ejection Fraction value, calculated by Simpson MOD for each view and MOD Bi-plane Ejection Fraction for the whole LV. All values are stored to the worksheet when approved.



CAUTION

AutoEF is only recommended for the probes in Table 8-6. Easy AutoEF is only available for adult TTE. The measurement accuracies of the 2D Auto EF measurement values reported in 'Measurement accuracy' on *page 8-238* are verified with these probes.

Table 8-6: Recommended probes - AutoEF

	Probes
Cardiac	M5Sc-RS, 3SC-RS
Pediatric	6S-RS, 12S-RS

Contents in this section

The following topics are covered in this section:

- 'Acquisition' on [page 8-119](#)
- 'Acquisition with ECG and stored files' on [page 8-119](#)
- 'Acquisition without ECG' on [page 8-119](#)
- 'Additional requirements for AutoEF when no ECG connected' on [page 8-120](#)
- 'Starting AutoEF' on [page 8-121](#)
- 'Launching AutoEF in live' on [page 8-121](#)
- 'Launching AutoEF from stored files' on [page 8-121](#)
- 'AutoEF on the A4CH view (Views acquired with view recognition)' on [page 8-122](#)
- 'EF results' on [page 8-123](#)
- 'Tracking Validation' on [page 8-123](#)
- 'Tracking correction' on [page 8-124](#)
- 'Possible causes of poor tracking' on [page 8-124](#)
- 'Trace adjustment of the endocardial border' on [page 8-125](#)
- 'Editing the endocardial border trace' on [page 8-125](#)
- 'To create a new endocardial border trace' on [page 8-126](#)
- 'Reviewing results when using one click workflow' on [page 8-127](#)
- 'Problem solving' on [page 8-128](#)
- 'Exiting AutoEF' on [page 8-129](#)
- 'Reprocessing data' on [page 8-129](#)

Acquisition

Acquisition with ECG and stored files

1. Create an exam, connect the ECG device and make sure to obtain a stable ECG trace.
2. Acquire 2D grey scale cineloops of an Apical 4 chamber view and an Apical 2 chamber view.

Acquisition without ECG

1. Create an adult Transthoracic Echocardiography (TTE) exam, start scanning.
2. Acquire and store 2D grey scale cineloops of Apical 4-chamber view or Apical 2-chamber view with length at least 3 seconds.

NOTE: *In order to run the “AutoEF without ECG” feature, the “AutoEFwoECG” option keys must be enabled.*

Acquisition requirements

- A frame rate higher than 40 frames per second is recommended. Lower frame rates are accepted by the tool (37 fps for raw data and 30 fps for DICOM). Higher frame rates will benefit the workflow by making it easier to achieve satisfactory speckle tracking. A higher frame rate is recommended for high heart rates.
- The system should be configured to store 100 ms before and after each heart cycle.
- If the acquisition has more than one heart cycle, the analysis will by default be done on the second to last heart cycle.
- The entire myocardium should be visible.
- A depth range that includes the entire left ventricle should be used.
- Acquisitions must be made without the use of contrast agents.
- There should be no foreshortening of the myocardium in the recording.
- One click workflow (available with Easy AutoEF option only) is only available for Adult TTE raw data images with ECG.
- The acquisition should have a standard 2Ch or 4Ch view.

Additional requirements for AutoEF when no ECG connected

- AutoEF without ECG is only supported for Adult TTE exams with raw data.
- AutoEF without ECG requires at least 3 seconds of data to detect cycle information.
- The acquisition has to represent a stable sinus rhythm for AutoEF without ECG to work.
- The left ventricle should not translate during the acquisition.
- Any intermittent artifact appearing in the recording (e.g. lung shadow) will degrade the results.
- The **Easy AutoEF** and **AutoEFwoECG** option keys must be enabled.

NOTE: *Accuracy of running AutoEF without ECG compared to AutoEF with ECG is detailed in the “2D AutoEF when Adult TTE raw data without ECG” section of the table at the end of ‘Measurement accuracy’ on page 8-238. AutoEF accuracy when manual edits are performed is detailed in the table section “2D Auto EF”. Finally, the table section named “2D AutoEF when Adult TTE raw data with ECG” adds a column describing accuracy w/o editing (within 95% confidence interval) compared to with manual editing.*

Starting AutoEF

Launching AutoEF in live

1. Create an exam, start scanning with or without ECG.
2. Acquire 2D grey scale 4 chamber or 2 chamber view.
3. Select *AutoEF* either in *Measure* menu or on the touch panel.

NOTE: To start *AutoEF* without storing files, the **Easy AutoEF** and **AutoEFwoECG** option keys must be enabled. The system will only allow user to perform the analysis on one view (either 4 chamber or 2 chamber). To combine both views, please launch *AutoEF* from stored files.

Launching AutoEF from stored files

1. Open any one of the stored apical views and press **Measure**.
2. Select *AutoEF* either in *Measure* menu or on the touch panel.

If View Recognition was enabled during acquisition, the system will try to identify a suitable pair of apical views for the analysis. If this succeeded and one click workflow is possible, the tool will launch and proceed to the result screen. If one click workflow is not possible, the tool will start up in the *Define ROI* stage with the selected apical view. If no suitable pair of apical images were found, the tool will launch and start up in the *Select View Stage*. (See Figure 8-32).

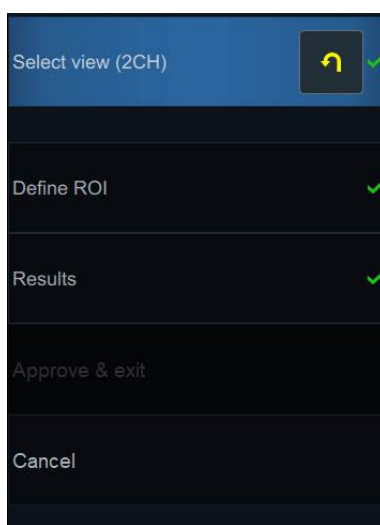


Figure 8-32. Select View stage

AutoEF on the A4CH view (Views acquired with view recognition)

If one click workflow is enabled (available with Easy AutoEF option only), the tool will proceed automatically to the result screen which shows the results for all views combined (if available). However, by clicking on any of the views in the result screen, the tool will provide the usual navigation between the stages of the AutoEF analysis. One click workflow is only available for Adult TTE raw data images.

1. When in *Define ROI* stage:

Verify that the view annotation shown to the upper left of the screen is correct. If it is not, either:

- Click the **Select View** stage button to reannotate to the correct view and proceed analyzing that image.
- Click on an A4CH image in the clipboard. This will discard analysis of the current loop and replace it with the one selected from clipboard. The tool will start in the *Select view* stage where it should be annotated as *A4CH*.

Pay attention to the left/right orientation of the image by comparing the LV wall names with a visual inspection of the image. If the image orientation is wrong:

- Go back to the *Select view* stage.
- Press **Left-Right Flip**.
- Verify the view by annotating it as *A4CH* again

NOTE: *You may alternatively exit AutoEF, invert the image and start AutoEF again.*

2. An automatic endocardial border is generated when entering the *Define ROI* stage. The endocardial border may be edited by clicking and dragging the points of the contours. See section 'ROI adjustment' on *page 8-52*.
3. When satisfied with the endocardial border, either stop moving the cursor and wait for automatic processing or click on the **Process** button. Now the system tracks the endocardium with time. On completion, it proceeds to show the results in the *EF result* screen. The endocardial border tracking must be visually controlled and validated as described below.

EF results

The *Results* stage opens with a multi frame EF result layout.

- The running loop is shown on the left. A green dotted line marks the inner border of the chamber. In case the system detects poor endocardial border tracking, the system automatically displays parts of the border in red.
- The maximal volume (ED) and minimal volume (ES) are displayed on the right side.

NOTE: Press **Go to ED** or **Go to ES** to display the ED and ES frames.

- The End Diastolic volume (EDV), the End Systolic Volume (ESV), and the resulting Ejection Fraction (EF), as well as the results for each view, are summarized in a table on the right side.

Tracking Validation

- Inspect the endocardial border tracking for the end systole and end diastole.
- If the results are visually correct, you may press **Approve and exit** to exit the tool and store the values to the worksheet, so they can be used in a report, or continue with **Approve and next view**.

Tracking correction

The following can be done if the endocardial tracking needs correction:

- Click **2CH** or **4CH** and then adjust **ES frame** and **ED frame** controls if different frames need to be selected for ES and ED.
- Edit misaligned points on the endocardial border trace as described on 'Editing the endocardial border trace' on *page 8-125*.
- Create a new endocardial border trace (See 'To create a new endocardial border trace' on *page 8-126*)

Possible causes of poor tracking

- Erroneous placement of the basal points when defining the border. If the basal points are placed too far from the annular region, the borders at the annular base will not move together with the underlying 2D image throughout the entire heartbeat.
- Erroneous placement of the apex point when defining the border. The point should be placed so that the resulting border trace covers mainly the endocardium. If the apex point is placed too high, the border trace will mainly cover the epicardium resulting in poor tracking.

Trace adjustment of the endocardial border

If the automatic endocardial border detection is not optimal the user can either adjust the trace or create a new trace as described below.

NOTE: Automatic endocardial border is based on an AI segmentation algorithm (available with Easy AutoEF option only) and is exclusively available for Adult TTE raw data images. This algorithm was trained, verified and validated on adult TTE cardiac raw data images. Note that in septal bulge cases, the automatic ROI will cut through the buldge. Unedited automatic ROI border on septal buldge cases may therefore overestimate volumes compared to manual tracing. Accuracy of running with Automatic ROI compared to manual ROI is reported in "Measurement accuracy" on page 8-238 as "accuracy w/o editing. The dataset used had recordings both with and without septal buldge cases.



WARNING

Poor tracking quality may lead to incorrect measurement results. The automatic endocardial border must be visually controlled and validated.

Editing the endocardial border trace

- Enter the Define ROI stage.
- Adjust the trace by moving the cursor over the endocardial border trace, select an anchor point and drag it to a new location. The shape of the endocardial border trace is updated accordingly.

In the upper right of the screen there is a pictogram indicating the core features of a good AutoEF ROI.

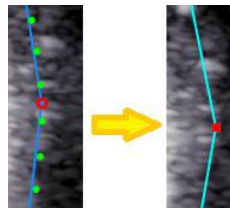


Figure 8-33. Moving an anchor on the trace

To create a new endocardial border trace

The system automatically displays a frame where the endocardial border is usually clearly visible. To use another frame, while in Define ROI stage, pause the playback by pressing Stop. Then, use the Frame slider (or rotary) to select a different frame for endocardial border definition.

To create a new automatic endocardial border trace, click the Reset stage symbol . This relaunches the automatic segmentation.

Sometimes the automatic endocardial border detection algorithm may fail to capture the correct border. In this case, a 3-Point alternative is provided.

To generate an endocardial border by this method, when in *Define ROI* stage, click on the button **3-Click**. The AutoEF tool will now prompt to click 3 landmarks. Follow the indications displayed on the screen when placing the three points.

When the third landmark is selected, an endocardial border is generated and can optionally be edited as for the automatic endocardial border.

NOTE: *If the endocardial border needs to be adjusted make sure to make the changes immediately after it is displayed, before the auto processing begins.*

NOTE: *The timing when auto processing will start is configurable (from Config).*

NOTE: *The Yo-yo function is turned on to help find correct location for the points.*

Reviewing results when using one click workflow

When using one click workflow (available with Easy AutoEF option only), several automatically processed elements should be inspected before final approval. Following items can be visually inspected from the AutoEF result screen (see Figure 8-34 on page 8-128).

What to inspect?	How to inspect?	How to edit if wrong?
View labels are correct	Check that the B-mode images correspond to the respective view labels as visible in the top left corner of each image.	Double click on the B-mode which is not corresponding to the view label. Then click the <i>Select View</i> stage in the menu and select a new image from clipboard. Continue the workflow with the new image.
ED and ES frames are correct	Check that ED and ES frames represent largest and smallest LV volume as visible in B-mode.	Double click on the B-mode with the problem or click on the 2CH/4CH button. Adjust ED/ES by using the frame sliders in the right-hand side menu or by dragging the ED/ES markers on the lower left ECG. Click Review EF to go back to the screen showing both views in ED/ES.
Tracking is correct (and thus implicitly the ROI and resulting EF is correct)	For each of the B-mode images, check that the ED and ES endocardial contours are anatomically correct with respect to the B-mode images.	Click 2CH to edit the 2CH contour or click 4CH to edit the 4CH contour. Adjust the ROI in the upper two images. Click Review EF to go back to the screen showing both views in ED/ES.

Exiting AutoEF

At any time, the tool can be cancelled by pushing the **Cancel** button. The plugin will close and any unsaved data will be lost.

When in the Results stage, the operator may click the Approve and exit button. Upon clicking this, the measurements are transferred to the worksheet and a result file with a screenshot of the result layout will be stored to clipboard. See also 'Reprocessing Data' on page 8-69.

Reprocessing data

The data from a saved AutoEF analysis may be reprocessed.

NOTE: *When doing reprocessing, if the operator chooses to store the results, the results will be treated as new analysis with new measurements in the worksheet and a new thumbnail in the clipboard.*

1. Single view analysis stored
 - Double-click on the thumbnail showing the AutoEF result layout. A dual screen is displayed showing the view result screen and the cineloop processed in that analysis.
 - Launch AutoEF. The tool will proceed to the *Results* stage. You may choose to reprocess the view already analyzed or to complete the analysis adding the missing view to the analysis.
2. Both views analysis stored
 - Double-click on the thumbnail showing the AutoEF result layout. A quad screen is displayed, showing the view result screen of the last processed view and the cineloops processed in the analysis.
 - Launch AutoEF. The tool will automatically proceed to the *Results* stage of the last processed view. You may choose to reprocess the views already analyzed or even replace the cineloops used in earlier processed views.

Cardiac Auto Doppler

Some cardiac and pediatric Doppler measurements are available in the measurements menu with an Auto button, enabling automatic measurements on Doppler spectrums.

NOTE: *The Cardiac Auto Doppler algorithm output is not affected by spectrum display settings like Compress and Reject. If these settings are modified, the trace/peak values might not appear to align with the spectrum on screen the same as it did before the modification. Thus, after adjusting spectrum display settings, you may want to readjust the tracing sensitivity to improve the fit between the displayed spectrum and the trace/peak values.*

When automatic measurement is available, the **Auto** button is visible in the Measurement menu, see Figure 8-35.

1. Select **Auto** to initiate automatic measurement detection.



Figure 8-35. Ready to start Cardiac Auto Doppler

Cardiac Auto Doppler (continued)

2. The generated trace is created and average measurement values are displayed, see Figure 8-36.

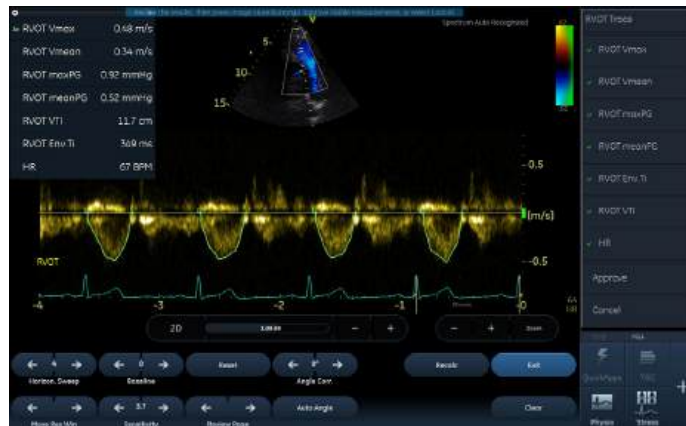


Figure 8-36. Cardiac Auto Doppler Measurement screen

NOTE: *The Cardiac Auto Doppler algorithm uses the QRS trig points from the ECG, and will run analysis on all full heart cycles displayed on screen.*

Cardiac Auto Doppler (continued)

3. The **Sensitivity** rotary can be adjusted to align the automated measurement as needed. Parameters in the list can be toggled on/off.

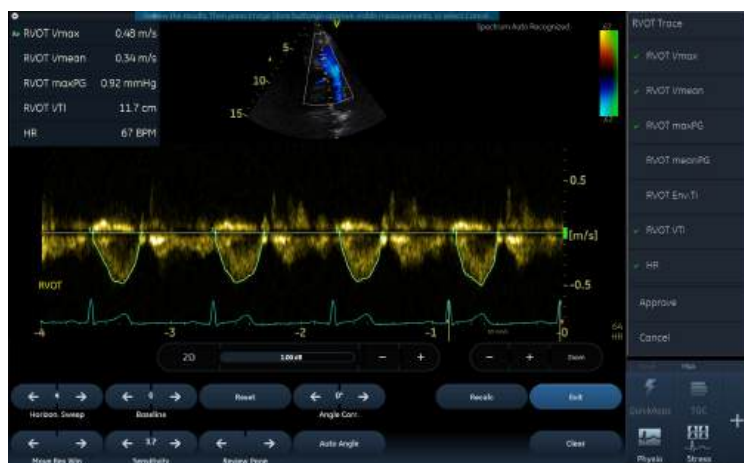


Figure 8-37. Toggle parameters on/off

NOTE: The Sensitivity changes apply only for non-rejected cycles.

Review and Approve

4. When hovering over a cycle, the cycle can be rejected or exclusively kept by selecting the corresponding symbol, see Figure 8-38. Press the **Recalc** button to restore rejected cycles.

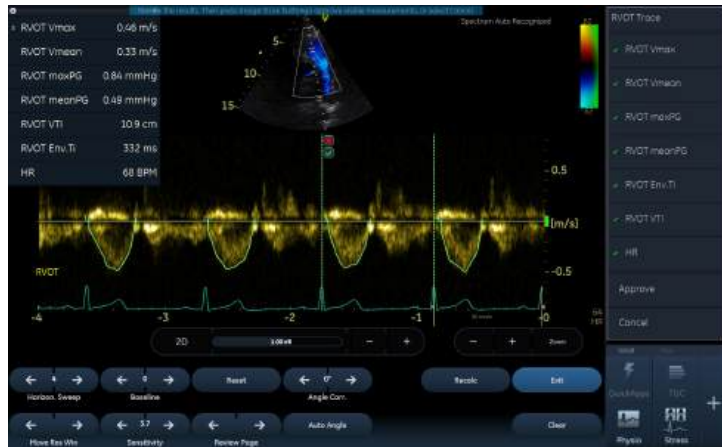


Figure 8-38. Reject or keep cycles

NOTE: When hovering over a specific cycle, the measurements will reflect only that specific cycle, indicated by the number of the cycle.

Review and Approve (continued)



The Cardiac Auto Doppler measurements use computer algorithms for envelope detection and recognition of points of interest. There is an inherent risk that these algorithms may sometimes give suboptimal or incorrect results. Verify the correctness of the displayed points and traces before storing them. All specific Cardiac Auto Doppler measurements listed in Table 8-1 on page 8-13 are based on the same underlying Cardiac Auto Doppler algorithm. Please see note in 'Measurement Uncertainties' on page 8-242 explaining the expected accuracy of Cardiac Auto Doppler when unadjusted.

5. When satisfied with all the displayed cycles, press **Approve** or **Store** to approve them.

NOTE:

*By pressing **Store**, the result values of auto measurements are approved and an image is stored to clipboard. By pressing **Approve**, the result values of auto measurements are approved, but no image is stored to clipboard. After **Approve** is pressed, additional measurements may be performed. If **Store** is pressed after these additional measurements are performed, an image showing both the results and the additional manual measurements will be stored to clipboard.*

Results

6. After **Store** or **Approve** is pressed, the results for each cycle are split into separate measurements and displayed as seen below.

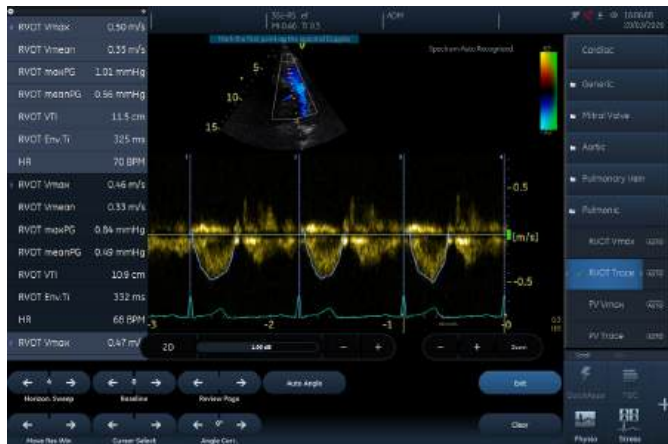


Figure 8-39. Approved measurement results

Go back to the beginning, see: '[Cardiac Auto Doppler](#)' on [page 8-130](#).

AI Auto Measure - 2D

Some Cardiac measurements are available in the measurement menu with an **Auto** button, enabling semi-automatic measurements on B-mode images.

On Parasternal Long Axis (PLAX) images recorded on adults using a Transthoracic Echocardiography (TTE) probe, the following auto 2D measurements are available: IVSd, LVIDd, LVPWd, IVSs, LVIDs, LVPWs. Parameters derived from these six measurements, including ESV, EDV, SV, EF, FS, and %FS will be automatically calculated once the measurements have been approved.

NOTE: *The Auto buttons will only appear if certain conditions are fulfilled:*

- *Adult cardiac TTE simplex B-mode image loop*
- *Depth <18 cm*
- *Contains at least one complete cardiac cycle R-R*
- *Not using a contrast application*
- *Not using write zoom*
- *Automatic view recognition identifies the loop as PLAX*

NOTE: *B-mode display settings like Compress and Gain, or any post process user adjustments, do not affect output from the AI Auto Measure - 2D algorithm.*

Initiating automatic measurements on B-mode images

1. Before pressing **Auto**, position the ECG marker in the cardiac cycle to be analyzed.
2. Select **Auto** to initiate the automatic measurements. The **Auto** buttons indicate which B-mode measurements are available, see Figure 8-40. By clicking any **Auto** button, all the available automatic B-mode measurements are performed.

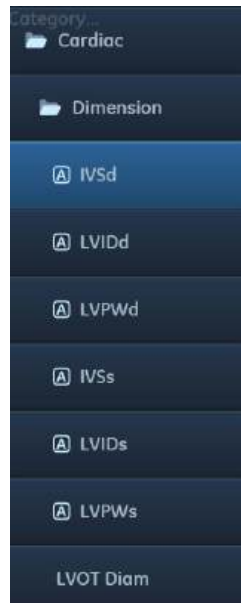


Figure 8-40. Automatic B-mode measurements

3. The display will switch to a Dual screen layout where an End Diastolic frame is shown to the left and an End Systolic frame is shown to the right, see Figure 8-41.

Initiating automatic measurements on B-mode images (continued)



- End Diastolic frame with automatically generated calipers
- End Systolic frame with automatically generated calipers

Figure 8-41. AI Auto Measure - 2D calipers

Initiating automatic measurements on B-mode images (continued)



The AI Auto Measure - 2D measurements use AI based computer algorithms for estimating the caliper end points. There is an inherent risk that these algorithms may sometimes give suboptimal or incorrect results, see the table below. Bulging septum, sigmoidal septum, foreshortened or tilted PLAX images were not used in training the algorithm. Automatic measurements on such images may not necessarily be useful. Verify the correctness of the displayed calipers, and manually adjust the caliper positions if needed, as described in the section Adjust caliper positions below, before storing them. If correctness cannot be achieved, even with manual adjustment, do not store the measurements. Note that, as an alternative, all the measurements provided by the AI Auto Measure - 2D tool can be obtained based on manual measurements in other views. The AI Auto Measure - 2D end point caliper placement algorithm was trained, verified and validated on adult cardiac images. Accuracy of running this algorithm without edits is provided in 'Measurement accuracy' on page 8-238.

Table 8-7: Expected performance of the six individual measurements provided by the AI Auto Measure - 2D tool

	IVSd	LVIDd	LVPWd	IVSs	LVIDs	LVPWs
Success rate	94%	93%	98%	98%	93%	87%

- When satisfied with the displayed calipers, press **Approve** or **Store** to approve them.

NOTE: *By pressing **Store**, the results of auto measurements are approved and transferred to Worksheet. Also, an image is stored to clipboard. By pressing **Approve**, the result values of auto measurements are approved and transferred to Worksheet, but no image is stored to clipboard.*

Adjust time frame

NOTE: The Cardiac Auto 2D algorithm uses the QRS trig point to determine End Diastole. End Systole is calculated based on End Diastole and heart rate.

1. To choose a different time frame for End Diastole, turn the **ED Frame**.
2. To choose a different time frame for End Systole, turn the **ES Frame**.
3. After modifying a frame, click **Recalc** to rerun automatic algorithm with the chosen frames as input.

*NOTE: When turning the **ED Frame** or **ES Frame**, the calipers will not update or change unless the **Recalc** button is pressed. Caliper brightness will be reduced the further away a frame is from the frame used for estimating the caliper.*

Adjust caliper position manually

1. Double-click on any caliper end point to move it.
2. Click once to set the new position.

Discarding calipers

1. Select a caliper name in the measurement menu to discard individual caliper measurements.
2. Click **Cancel** to discard all automatic measurements.

Figure 8-42 shows an example where LVPWs is discarded in the menu and thus corresponding caliper is not visible.

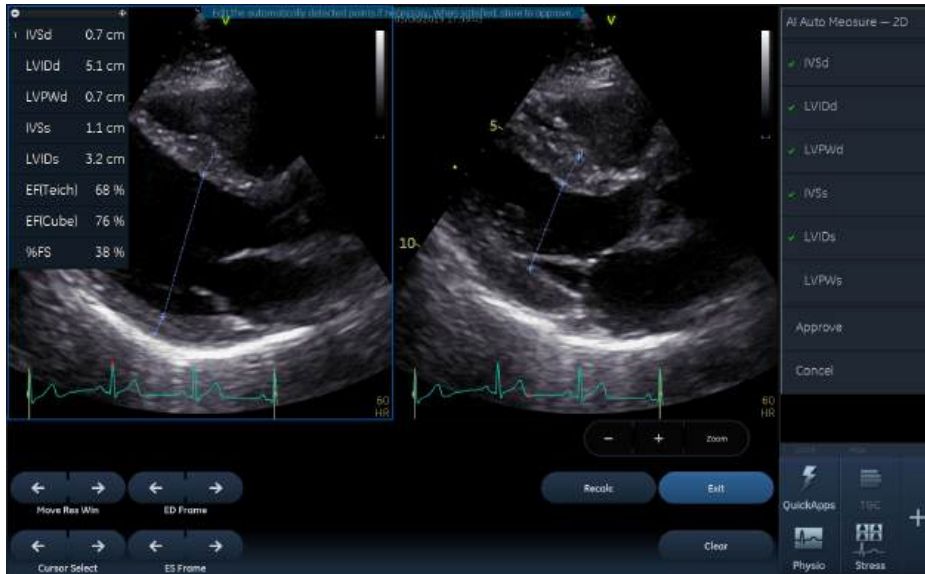


Figure 8-42. Example of discarded caliper

Pediatric Z score measurement study

Several publications exist on the relation between the size / age / sex of a patient, and measured values for different pediatric heart measurements. The most typical approach is to normalize measured values against body surface area, BSA.

NOTE: *When entering the patient's height and weight in the Patient info and exam screen (see Figure 3-63 on page 3-72), BSA will automatically be calculated.*

When BSA for a patient is known, these relations make it possible to calculate the expected value, Z_0 , for a given measurement. And after performing a measurement, a Z-score can be calculated, describing the relationship between Z_0 and the observed value:

1. The sign of the Z-score shows whether the observed value is higher or lower than expected. Values above Z_0 give positive Z-scores, values below Z_0 give negative Z-scores.
2. The magnitude of the Z-score quantifies how many standard deviations the observed value is away from Z_0 , and thus quantifies normality/abnormality.

Pediatric Z score measurement study (continued)

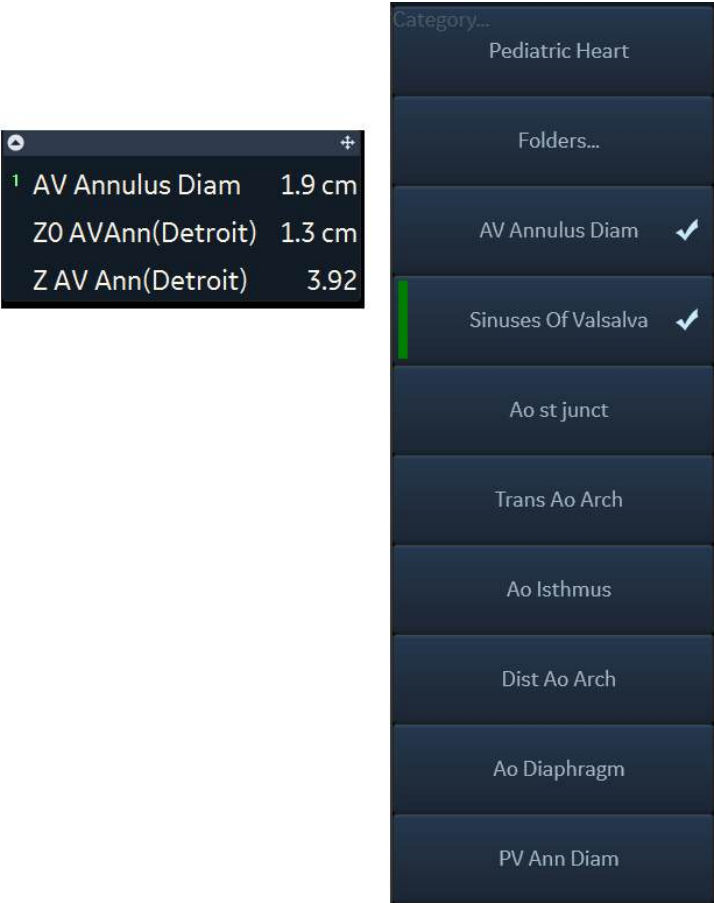


Figure 8-43. The Result Window after Measuring LVIDd

Pediatric Z score measurement study (continued)

In the example shown in figure 9-26, the measured value is higher than the Z0 value predicted by the Detroit publication, leading to a positive Z-score.

A list of supported publications and related measurements for Z-score calculations can be found in the reference manual. To select which of these should be used, enter **Config -> Meas/Text -> Measurement menu**. Under Pediatric Heart, press the Z-score button to display a dialog where it is possible to select what publication to use. It is also possible to select/deselect individual Z-score parameters by enabling/disabling them as described under 'Configuration of the Measurement menu' on *page 8-205*.

4D/Multi-plane LV measurements and analysis

Introduction

Depending on the data set, acquired by 6VT-D, the 4D TEE probe, the following 4D/multi-plane LV analysis tools are available on the Vivid *iq*:

Tool	Data set		
	4D	Tri-plane	Tri-plane TSI
4D Automated LV Quantification	page 8-145	-	-
Tri-plane LV Volume measurement	page 8-159	page 8-159	-
Bi-plane LV Volume measurement	-	page 8-163	-

4D Auto LVQ (option)

The 4D Auto LVQ (Automated Left Ventricular Quantification) tool enables the estimation of the left ventricular volumes and the ejection fraction in 4D data sets based on automatic border detection. The automatic border detection is created after placing two points in an end-diastolic apical view, one at the center of the LV base and one at the apex.

Requirements

The 4D Auto LVQ tool is available on 4D tissue data sets in replay mode only.

NOTE: *Bi-plane and tri-plane data set is not available for LVQ calculation.*



CAUTION

The tool cannot be used on 4D acquisitions with volume rate equal or lower than 12 vps.



CAUTION

DO NOT use the 4D Auto LVQ tool in these cases:

- For volume measurements: The acquisition has a volume rate lower than 20% of the heart rate, e.g., 12 vps at 60 bpm, 20 vps at 100 bpm and 30 vps at 150 bpm.
- For 4D Strain measurements: The acquisition has a volume rate lower than 40 percent of the heart rate, e.g., 24 vps at 60 bpm, 40 vps at 100 bpm and 60 vps at 150 bpm.
- The image quality is poor.
- The acquisition has stitching artifacts (see page 6-7 on how to avoid stitching artifacts).
- The acquisition has significant reverberation artifacts.
- A significant part (more than 25%) of the left ventricular walls or the detected contours are outside the ultrasound sector.
- Segments are outside the image sector.
- The lateral resolution is low.

Requirements (continued)



CAUTION

The tool must not be used on other chambers than the human adult left ventricle.

NOTE: *When the 4D Auto LVQ tool is used on Vivid iq, it is possible to store the traces, bullseye, 3D model, and measurements shown as part of the user interface to images files by pressing the **Store** button. However, if such image files are to be sent to a DICOM server using a dataflow with RAW data disabled, DICOM title bar must be enabled on the Vivid iq in order for the images to contain traces, bullseye, 3D model, and measurements as part of the stored DICOM Multiframe/Singleframe files.*

Starting the 4D Auto LVQ tool

1. Open a Full volume acquisition.
2. Press **Measure**.
3. Select **Volume/4D Auto LVQ** (Figure 8-44).

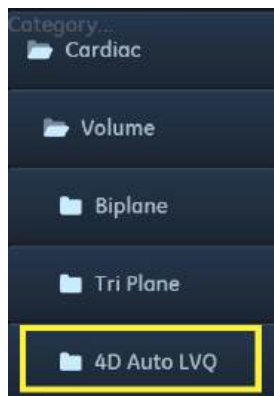


Figure 8-44. 4D Auto LVQ measurement selection

Starting the 4D Auto LVQ tool (continued)

The *Measurement* menu is displayed with the Alignment tool selected (Figure 8-44).

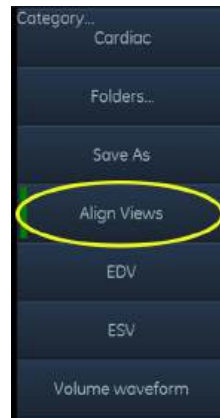


Figure 8-45. Measurement menu

The main screen displays three apical and a short axis views.

Starting the 4D Auto LVQ tool (continued)

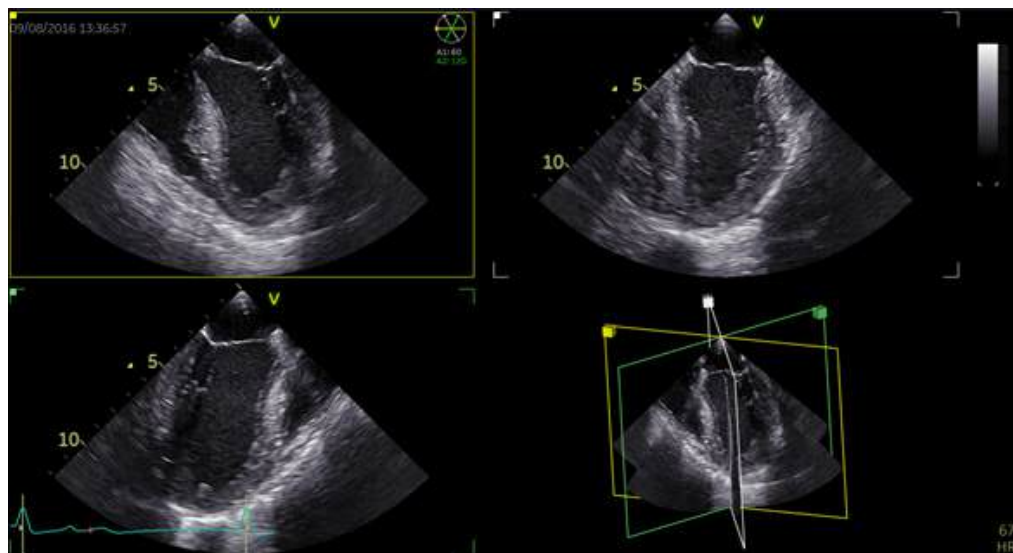


Figure 8-46. Slice alignment screen

Slice alignment

Slice alignment is used to identify the long axis of the left ventricle, the three standard apical views and the atrio-ventricular plane. Slice alignment performed and approved before running 4D Auto LVQ is used.

See page 6-30 for more information on Slice alignment.

End-diastolic volume contour detection

1. Select **EDV** (End-Diastolic Volume).

The default screen displays three apical views, three short axis views and an interactive view (Figure 8-47).

The system automatically displays the loops at the estimated end diastolic frame.

2. If the automatic end diastolic frame detection is not optimal, use the **Move ED** control to set the new end diastolic frame.
3. In one of the apical views, place two points: one at the center of the LV base and one at the apex.

A contour is automatically drawn in all views (see Figure 8-47).

NOTE: *Erroneous contour detection of the left ventricle may lead to incorrect measurement results. The contour detection should be visually checked and edited if required.*

The contour detection should be checked in all slices.

NOTE: *Press **Layout** several times on the side bar to display the apical slices in large size one by one.*

The contour detection quality can be visualized by moving the cursor through the LV and observe the contour detection in the interactive view. The position of the interactive view updates according to the cursor position in the other views.

To lock the interactive view, press **Lock view**. When the interactive view is locked the position can be controlled using the **Move view** control.

Adjust **Contour visibility** to change the display intensity of the contour (or hide it).

End-diastolic volume contour detection (continued)

To run the cineloop, press **Pause** on the Control panel.

To stop the cineloop, press **Pause** on the Control panel. The end diastolic frame is displayed.

To edit the contours, see 'Contour adjustment' on *page 8-156*.

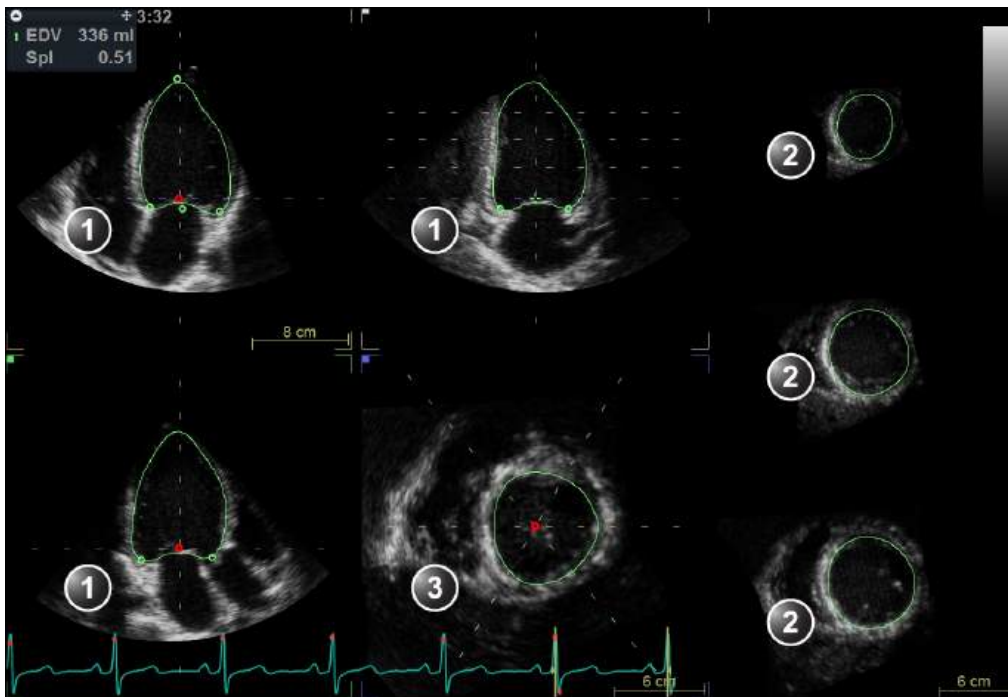
To reset the contours and start over, press **Reset**.

The following measurements are available:

- End diastolic volume
- Sphericity Index

NOTE: You can press **Store** at any point during the procedure.

End-diastolic volume contour detection (continued)



1. Apical views
2. Short axis views
3. Interactive view

Figure 8-47. Left ventricle contour detection (end-diastole)

End-systolic Volume contour detection

1. Select **ESV** (End-Systolic Volume).
The system automatically displays the loop at the estimated end systolic frame within the same heart cycle.
2. If the automatic end systolic frame detection is not optimal, use the **Move ES** control to set the new end systolic frame.
3. In one of the apical views, place two points: one at the center of the LV base and one at the apex.

A contour is drawn in all views.

NOTE: *If the Auto or Manual contour detection method was used to define the EDV contour (see step 3 on page 8-151) the same method is used for the ESV contour detection.*

NOTE: *Erroneous contour detection of the left ventricle may lead to incorrect measurement results. The contour detection should be visually checked and edited if required.*

The contour detection should be checked in all slices.

NOTE: *Press **Layout** several times on the Control panel to display the apical slices in large size one by one.*

The contour detection quality can be visualized by moving the cursor through the LV and observe the contour detection in the interactive view. The position of the interactive view updates according to the cursor position in the other views.

To lock the interactive view, press **Lock view**. When the interactive view is locked the position can be controlled using the **Move view** control.

End-systolic Volume contour detection (continued)

Adjust **Contour visibility** to change the display intensity of the contour (or hide it).

To run the cineloop, press **Pause** on the Control panel.

To stop the cineloop, press **Pause** on the Control panel. The end systolic frame is displayed.

To edit the contours, see 'Contour adjustment' on *page 8-156*.

To reset the contours and start over, press **Reset**.

The following measurements are available:

- End diastolic volume
- End systolic volume
- Ejection Fraction
- Sphericity Index
- Cardiac Output
- Stroke Volume
- Heart Rate

Contour adjustment

The contour detection should be checked. If the contour detection is not optimal, it can be adjusted by adding attracting points to the contour. An attracting point will pull the contour toward that point.

NOTE:

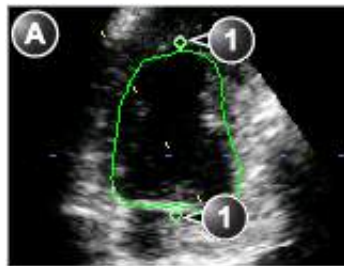
1. Place the cursor at the location where to add a point.

Attracting points can be added in any slice. Make sure to lock the interactive view if adding attractive points in the interactive view.

2. Press **Set**.

A point is added and the contour is modified (Figure 8-48).

3. To delete an attracting point, double click on the point or press **Undo**.



a. Original contour

1. Original attracting points



b. Modified contour

2. Added attracting point

Figure 8-48. Contour adjustment

Volume waveform

Display and adjustment

1. Press **Volume waveform**.

The data is processed and the *Result* screen is displayed (Figure 8-49) showing:

- The four running views with dynamic contours
- A volume waveform curve with end diastolic and end systolic markers
- A dynamic LV surface model
- The Measurement result table

NOTE: Press **Layout** on the Side bar to display a large LV surface model.

2. Press **Go to ED** to display the end diastolic frame.
Press **Go to ES** to display the end systolic frame.
3. The contour detection may still be adjusted:
 - Press **Pause** or press **Set** on any view to stop the cineloops. Scroll to correct frame.
 - Add or remove attracting points to modify the contour as described in 'Contour adjustment' on *page 8-156*.
 - Press **Volume waveform** to reprocess the data.
4. The end diastolic and end systolic markers on the volume waveform curve can be adjusted:
 - Adjust **Move ED** and **Move ES** controls to move the end diastolic and end systolic markers on the curve.

The measurement results are updated.

Display and adjustment (continued)

The following measurements are available:

- End diastolic volume
- End systolic volume
- Ejection Fraction
- Heart Rate
- Stroke Volume
- Cardiac Output
- Sphericity Index

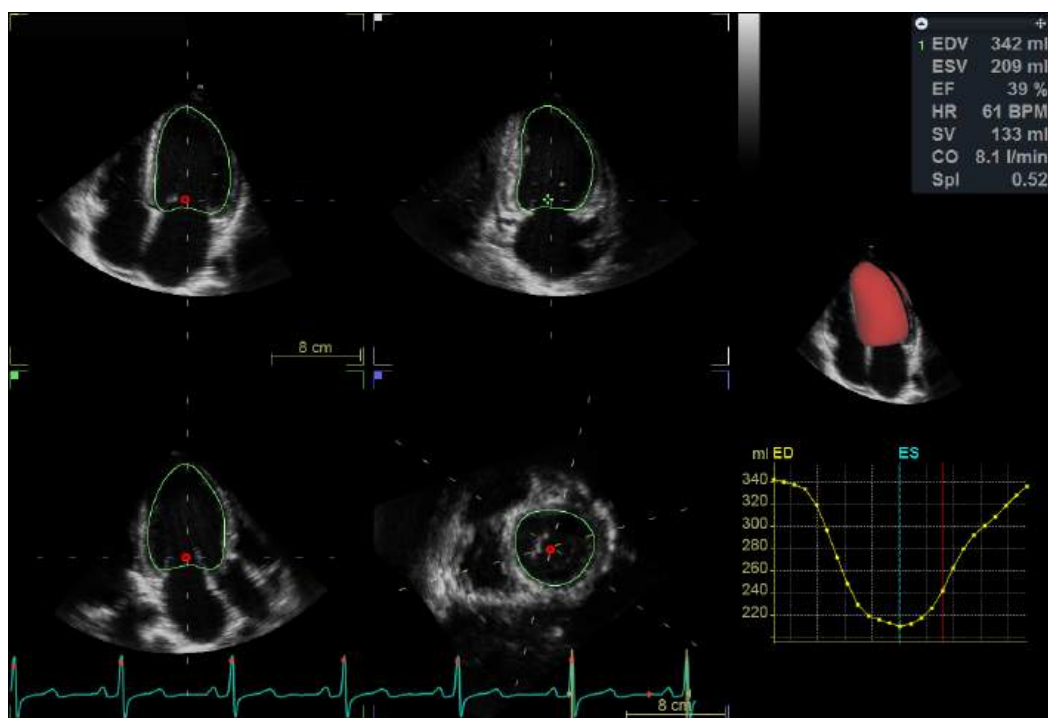


Figure 8-49. The Volume waveform screen

Manual left ventricular volume measurements

Tri-plane acquisition

This procedure describes the calculation and reconstruction of the left ventricular volume from a Tri-plane acquisition. The Tri-plane acquisition should be a Tri-plane greyscale acquisition, not a Tri-plane color acquisition.

1. In Tri-plane mode, acquire an Apical 4 chamber view in scan plane 1 (yellow).
2. Rotate scan plane 2 and 3 to display an Apical 2 chamber view in scan plane 2 (white) and an Apical long axis view in scan plane 3 (green).
3. Press **Freeze (Pause** if on a stored image).
4. Press **Measure**.

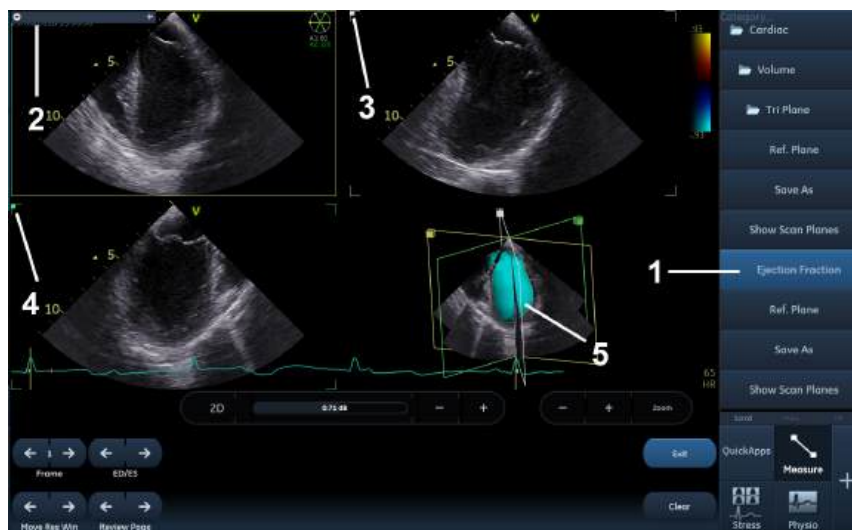
The *Measurement* menu is displayed.

5. In the *Measurement* menu select **Volume** and **Tri-plane**.

The *Measurement* screen is displayed with the *Ejection fraction tool* selected (see Figure 8-50).

The end diastolic frame of the current cardiac cycle is displayed and the cursor is moved to the reference scan plane.

Tri-plane acquisition (continued)



1. Ejection fraction tool for Tri-plane
2. Scan plane 1 (yellow): Apical 4 chamber view
3. Scan plane 2 (white): Apical 2 chamber view
4. Scan plane 3 (green): Apical long axis view
5. Volume reconstruction

Figure 8-50. The Tri-plane measurement screen

6. Place the cursor to the start point for the trace.
7. Press **Set** and draw a contour of the left ventricle.
To edit the contour while drawing:
 - Follow the contour backward to erase it and redraw.
 - Press **Undo** to erase the contour stepwise and redraw.
 - Press **Delete** to remove the entire contour and redraw.
8. Press **Set** to complete the contour.
The cursor is automatically moved to the next scan plane.
The crossing point of the trace done in the first scan plane is marked in the second scan plane.

Tri-plane acquisition (continued)

9. Draw a contour of the left ventricle in scan plane 2 and 3 following the same procedure.

When the last end-diastolic contour is drawn, an end-systolic frame is automatically displayed. The system automatically enters scroll mode. Using the trackpad, ensure that the correct end-systolic frame is displayed.

Press **Set** to leave scroll mode.

10. Repeat steps 6 to 9 to draw a contour of the left ventricle at end-systole in all the scan planes.

The measurement results, including end-diastolic and end-systolic volumes and the left ventricular ejection fraction, are displayed in the *Measurement result* table.

NOTE: *Other measurements may be displayed by configuring the Measurement menu, refer to the scanner's or workstation's User manual for more information about Measurement menu configuration.*

11. If in single screen mode, press **Layout** to display the Volume reconstruction of the left ventricle in the *Geometric model*.

12. Press **Layout** again to display an enlarged *Geometric model*.

The Volume reconstruction can be rotated in all directions (see page 8-162).

Multi beat 4D acquisition

This procedure describes the calculation and reconstruction of the left ventricular volume from a Multi beat 4D acquisition.



CAUTION

ECG gated acquisition may by nature contain artifacts, that may have impact on the measurements.

See the recommendations on page 6-7 to avoid stitching artifacts during Multi-beat 4D acquisition.

1. Using the Multi beat 4D acquisition mode (see page 6-7), acquire a 4D Apical 4 chamber image.
2. Press **Freeze**.
3. Orientate the reference cut-plane to display an Apical 4 chamber.
4. Press **Measure**.
The *Measurement* menu is displayed.
5. In the *Measurement* menu select **Volume** and **Tri-plane**.
The *Measurement* screen is displayed with the *Ejection fraction tool* selected.
6. Follow the procedure described in 'Tri-plane acquisition' on page 8-159 from step 6.

Rotation of the Volume reconstruction

The volume reconstruction displayed in the *Geometric model* can be rotated in any directions.

1. Place the pointer in the *Geometric model*.
2. Press and hold down **Set** and use the trackpad to rotate the volume reconstruction.

Bi-plane acquisition

This procedure describes the calculations of the left ventricular volume from a Bi-plane acquisition. The volume calculation is based on the Method of disk.

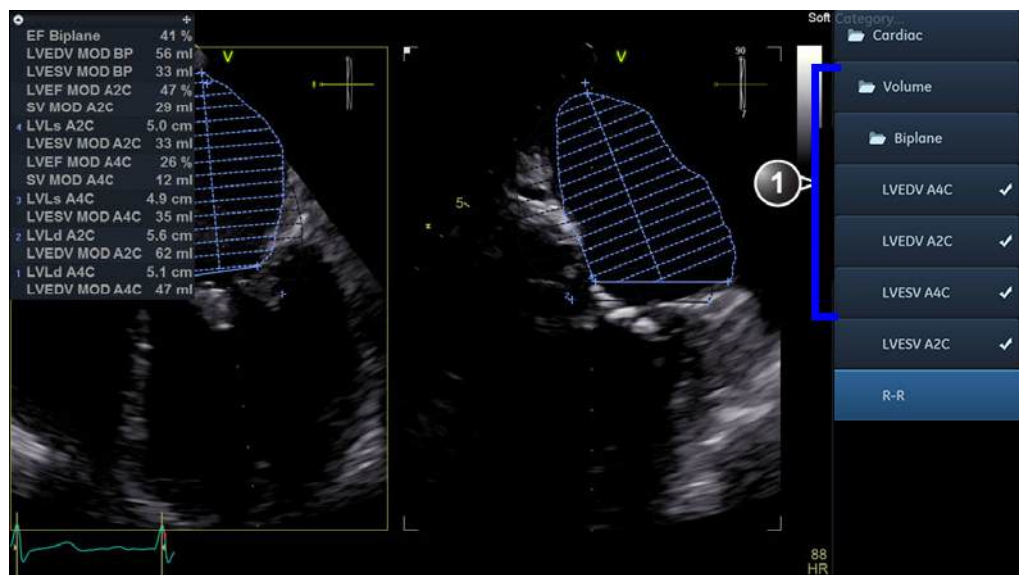
1. In Bi-plane mode, acquire an Apical 4 chamber view in scan plane 1 (yellow).
2. If required, rotate scan plane 2 to display an Apical 2 chamber view.
3. Press **Freeze**.
4. Using the trackpad, scroll through the cineloop to display the end-diastolic frame.
5. Press **Measure**.

The *Measurement* menu is displayed.

6. In the *Measurement* menu select **Volume** and **Bi-plane**.

The *Trace tool* for the Left ventricular end-diastolic volume for the Apical 4 chamber view is selected.

Bi-plane acquisition (continued)



1. Trace tools

Figure 8-51. The Bi-plane measurement screen

Bi-plane acquisition (continued)

7. In scan plane 1 (yellow), place the cursor to the start point for the trace.
8. Press **Set** and draw a contour of the left ventricle.
9. Move the cursor to the apex and press **Set** to measure the length.

The trace tool for the Left ventricular end-diastolic volume for the Apical 2 chamber view is selected.

10. Repeat steps 8 and 9 in the scan plane 2 (measurement in the Apical 2 chamber view).

The trace tool for the Left ventricular end-systolic volume for the Apical 4 chamber view is selected.

11. Using the trackpad, scroll through the cineloop to display the end-systolic frame in the same heart cycle.
12. Press **Trackpad** to activate the **M&A** tool.
13. Repeat steps 7 to 10 to perform the end-systolic measurements in the Apical 4 chamber and 2 chamber views.

The Ejection fraction (Bi-plane) and the end-diastolic and end-systolic left ventricular volumes are calculated.

4D Auto MVQ

The 4D Auto MVQ (Automated Mitral Valve Quantification) tool allows the user to perform computer assisted identification and segmentation of 4D TEE images of the Mitral Valve (MV). Upon completion of the segmentation the tool will provide metrics for the MV annulus and leaflet during systole.

The 4D Auto MVQ tool is an option for Vivid *iq* when 4D is enabled.

Requirements

4D Auto MVQ is available on 4D trans-esophageal echocardiographic (TEE) tissue data sets in replay mode only.

NOTE: *Bi-plane and tri-plane data set is not available for MVQ calculation.*



CAUTION

The results may be inaccurate when the tool is used on loops with volume rate lower than 12 vps.



CAUTION

DO NOT use the 4D Auto MVQ tool if:

- The image quality is poor.
- The acquisition has stitching artifacts (see page 6-7 on how to avoid stitching artifacts).
- The acquisition has significant reverberation artifacts.
- Any part of the valve or annulus is outside the ultrasound sector.
- The lateral resolution is low.



CAUTION

The tool must not be used on other structures than the mitral valve.

Starting 4D Auto MVQ

1. Open a 4D TEE acquisition. The acquisitions should be made from mid-esophagus centered on the mitral valve either from the full view or using 4D Zoom.
2. Press **Measure**.
3. Select **Valve/4D Auto MVQ** (Figure 8-52)

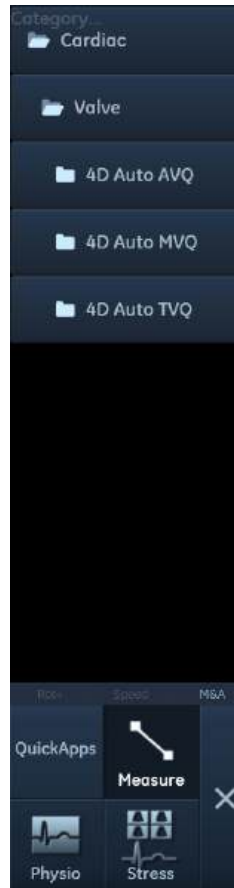


Figure 8-52. Selecting the 4D Auto MVQ tool.

Starting 4D Auto MVQ (continued)

The *Measurement* menu is displayed with the *Align Views* tool selected (Figure 8-53).

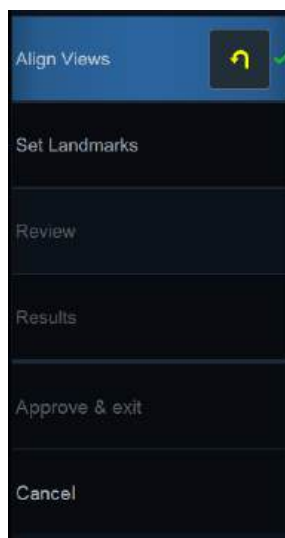


Figure 8-53. Measurement menu

Align Views

Align Views stage presents to the user two long axis slices (90-degree rotated with respect to each other) and short axis 3D view at the annulus plane (Figure 8-54).



Figure 8-54. Align Views screen

Align Views (continued)

The alignment of the data must be performed in order to identify standard views: Mitral-Commissural view (MC, top left), Antero-Posterior Long Axis view (APLAX, top right) and short axis 3D view aligned with MV annulus (Figure 8-54).

To perform optimal alignment:

- Translate and tilt SAX plane so that it is aligned and just above MV (on atrium side) in APLAX and MC views.
- In APLAX and MC views, translate and tilt the SAX plane so that their intersection is in the center of MV.
- Adjust the center line in APLAX And MC so that their intersection is in the center of MV.

MC, APLAX, and SAX are always orthogonal in all views.

The user must identify in the sequence the frames corresponding to end-diastole (ED) and end-systole (ES)

1. ED and ES are automatically estimated and **Set ED** and **Set ES** buttons can be used to modify and correctly mark ED and ES frames.
2. To select another frame adjust the **Frame** control.

Set Landmarks

1. Select **Set Landmarks**.

The default screen displays two long axis views (MC and APLAX) and short axis 3D view at the annulus plane aligned according to surgical view (the 3D looking from atrium to MV and with aortic valve on top) (Figure 8-55).

2. Place landmarks on: two mitral annulus hinge points (MA1 and MA2) on MC view and on APLAX view on Posterior annulus hinge (P), Anterior annulus hinge (A), Coaptation (Coap) and Right Sinus Aortic Annulus (Ao) points.
3. When last landmark is placed segmentation is automatically launched.



Figure 8-55. Set Landmark stage

Review

1. The *Review* stage is automatically entered.
The default screen displays: (1) MC long axis views, (2) LAX views, (3) short axis 3D view at the annulus plane aligned according to surgical view (the 3D looking from atrium to MV and with aortic valve on top) and (4) an interactive 3D view of segmented MV (Figure 8-56).

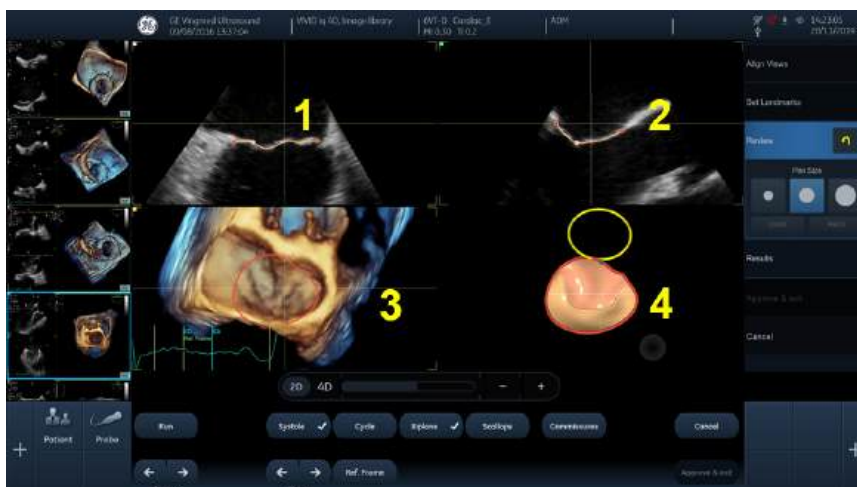


Figure 8-56. The Review stage

Review (continued)

2. The MV segmentation should be checked in all slices. To visualize the MV segmentation in all slices, rotate the reference slices in short axis view (dotted lines) and observe the segmentation in the interactive view. In 3D interactive view the model laser lines update according to slice position in the 3D short axis view. The segmentation is correct when segmented model overlaps MV leaflets.

NOTE: *Erroneous contour detection of the mitral valve may lead to incorrect measurement results. The contour detection should be visually checked and edited if required.*

3. The MV segmentation may be adjusted by clicking and dragging leaflet contours in 2D views or by clicking and dragging handles (dots on annulus and on leaflet free edges).
4. In commissure layout the user can modify commissure points. On left 3D image the user can place mouse cursor on one of the commissures while loop is playing and click. Computation is launched and after few seconds the modified MV model is displayed.

Results (continued)

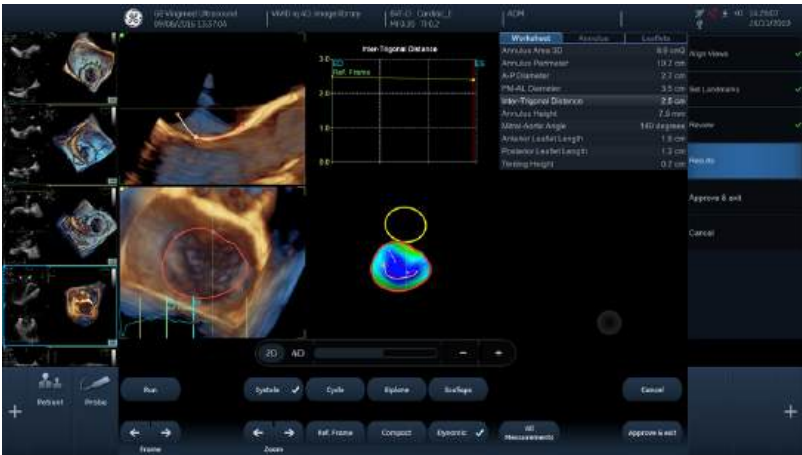


Figure 8-58. The Results screen, showing Dynamic Layout

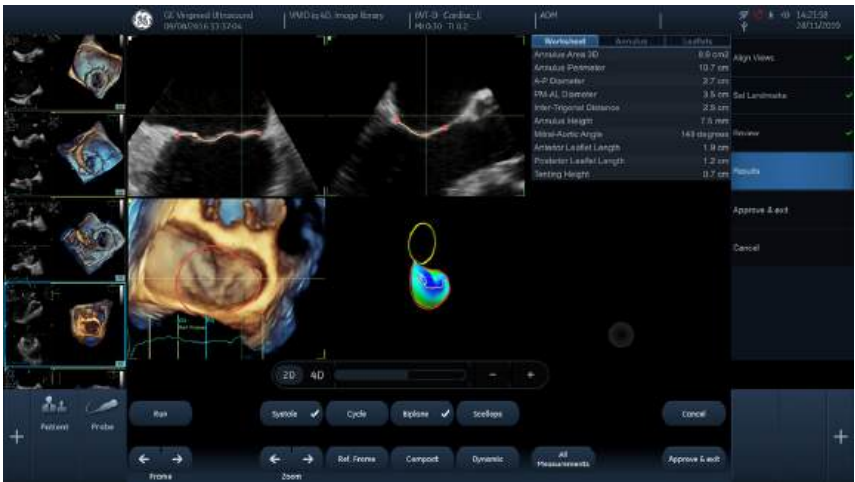


Figure 8-59. The Results screen, showing Measurement layout

Approval



CAUTION

The 4D Auto MVQ tool involves partly automated steps (automatic segmentation of MV). There is an inherent risk that these steps may fail. Verify the correctness of the borders, tracked points and 3D model using the displayed verification graphics in the tool before approving.

Press **Approve and exit** to store the measurements shown in the *Worksheet* tab of the measurement table.

The measurements are transferred to the Worksheet.

To exit without approving, press **Cancel**.

NOTE: Measurements that are not approved will not be saved.

4D Auto AVQ (option)

Introduction

The 4D Auto AVQ (4D Automated Aortic Valve Quantification) tool allows the user to perform computer assisted alignment of 4D TEE images of the Left Ventricular Outflow Tract (LVOT) as well as segmentation of the LVOT and aortic root. Upon completion of the segmentation the tool will provide metrics for the aortic annulus diameter and area.

Requirements

The 4D Auto AVQ tool is available on 4D trans-esophageal echocardiographic (TEE) tissue data sets in replay mode only.

NOTE: *Bi-plane and tri-plane data set is not available for LVQ calculation.*



CAUTION

The tool cannot be used on acquisitions with volume rate equal or lower than 12 vps.



CAUTION

DO NOT use the 4D Auto AVQ tool if:

- The image quality is poor.
- The acquisition has stitching artifacts.
- The acquisition has significant reverberation artifacts.
- The lateral resolution is low.
- Segments are outside the image sector.



CAUTION

The tool must not be used on other structures than the aortic valve.

Starting the 4D Auto AVQ tool

1. Open a 4D TEE acquisition. The acquisitions should be made from mid-esophagus roughly centered on the aortic valve using 4D Zoom.
2. Press **Measure**.
3. Select **Valve/4D Auto AVQ**.

The Measurement menu is displayed with the Alignment tool selected.

The main screen displays two long axis slices (90 degree rotated with respect to each other), a short axis view at the annulus plane and a free view (Figure 8-60).



Figure 8-60. Slice alignment screen

Slice alignment

The alignment of the LVOT is done automatically, presenting to the user two long axis slices (90-degree rotated with respect to each other) and short axis view at the annulus plane (Figure 8-60).

1. To select another frame adjust the **Frame** control.
2. If necessary the auto alignment can be further adjusted by rotating any of the views and by moving the annulus plane.

LVOT segmentation

1. Select **LVOT segmentation**.

The default screen displays two long axis views, one short axis view, an interactive view and a surface model (Figure 8-61).

The LVOT is automatically segmented and the result is presented in the mid-systolic frame (defined as 15% of the R-R interval). The segmentation is shown as curves where the 3D LVOT boundary intersects the 2D slices as well as a surface model.

2. The LVOT segmentation should be checked in all slices. To visualize the LVOT segmentation in all slices, move the blue line through the LVOT in one of the long axis views and observe the segmentation in the interactive view. The position of the interactive view updates according to the blue line position in the long axis view.
3. The LVOT segmentation may be adjusted by adding attracting points in the interactive view.
 - Press **Lock view** to lock the interactive view.
 - Place the cursor at the location where to add a point.
 - Press **Set**.

A point is added and the segmentation is modified.

LVOT segmentation (continued)



1. Long axis view
2. Short axis view
3. Interactive view
4. 3D surface model

Figure 8-61. LVOT segmentation

Measurements

1. Select **Measurements**.

The final segmentation result is shown along with a graph showing the aortic annulus(AA) area in relation to the SAX plane lateral position (distance from aortic valve).

The following measurements are available:

- AA diameter: diameter calculated based on the perimeter of the segmentation in the aortic annulus plane at mid-systole
- AA max diameter: length of the major semi-axis of an ellipse fit to the aortic annulus at mid-systole.
- AA min diameter: length of the minor semi-axis of an ellipse fit to the aortic annulus at mid-systole
- AA area: area of the detected aortic annulus at mid-systole

Approval

1. Press **Approve and exit** to store the measurements shown in the *Measurement result* table.

The measurements are transferred to the Worksheet.

To exit without approving, press **Cancel**.

NOTE: *Measurements that are not approved will not be saved.*

Advanced vascular measurements and analysis

Naming format for vessels

When you want to measure a vessel, on the Measurement Window, you select the folder for the vessel. Many vessel folders are labeled with an abbreviation. The following table lists abbreviations used for naming vascular vessels.

Table 8-8: Vascular Vessel Abbreviations

Acronym	Name
ACA	Anterior Cerebral Artery
Acc RA	Accessory Renal Artery
AComA	Anterior Communicating Artery
Anast	Anastomosis
ArcA	Arcuate Artery
ATA	Anterior Tibial Artery
ATV	Anterior Tibial Vein
AVF	Arteriovenous Fistula
Axill	Axillary Artery
Axill V	Axillary Vein
BA	Basilar Artery or Brachial Artery
Bas V	Basilic Vein
BasV Antecub	Basilic Vein Antecubital Fossa
BIF IMT F/N	Bifurcation Intima Media Thickness Far/Near
Brac V	Brachial Vein
CA	Celiac Artery
CCA	Common Carotid Artery

Table 8-8: Vascular Vessel Abbreviations (Continued)

Acronym	Name
Ceph V	Cephalic Vein
Ceph V Antecub	Cephalic Vein Antecubital
CFA	Common Femoral Artery
CFV	Common Femoral Vein
CHA	Common Hepatic Artery
Com Femoral	Common Femoral Artery
CIA	Common Iliac Artery
CIV	Common Iliac Vein
Com Iliac A	Common Iliac Artery
DFA	Deep Femoral Artery
DFV	Deep Femoral Vein
Dors Pedis	Dorsalis Pedis
DPA	Dorsalis Pedis Artery
ECA	External Carotid Artery
EIA	External Iliac Artery
EIV	External Iliac Vein
Fr. Branch	Frontal Branch
FV	Femoral Vein
GBWall	Gall Bladder Wall
GDA	Gastro duodenal Artery
GR	Graft
GSV	Greater Saphenous Vein
HA	Hepatic Artery
Hilar A	Hilar Artery
HV	Hepatic Vein
IIA	Internal Iliac Artery
IIV	Internal Iliac Vein
ICA	Internal Carotid Artery (Transcranial Doppler)
ICA	Interior Carotid Artery (Carotid Artery)
IJV	Internal Jugular Vein

Table 8-8: Vascular Vessel Abbreviations (Continued)

Acronym	Name
IMA	Inferior Mesenteric Artery
IMT	Intima Media Thickness
IMV	Inferior Mesenteric Vein
Inn	Innominate
Int. Lobular A	Interlobular Artery
IVC	Inferior Vena Cava
LSV	Lesser Saphenous Vein
MCA	Middle Cerebral Artery
Mcub V	Median Cubital Vein
Mid Hep V	Middle Hepatic Vein
MPV	Main Portal Vein
MRA	Main Renal Artery
Par. Branch	Parietal Branch
PCA	Posterior Cerebral Artery
PComA	Posterior Communicating Artery
Peron	Peroneal
POP	Popliteal
Pseudo	False Artery (aneurysm)
PTA	Posterior Tibial Artery
PTV	Posterior Tibial Vein
PV	Portal Vein
RA	Renal or Radial Artery
RV	Renal or Radial Vein
SA	Splenic Artery
Sap Fem Junc	Sapheno-Femoral Junction
Seg. A	Segmental Artery
SFA	Superficial-Femoral Artery
SFJV	Sapheno-Femoral Junction Vein
SMA	Superior Mesenteric Artery
SMV	Superior Mesenteric Vein

Table 8-8: Vascular Vessel Abbreviations (Continued)

Acronym	Name
SSV	Small Saphenous Vein
STA	Superficial Temporal Artery
SUBC	Subclavian Artery
SUBC V	Subclavian Vein
SV	Splenic Vein
SV Pop Junc	Small Saphenopopliteal Junction
TCD	Transcranial Doppler
TIPS	Transjugular Intrahepatic PortalSystemic Shunt
UA	Ulnar Artery
UV	Ulnar Vein
VERT	Vertebral Artery
VES	Vessel

Intima-Media Thickness

Introduction

IMT is not available for Vivid *iq* Standard package.

The Intima-Media Thickness (IMT) is calculated based on automatic contour detection of the Intima and Media layers on a user-defined search region along the vessel wall. Multiple IMT measurements are made between pairs of intima and adventitia points along the wall (Figure 8-62). IMT can be measured both on the posterior and the anterior walls of the vessel. IMT should be done on 2D mode images, not on Color mode images.

The IMT measurement is available with linear probes only.

NOTE: *Due to the physical properties of ultrasound imaging, the posterior IMT measurement is generally more accurate than the anterior IMT measurement.*

The following parameters are calculated:

- Average IMT
- Maximum IMT
- Minimum IMT
- Standard deviation of IMT measurements
- Number of successful IMT measurements

Introduction (continued)

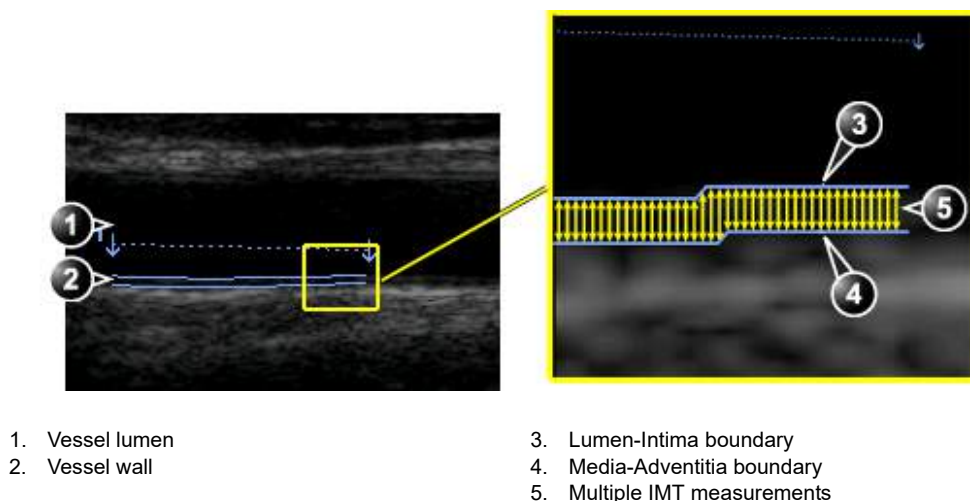


Figure 8-62. IMT measurement (Posterior wall)

IMT Measurement procedure

The following procedure describes the posterior IMT measurement.

1. Acquire a longitudinal scan of the carotid artery and optimize the image.
2. Press **Freeze**.
3. Scroll to an end-diastolic frame where the intima layer is clearly visible.
4. Press **Measure**.
5. Select the appropriate IMT measurement. If measuring the IMT of the posterior wall of the right common carotid select **Rt** and **CCA IMT Post** (Figure 8-63).

IMT Measurement procedure (continued)

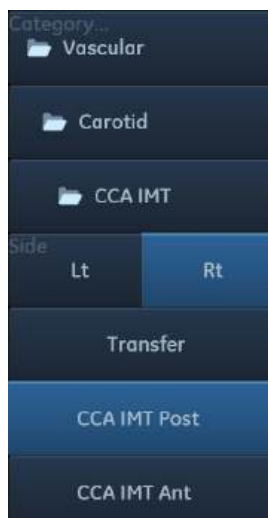


Figure 8-63. IMT Measurement menu (Right Common Carotid Posterior IMT measurement tool)

6. Place the cursor in the artery closer to the posterior wall and press **Set** to anchor the start of the search region (Figure 8-64, left).

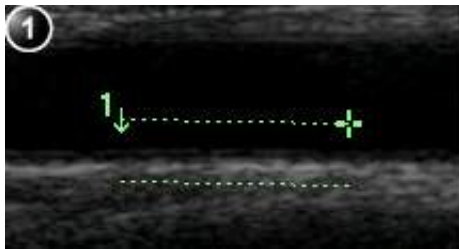
IMT Measurement procedure (continued)

7. Move the cursor parallel to the artery to define the end point of the search region. Make sure the Intima and Media layers are within the search region (indicated by the lower dotted line in Figure 8-64, left).

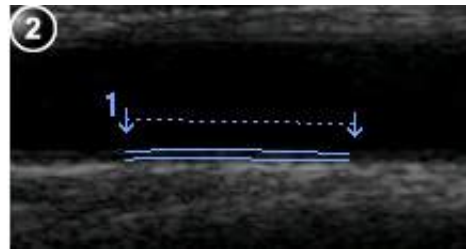
Press **Set** to anchor the point. For the posterior wall the contour detector searches for the leading of the edges of the intima and adventitia layers. The detected contours are drawn in the image (Figure 8-64, right).

The measurement calculations are displayed in the *Measurement result* table.

NOTE: *If the Intima and Media layers are not within the search region, the contour is not drawn. Select (double click) and move the anchored points closer to the Intima layer.*



1. Measurement segment



2. IMT trace

Figure 8-64. IMT Measurement segment and traces

8. If the contour is not optimal, adjust **Trace Fit** to modify the traces according to different threshold values.

If the contour is still not optimal, try to perform the IMT measurement on another frame, preferably close to the end diastole.

IMT trace approval

NOTE: Erroneous contour detection of the Intima and Media layers may lead to incorrect measurement results. The contour detection should be visually checked and edited if required.

Since the IMT measurements are done semi-automatically, the operator has to approve the detection by visual inspection before storing the results in worksheet and report.

1. If the traces fit both layers of the posterior wall, approve the measurement by selecting **Transfer** in the *Measurement* menu.

Once transferred, the calculations can be viewed in the worksheet and report.

NOTE: Measurements that are not approved will not be saved.

*NOTE: Any image adjustments (e.g Gain or zoom) on approved (transferred) measurements will unassign the measurements. Press **Transfer** to approve the measurements again.*

Pediatrics Calculations

Overview

Pediatrics measurements offer two different types of measurement studies:

- Generic. The Generic Calculations study is common to all applications. See 'Assign and Measure modality' on *page 8-7 for more information*.
- Pediatric Hip (PedHip).

This section describes Pediatrics 2D-Mode measurements.

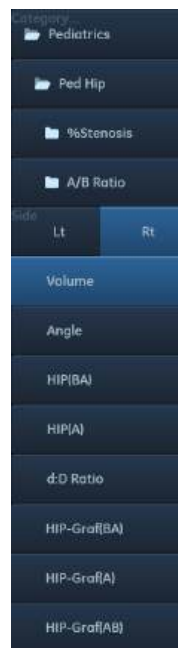


Figure 8-65. Pediatrics B-Mode Measurement Side Bar

Overview (continued)

The following generic measurements are common to other exam applications:

- %Stenosis
- Volume
- Angle
- A/B Ratio

See '2D-Mode' on *page 5-3 for more information.*

Hip Dysplasia Calculation

The HIP calculation assists in assessing the development of the infant hip. In this calculation, three straight lines are superimposed on the image and aligned with the anatomical features. The two angles are computed, displayed, and can be used by the physician in making a diagnosis.

The three lines are:

1. The baseline connects the osseous acetabulum convexity to the point where the joint capsule and the perichondrium unite with the iliac bone.
2. The inclination line connects the osseous convexity to labrum acetabulare.
3. The Acetabulum roof line connects the lower edge of the osilium to the osseous convexity.

The α (Alpha) angle is the supplement of the angle between 1 and 3. It characterizes the osseous convexity. The β (Beta) angle is the angle between lines 1 and 2. It characterizes the bone supplementing additional roofing by the cartilaginous convexity.

Making Hip Dysplasia Measurement

To make a Hip Dysplasia measurement:

1. From the Side Bar, select either the **right** or **left side** (orientation) and then select **HIP(BA)**.
A horizontal dotted line displays.
2. To place the baseline, use the **Trackpad**. Position the crosshairs edge at the osseous convexity of the ilium.
3. To rotate or change inclination, adjust the **HIP Rotate**.
4. To fix the baseline, press on **Set** button.
The system displays a second dotted line at an angle.
5. To place the line along the inclination line of the osseous convexity to labrum acetabulare, use the **Trackpad**.
6. To rotate or change inclination, adjust the **HIP Rotate**.
7. To fix the second measurement line, press on **Set** button.
The system displays a third dotted line at an angle.
8. To place the caliper along the acetabular roof line, use the **Trackpad**.
9. To rotate or change inclination, adjust the **HIP Rotate**.
10. To fix the third measurement line and complete measurement, press on **Set** button.

The system displays the hip measurements (α and β) in the Results Window.

Alpha HIP

The Alpha HIP measurement measures the angle between the iliac baseline and the bony roof line. To make an Alpha HIP measurement:

1. From the Side Bar, select either the **right** or **left side** (orientation) and then select **HIP(A)**
A horizontal dotted line displays.
2. To place the baseline, use the **Trackpad**. Position the crosshairs edge at the osseous convexity of the ilium.
3. To rotate or change inclination, adjust the **HIP Rotate**.
4. To fix the baseline, press on **Set** button.
The system displays a second dotted line at an angle.
5. To place the caliper along the acetabular roof line, use the **Trackpad**.
6. To rotate or change inclination, adjust the **HIP Rotate**.
7. To fix the second measurement line, press on **Set** button.
The system displays the alpha hip measurement (α) in the Results Window.

d:D Ratio Measurement

The d:D Ratio measurement measures the percentage of the femoral head coverage under the bony roof. To make this measurement:

1. From the Side Bar, select either the **right** or **left side** (orientation) and then select **d:D Ratio**.
A horizontal dotted line displays.
2. Use the **Trackpad** to place the baseline along the ilium. Position the crosshairs edge at the osseous convexity of the ilium.
3. To rotate or change inclination, adjust the **HIP Rotate**.
4. Press on **Set** button to fix the baseline.
5. The system displays a circle representing the femoral head. Use the **Trackpad** to position the circle.
6. Use the **HIP Rotate** to size the femoral head circumference.
7. Press on **Set** button to fix the femoral head circumference.

The system displays the d:D ratio for the femoral head in the Results Window.

OB measurements and calculations

1. From an obstetric exam on a scan in Freeze, press **Measure**.
2. Select the desired study.
3. Perform the required measurements from the selected study.

Follow the on-screen indications when performing measurements.

OB graphs

OB Graphs allow you to assess fetal growth compared to a normal growth curve. When a patient has completed two or more ultrasound exams, you can also use the graphs to look at fetal trending. For multi-gestational patients you can show curves for all fetuses and compare the growth on the graphs. The Vivid *iq* provides the following two basic types of graphs:

- **Fetal Growth Curve graphs** – shows one measurement per graph. These graphs show the normal growth curve, positive and negative standard deviations or applicable percentiles, and ultrasound age of the fetus using the current measurement. For multi-gestational pregnancies, you can show curves for all fetuses. If previous exam data is available, the graph can show fetal trending.
- **Fetal Growth Bar graph** – shows the ultrasound age and the gestational age based on patient data. Plots all measurements on one graph.



CAUTION

The system provides calculations (e.g. estimated fetal weight) and charts based on published scientific literature. The selection of the appropriate chart and clinical interpretation of calculations and charts are the sole responsibility of the user. The user must consider contraindications for the use of a calculation or chart as described in the scientific literature. The diagnosis, decision for further examinations and medical treatment must be performed by qualified personnel following good clinical practice.

To view OB graphs

1. Press **Worksheet**.
2. Press **Graph**.

The Fetal growth curve graph is displayed. The horizontal axis shows the fetal age in weeks. The system determines this age from the data entered in the *Patient info and exam* screen. Depending on the measurement selected the vertical axis displays measurements (mm or cm), ratios (%) or fetal weight (g).

The Fetal growth curve graph shows the following information for the selected measurement:

- The normal growth curve
- The standard deviations or relevant percentiles
- The gestational age of the fetus, using patient data (vertical dotted line)
- Using the current ultrasound measurement data, where the fetus is on the growth curve

From the OB graphs screen, the user can enter relevant information in the *Fetus position* and *Placenta* fields.

To select the measurement

1. Select the measurement in the *Measurement type* field.
A list of available measurements is displayed.
2. Select the measurement to display.

To select the age to use

1. Adjust **Select GA**.

The plot displays either gestational age (GA) from the LMP, or the composite ultrasound age (CUA).

When selected, the gestational age may be changed by the user.

1. Select the **GA (LMP)** value.

An editing window is displayed.

2. Enter a new value and select **OK**.

The GA (LMP) label is changed to GA(GA) showing the new value entered. This information is also updated in the *Patient info and exam* screen. In addition the EDD (LMP) is updated to EDD (GA) with new calculated value.

To view single or quad screen

1. Press **Quad** to display four graphs simultaneously.
2. To select the measurements to display in the quad screen, select the drop-down button on the left of each graph and select the desired measurement.
3. Press **Single** to display single graph screen again.

Fetal trending

When you have ultrasound data from more than one exam of a patient, you can use the data to look at fetal trending on the Fetal growth curve graphs. Fetal trending requires that a LMP value is entered in the *Patient info and exam* screen.

1. Press **Worksheet**.
2. Press **Graphs** and select the desired measurement to display.
3. Press **Plot both**.

The system automatically finds the data from previous ultrasound exams, and displays it on the graph with the present data.

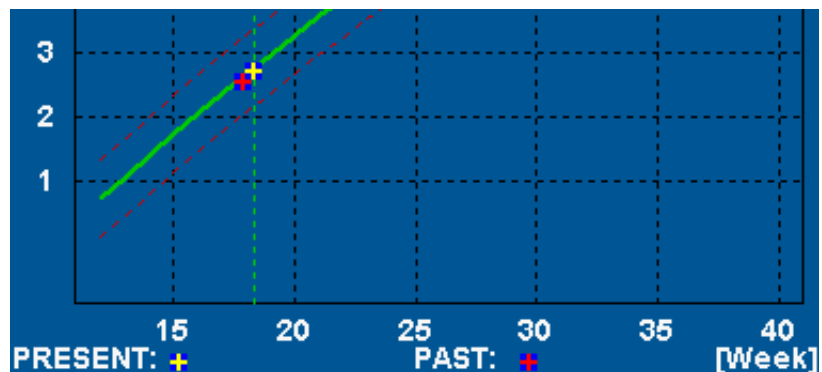


Figure 8-66. Fetal trending graph

Fetal growth bar graph

The fetal growth bar graph shows current exam measurements and the normal growth range based on the gestational age. It shows all measurements on one graph.

1. Press **Worksheet**.
2. Press **Graph**.
3. Press **Bar**.

The fetal growth bar graph is displayed.

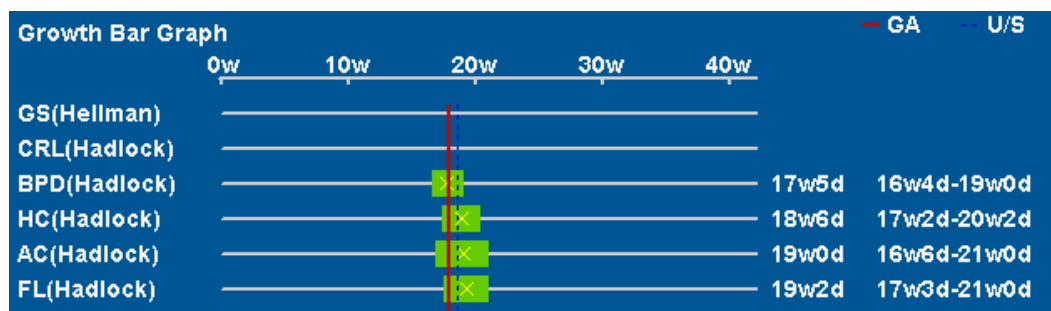


Figure 8-67. Fetal growth bar graph

- The horizontal axis shows the gestational weeks.
- The red vertical line shows the gestational age using the patient data.
- The blue dotted vertical line shows the ultrasound age using the current measurements.
- The yellow x shows the ultrasound age for each measurement.
- The green rectangle shows the normal age range for the measurement.

Measurement package configuration

There are many more measurements and parameters in the measurement package than shown in the default *Measurement* menu. Use the configuration system to set up the measurements that should be available in the *Measurement* menu and which parameters should be calculated.

A list of all cardiac calculations with needed measurements and location in the Measurement package can be found in the Reference manual.

Basic operations

Opening the Measurement configuration package

1. Press **Config** on the Shortcut Bar and select the category **Measure/Text**.

The *Measurement menu* sheet is displayed (Figure 8-68).

Display of the Measurement categories

1. Press **M&A categories** in the *Configuration* window.
The M&A categories are displayed in a pop-up window.
2. Check the categories to be displayed.

Uncheck the categories to hide.

To select a Measurement category in the *Measurement* menu:

1. Select the heading of the *Measurement* menu.
The measurement categories are displayed in a sub-menu.
2. Select the Measurement category to display.

Moving an item in the Measurement menu

1. Select an entry in the *Measurement* menu.
2. Press  or  to move the selection up or down inside the *Measurement* menu.

Deleting an item in the Measurement menu

Only user-created items can be deleted.

1. Select an entry to delete in the *Measurement* menu.
2. Press  to delete the item.

Display/hide a folder or a measurement in the Measurement menu

The Measurement menu (Folders and Measurements) can be configured to display only the entries (folders and measurements) of interest.

To hide a folder or a measurement:

1. Uncheck the actual folder or measurement in the *Folder* or *Measurement* field in the *Configuration* window.

To display a hidden folder or measurement:

1. Check the actual folder or measurement in the *Folder* or *Measurement* field in the *Configuration* window.

Auto-sequence of measurements within a folder

1. In the *Measurement menu* sheet, select a folder in the *Measurement* menu.
2. Check **Auto sequence**.

When performing the first measurement in the folder, the next measurement is automatically selected.

Creating a user-defined folder

1. If the folder is to be inside another folder, select the actual folder in the *Measurement* menu.
2. Press **Add folder**.
The *Measurement* menu is updated.
3. Enter the folder name in the *Name text* field.

Measurement package configuration - example

The following example based on calculation of AV CO (Cardiac Output by Aortic Flow) describes how to configure the measurement package so that necessary measurements and the resulting calculations are displayed on screen.

Calculation of Cardiac Output by Aortic Flow requires the measurement of:

- AV diameter located in the folder *Dimension* (2D mode)
- AV VTI located in the folder *Aortic* (Doppler AV Trace).
- Heart rate

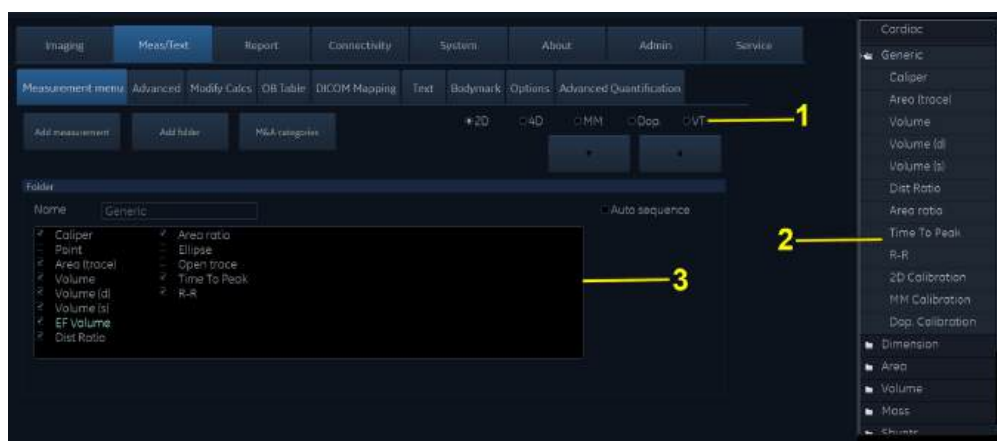
If a calculated parameter (e.g. AV CO in AV Trace measurement) requires another parameter to be calculated (e.g. AV Diam) the user must first measure the required parameter (e.g. AV Diam) before the dependent parameter (e.g AV CO in AV Trace) gets calculated.

Configuration of the Measurement menu

If the AV diameter measurement is not present in the folder *Dimension* in the *Measurement* menu, follow the following procedure:

1. Press **Config** and select the category **Measure/Text**.
The *Measurement menu* sheet is displayed (Figure 8-68).
2. AV Diam is a 2D measurement, make sure that **2D** is checked in the *Measurement* sheet.
3. Select folder **Dimension** in the *Measurement* menu.
A list of all available measurements for the selected folder is displayed in the *Measurement menu* sheet.
4. Check the box in front of **AV Diam**.
The AV Diam measurement is displayed in the folder *Dimension* in the *Measurement* menu.
5. For the AV VTI measurement, check **Doppler** in the *Measurement menu* sheet and select the folder **Aortic** in the *Measurement* menu.
6. Check the box in front of **AV Trace**.
The AV Trace measurement is displayed in the folder *Aortic* in the *Measurement* menu.

Configuration of the Measurement menu (continued)



1. Select the scanning mode for the measurement to add to the Measurement menu.
2. Select the folder for the measurement to add.
3. Select the measurement to add.

Figure 8-68. Configuration of the Measurement menu

Configuration of the Measurement result table

If AV CO calculation is not displayed in the *Measurement result* table, follow the following procedure:

1. Press **Config** and select the Config category **Measure/Text**.
The *Measurement menu* sheet is displayed.
2. The AV CO calculation is based on Doppler AV Trace measurement in the folder *Aortic*, check **Doppler** in the *Measurement menu* sheet and select the folder **Aortic**.
A list of all available measurements and calculations for the selected folder is displayed in the *Measurement menu* sheet.

NOTE: *Entries in green are calculated measurements.*

3. In the *Measurement menu* sheet, double-click on the **AV Trace** measurement.
A list of all available output parameters for the AV Trace measurement is displayed in the *Measurement menu* sheet.
4. Check the box in front of **AV CO**.
The AV CO calculation will be displayed in the *Measurement result* table.

User-defined formulas

User-defined formulas (studies, parameters, functions, etc.) can be created using existing measurements or by defining new measurements. The following example describes the creation of a formula based on existing measurements.



CAUTION

GE does not take any responsibility for the correctness of the user-defined studies, parameters or functions.

In order to retain measurements from user-defined formulas when transferring between system, for instance between a Vivid *iq* and an EchoPAC review station, the user-defined formulas must first be exported to the transfer destination before transferring the exam data.

To transfer user-defined formulas, see 'Data Backup and Restore' on *page 10-101*

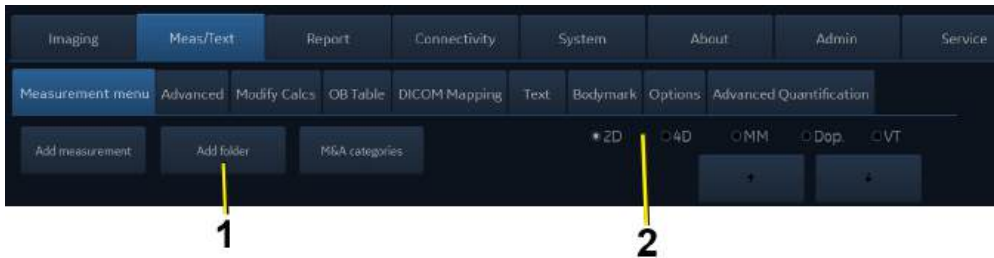
User-defined formula - example

The workflow for user-defined formula is:

- If the user-defined formula is based on several measurements of different types, create a user-defined folder in the *Measurement* menu so that all measurements and the formula are grouped together. If the formula is based on a single measurement you may select an existing appropriate folder.
- Add the measurement(s) needed for the formula to the user-defined (or existing) folder.
- Create the formula based on the added measurements.

The following procedure describes the creation of user-defined LIMP formula as follows: My LIMP = (MCO-AV ET)/AV ET.

Creation of a user-defined folder

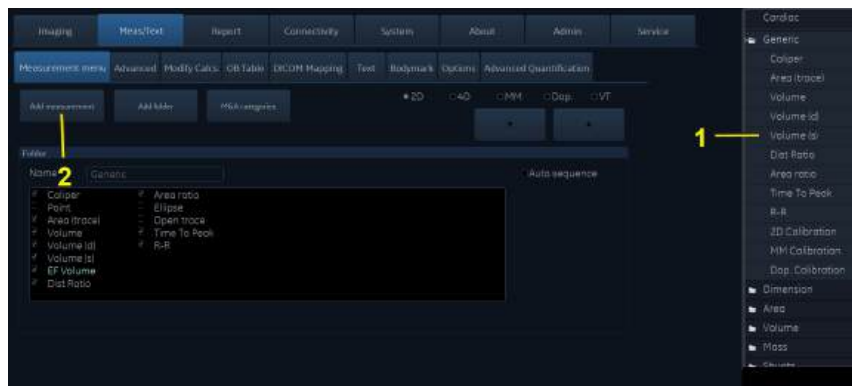


1. Create a folder in the Measurement menu.
2. Select the appropriate scanning mode.

Figure 8-69. The Measurement menu sheet (Add folder)

1. Press **Config** and select the category **Measure**.
2. MCO and AV ET are Doppler measurements, select **Doppler** in the *Measurement menu* sheet.
3. Select **Add folder**.
4. Give the folder a name (e.g. "My Folder").

Adding measurements



1. Select the user-defined folder.
2. Press Add measurement.

Figure 8-70. The Measurement menu sheet (Add measurement)

Adding measurements (continued)

1. Select the user-defined folder (e.g. “My Folder”) in the *Measurement* menu.
2. Press **Add Measurement** in the *Measurement menu* sheet.
The *Add measurement* window is displayed.

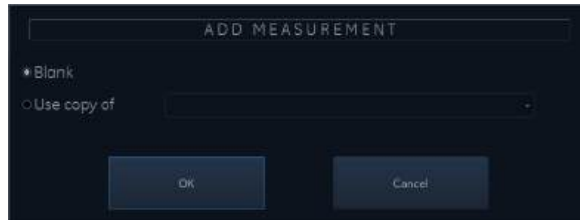
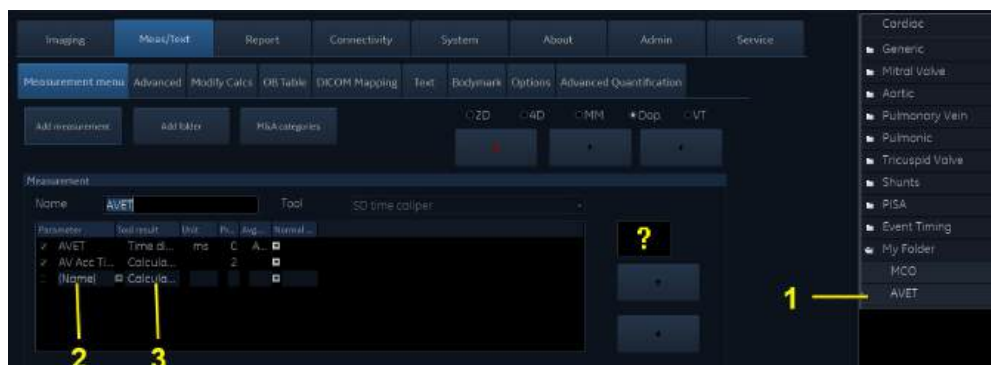


Figure 8-71. The Add measurement window

3. MCO and AV ET are measurements that already exist on the system, check **Use copy of** and select **MCO** from the drop down menu.
4. Select **OK** to add the MCO measurement.
5. Repeat steps 2 to 4 to add the AV ET measurement.

Creation of the formula



1. Select the last measurement.
2. Double click and enter the formula name.
3. Select "=" to create the formula.

Figure 8-72. The Measurement menu sheet

The formula for this example is as follows:

My LIMP = (MCO-AV ET)/AV ET

1. In the user-defined folder (e.g. "My folder"), select the last measurement created (e.g. AV ET).
2. Click beneath the last line in the *Parameter list* in the *Measurement menu* sheet to add a new line.
3. Double-click (Name) and enter the name for the formula (e.g. My LIMP).
4. Select .

The *Edit formula* window is displayed.

Creation of the formula (continued)

The screenshot shows the 'EDIT FORMULA' dialog box. The 'Name' field contains 'MYLIMP'. The 'Parameters' section has two rows: '2D / 4D' with a dropdown set to 'MM', and 'Doppler' with a dropdown set to 'VT'. Below these are 'Operators' and 'Functions' dropdown menus. At the bottom, there is a 'Formula' text field and a 'Unit' dropdown menu. On the right side, there are 'OK', 'Cancel', and 'Check' buttons.

Figure 8-73. The Edit formula window

5. Select "(" from the *Operators* drop-down menu.
6. In the *Doppler* drop-down list, select **MCO [My Folder, MCO]**.
Make sure to select the measurement located in the user-defined folder (e.g. "My Folder").
7. Select "-" from the *Operators* drop-down menu.
8. In the *Doppler* drop-down list, select **AV ET [My Folder, AVET]**.
9. Select ")" from the *Operators* drop-down menu.
10. Select "/" from the *Operators* drop-down menu.

NOTE: *Operators may also be entered using the alphanumeric keyboard.*

Creation of the formula (continued)

11. In the *Doppler* drop-down list, select **AV ET [My Folder, AVET]**.

The Formula line should display: $\{\text{MCO}\} - \{\text{AVET}\} / \{\text{AVET}\}$.

No units are necessary since the formula is a ratio ('About units' on *page 8-217*).

12. Press **Check** to make sure that the syntax for the formula is correct.

User-defined measurements



WARNING

Please remember that you are responsible for confirming the correctness and accuracy of the user input formula that is added to your system on your behalf.

Some user-defined formula may require measurements that do not exist on the system. The following example based on a generic distance measurement illustrates how to create user-defined measurements.

1. Press **Config** and select the category **Measure**.
2. In the *Measurement menu* sheet, select the appropriate scanning mode for the measurement to be created (e.g. 2D).
3. Select the appropriate folder in the *Measurement menu* (e.g. Dimension).
4. Press **Add Measurement** in the *Measurement menu* sheet.
The *Add measure* window is displayed.

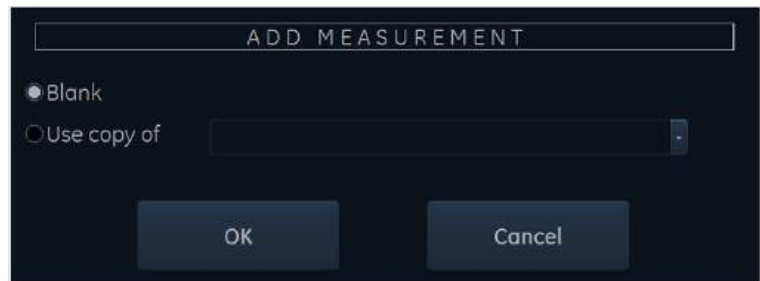
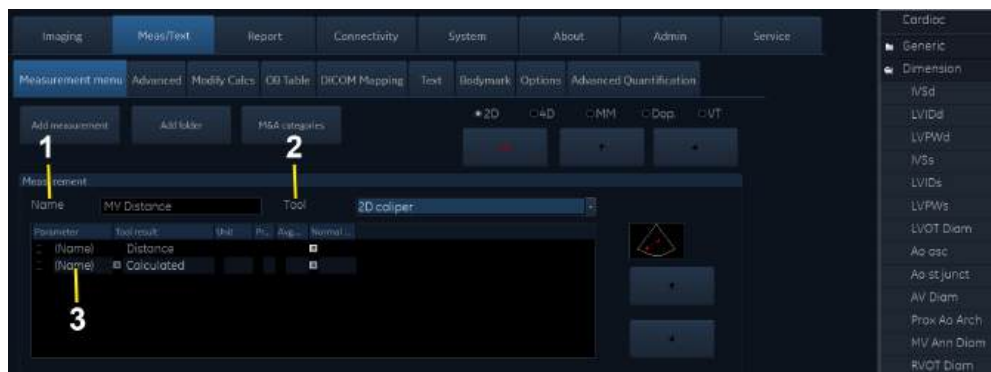


Figure 8-74. The Add measure window

User-defined measurements (continued)

5. Check **Blank** and press **OK**.

The *Measurement menu* sheet is updated.



1. Enter a name for the measurement.
2. Select the appropriate measurement tool.
3. Double click and enter the formula name.

Figure 8-75. The Measurement menu sheet

6. In the *Measurement menu* sheet, enter the name for the measurement (e.g. My Distance).
7. Select the appropriate measurement tool in the drop-down menu, next to **Tool** (e.g. 2D Caliper).
8. Double-click **(Name)** in the appropriate parameter (e.g. Distance) and enter a name for the parameter (e.g. My Length).

If desired change the unit and the number of decimals for the measurement by double clicking the values under *Unit* and *Precision* (see also 'About units' on page 8-217).

About units

Be aware of the following:

- All formulas are calculated in SI units (see table below).
- If no unit is specified in the *Edit formula* window when defining a formula, the displayed value will be in SI unit.

To define a different unit

1. When creating a formula, enter the unit to use when displaying the formula output. E.g. if Y in the formula $Y=f(x)$ is to be displayed in cm, enter cm in the *Unit* field (see Figure 8-73 on page 8-213).

The *Unit* field is case sensitive, make sure to enter the exact unit as shown in the table below (Alternative unit column).

2. The output of a formula must always be in an SI unit (see table below). Conversion to the specified display unit is then done automatically.

Example: an user wants to add a regression formula for estimating a length **B** from a measured length **A**, both in cm.

The formula is: $B = 2.4 + 1.1 \cdot A$.

- As **A** is a measurement value the system will enter the formula in the SI unit for length (m). The formula expects A in cm, and to get that, **A** must be multiplied by 100:

$$B = 2.4 + 1.1 \cdot A \cdot 100$$

- The formula now gives **B** in cm. Converting the output from cm to the SI unit (m), is done by dividing by 100:

$$B = (2.4 + 1.1 \cdot A \cdot 100) / 100$$

The output is now in m, and by entering this formula into the system the user gets the expected result. Measuring an **A** of 2 cm gives: $B = (2.4 + 1.1 \cdot 0.02 \cdot 100) / 100 = 0.046$ m.

Before display of the value it is converted according to the specified display unit (cm), and the system displays 4.6 cm. If the selected display unit was set to mm the formula would give the exact same output, 0.046 m, but the automatic unit conversion would now instead give a displayed value of 46 mm.

Calculation	SI	Alternative unit
Time	s	ms - msec - min - h

Calculation	SI	Alternative unit
Ratio	%	
Frequency	bpm	
Angle	rad	deg - grad
Distance	m	cm - dm - cm - mm - inch - feet- pixels
Velocity	m/s	dm/s - cm/s - mm/s - inch/s
Acceleration	m/s ²	dm/s ² - cm/s ² - mm/s ² - inch/s ²
Area	m ²	dm ² - cm ² - mm ² - inch ²
Volume	m ³	dm ³ - cm ³ - l - dl - cl - ml - gallon - quart
Volume flow	m ³ /s	dm ³ /s - cm ³ /s - l/s dl/s - cl/s - ml/s - m ³ /min dm ³ /min - cm ³ /min - l/min - dl/min - cl/min ml/min - ml/m ²
Pressure	mm Hg*	Pa - kPa - bar - torr - atm - psi
Pressure/time	mm Hg/s	mmHg/s
Mass	kg	g - ounce - pound
Other		mmHG - Date - WeekDay - Day - NoUnit l/minm ² - g/m ² - cm/m ²
* The correct SI unit for pressure is Pa, but here mm Hg was used as base unit as it is a standard pressure unit to use in medicine.		

Advanced settings

The Advanced sheet

The *Advanced* sheet enables further configuration of the Measurement function. The settings are divided into application specific parameters and global parameters.

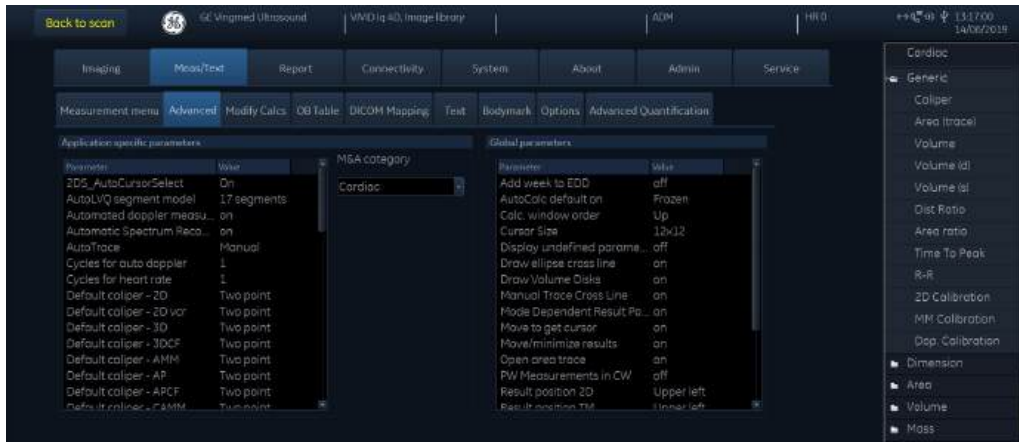


Figure 8-76. The Advanced sheet

1. If configuring application specific parameters, select an application from the *M&A category* pull-down menu.
2. Select the configuration value next to the parameter to configure.
A pull-down menu is displayed.
3. Select a new value from the pull-down menu.

The Modify calculations sheet

The *Modify calculation* sheet is used to configure the calculations to be performed when doing a Doppler vascular measurements.

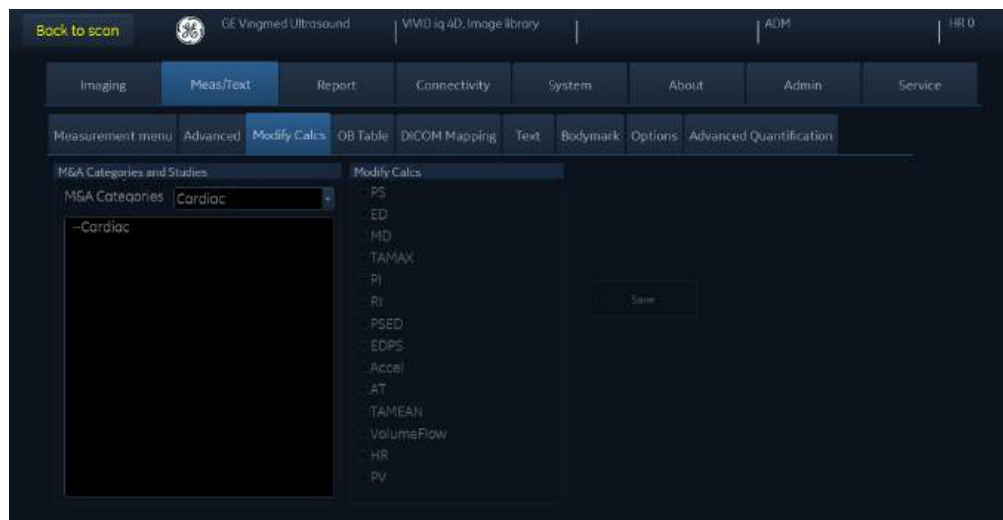


Figure 8-77. The Modify calculations sheet

The following example describes how to configure the Carotid Doppler calculations.

1. In the *Modify calculations* sheet, select **Vascular** next to *M&A Categories*.
The *Vascular measurement category* is displayed.
2. Select **Carotid**.
The available calculations are displayed.
3. Check the desired calculations to be performed.
4. Press **Save**.

The OB table sheet

The OB table sheet enables the creation and edition of user-defined OB tables.

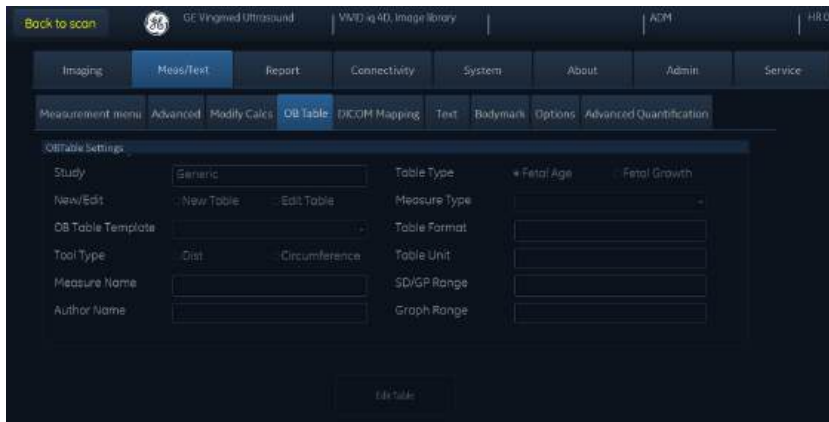


Figure 8-78. The OB table sheet

The following example describes how to create a fetal age OB-2/3 table based on Bi Parietal Diameter measurements.

1. In the **Meas/Text** category, select the **Measurement menu**.
2. In the *Measurement menu* sheet, select **2D** mode.
3. Select the **OB table** sheet.
4. In the *Measurement menu*, select the category **Obstetrics** and the **OB-2/3** measurement study.
5. In the *OB table* sheet, check **New table**.

The OB table sheet (continued)

6. Enter or select the following:
 - **OB Table:** when creating a new OB table, select Template (1 - 7) which you want to use as the basis of the user programmable OB Table (page 8-222).
When editing an existing user OB table, select the desired OB table to edit.
 - **Tool type:** Select the type of measurement (e.g. Distance)
 - **Measure Name:** type the name of measurement that will display in the *Measurement* menu (e.g. My BPD Measure).
 - **Author Name:** Type the author's name (e.g. My Name).
 - **Table Type:** If necessary, select the table type (e.g. Fetal Age).
 - **Measure type:** select the desired measurement (e.g. BPD).
7. Select **Edit table**.
The OB Table spreadsheet is displayed, showing the table template selected.
8. Enter the Min, Max and Interval values in the *Parameters* field.
The system automatically fills in the *MEAS column*.
9. Enter the input values for the *MEAN* and *SD columns*.
10. Select **Exit to save**.

The OB table templates

Template 1 (based on Hadlock)				
Fetal age	format:	MEAS	MEAN	SD
	Unit:	mm	week	week
	Table range:	1 SD		
	Graph range:	1 SD		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	Min:	[#w#d]		
	Max:	[#w#d]		

Template 1 (based on Hadlock)				
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	week	mm	week
	Others are same as above			

Template 2 (based on Tokyo)				
Fetal age	Format:	MEAS	MEAN	SD
	Unit:	mm	day	day
	Table range:	1 SD		
	Graph range:	1 SD		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	SD:	[day (+/-)]		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	day	mm	day
	Others are same as above			

Template 3 (based on Osaka)				
Fetal age	Format:	MEAS	MEAN	SD
	Unit:	mm	day	mm
	Table range:	1 SD		
	Graph range:	1 SD		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	SD:	[(mv-pv)/sd]		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	day	mm	day
	Others are same as above			

Template 4 (based on several European tables)				
Fetal age	Format:	MEAS	MEAN	SD
	Unit:	mm	weekday	mm
	Table range:	5%–95%		
	Graph range:	5%–95%		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	GP:	[%] Calculated by Fetal growth table. If Fetal growth table is not edited, GP is not calculated.		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	weekday	mm	day
	Others are same as above			

Template 5 (based on several European tables)				
Fetal age	Format:	MEAS	MEAN	SD
	Unit:	mm	weekday	mm
	Table range:	1 SD		
	Graph range:	5%–95%		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	GP:	[%] Calculated by Fetal growth table. If Fetal growth table is not edited, GP is not calculated.		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	weekday	mm	day
	Others are same as above			

Template 6 (based on several European tables)					
Fetal age	Format:	MEAS	MIN	MEAN	SD
	Unit:	mm	weekday	weekday	weekday
	Table range:	10%–90%			
	Graph range:	10%–90%			

Template 6 (based on several European tables)					
Measurement result	Value:	[cm]			
	GA:	[#w#d]			
	GP:	[%] Calculated by Fetal growth table. If Fetal growth table is not edited, GP is not calculated.			
Fetal growth	Format:	AGE	MIN	MEAN	SD
	Unit:	weekday	mm	mm	mm
	Others are same as above				

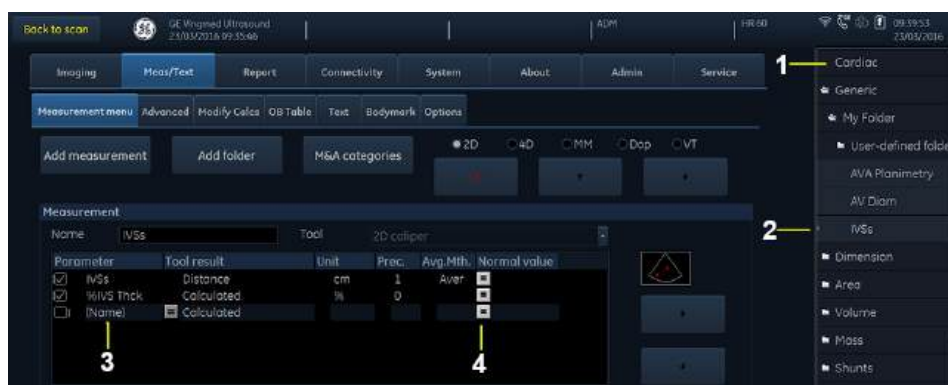
Template 7 (based on several European tables)				
Fetal age	Format:	MEAS	MEAN	SD
	Unit:	mm	weekday	mm
	Table range:	1 SD		
	Graph range:	10%–90%		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	GP:	[%] Calculated by Fetal growth table. If Fetal growth table is not edited, GP is not calculated.		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	weekday	mm	mm
	Others are same as above			

Normal values

Normal values can be defined by the user for all parameters. A Normal value can be either a range or a threshold. Normal values entered are grouped by measurement category (e.g. Cardiac, Pediatrics...etc).

Normal values are displayed in the report if the report template used is configured to display normal values (page 11-39).

To define a Normal value



1. Measurement category
2. Selected measurement
3. Parameters
4. Press to define Normal value

Figure 8-79. Adding Normal value

To define a Normal value (continued)

1. Press **Config** and select the Config category **Measure/Text**.
The *Measurement menu* sheet is displayed (Figure 8-79).

2. In the *Measurement* menu, browse to the measurement of interest.

The parameters for the selected measurements are displayed in the *Measurement menu* sheet.

NOTE: *To change Measurement category, press the heading in the Measurement menu and select another Measurement category.*

3. Select  in the *Normal value* column.
The *Normal value* window is displayed.



Figure 8-80. The Normal value window

To define a Normal value (continued)

4. In the *Normal value* window:
 - Select the Normal value type (Range, Above or Below).
 - Type in the Normal value.
 - Optionally enter a reference for the Normal value.
5. Select **OK**.

The Normal value is displayed in the *Measurement menu* sheet.

To display Normal values and references in the Report, the Report template must be configured to show Normal values ('Inserting an Image container' on *page 11-39*). Measurements outside the Normal value are highlighted with an "!" in the report.

Advanced Quantification

The quantification tools AFI, AFIRV, AFILA and AutoEF are configured by the *Advanced Quantification* tab.

To modify a configuration for a tool listed in the *Advanced Quantification* tab:

1. Press **Config** on the shortcut bar and select the category **Measure/Text**.
2. Click on the **Advanced Quantification** tab. The Advanced Quantification tab is shown, see Figure 8-81.
3. Select the page of the tool to configure.
4. Adjust the configuration parameter for the respective tools.

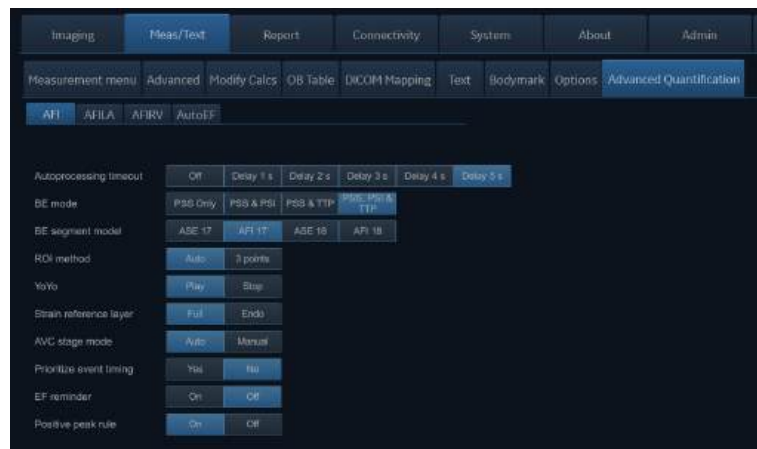


Figure 8-81. Advanced Quantification tab with configuration options for AFI

AFI is described on page 8-30. AFI on RV is described on page 8-74. AFI on LA is described on page 8-96. Auto EF is described on page 8-117.

Circumference and area (spline trace) measurement

To trace the circumference of a portion of the anatomy and calculate its area:

1. Press **Measure**.
2. Select **Generic > Spline Trace**, and a caliper displays.
3. To position the first caliper at the start point, move the Trackpad.
4. To fix the trace start point, press **Set**. The second caliper appears at the same position as the first caliper is fixed.
5. To position the second caliper, move the Trackpad and press **Set**. The third caliper appears at the same position.

NOTE: *The spline trace requires at least three points to draw the trace. Continue setting the points of the trace until the desired points are set.*

NOTE: *You can move the trace back towards the previous placed point to delete the previous caliper one by one.*

NOTE: *If **Clear** is pressed, all the calipers disappear, and the current measurement is cancelled.*

6. Double click **Set** after the last caliper is fixed to finalize the spline trace. All points disappear except the first and the last one and the spline trace turns blue.

NOTE: *Pressing **Set** twice finishes the trace measurement.*

NOTE: *If the end point is close to the start point, there will only be a rounded shape mark after the spline trace is finalized. If the end point is far from the start point, there will be a straight line link the two points.*

Edit the spline trace

You can edit the spline trace in two ways:

Method 1:

1. Hover the cursor near a finished spline trace until it turns green, then double-click and drag the trace to a desired target position.

NOTE: Pressing **Clear** at this time removes all points and the trace graphic.

NOTE: To remove a point, press **Delete Point** once the point is selected.

2. After performing a Single Edit on one point of the trace (the trace will stay in green), single-click to select any other point on the trace and drag to a desired target position.
3. Click outside the trace to end the trace.

Method 2:

1. Select **Cursor Select**. The spline trace changes to green and all points appear on the trace as green.
The pick-caliper will be on the first or the last trace point depending on the user cursor select forward or backward. The message "Set the point" displays at the top of the screen.

NOTE: The pick-caliper is used to select and move the trace points.

2. Move the pick-caliper to the desired position and press **Set**. The point is fixed.
3. After performing a Single Edit on one point of the trace (the trace will stay in green), single-click to select any other point on the trace and drag to a desired target position.
4. Click outside the trace to end the trace.

Volume (Spline Volume) measurement

To make a volume calculation using spline tool:

1. Press **Measure**.
2. Select **Cardiac/Pediatric Heart > Generic > Spline Volume**, and a caliper displays.
3. To position the first caliper at the start point, move the Trackpad.
4. To position the second caliper, move the trackpad and press **Set**. The third caliper appears at the same position.

NOTE: *The Trace requires at least three points to draw. Continue setting the points of the Trace until the desired points are set.*

5. To cancel last fixed caliper, move the trackpad backtrace along the Trace or click **Delete Point**.

NOTE: *Move cursor to the fixed calipers and retreat along the Trace. Use the **Clear** key to erase all of fixed calipers.*

6. Double click **Set** after the last caliper is fixed to finalize the Trace. The Rotation Axis will appear in the middle of the first and the last point.

NOTE: *Pressing **Set** twice finishes the Trace measurement and confirm the apex.*

7. To position the apical point of rotation axis, move the trackpad and press **Set** to confirm the apex. All points disappear except the apex, the first and the last one and the Trace turn blue.

NOTE: *Move the trackpad to apex or any other fixed calipers on the Trace and double click **Set** to reset the position that selected.*

Volume (Spline Volume) measurement (continued)



HINTS

- Volumes are most accurate when measurements are taken in the sagittal and axial scan planes.
- To display sagittal and axial plane images simultaneously, use the side-by-side dual format option.

NOTE:

If you change the parameters or category during the volume measurement, please follow the procedure below before you restart the measurement.

1. Check the number of each measurement in the summary window.
2. If the numbers are not all the same, it shows that you have the calculation which is not completed. Open the Worksheet and clear that calculation.

Edit the spline volume

NOTE: To reconfirm the apex, double click the apex point.

NOTE: When editing other points, the Rotation Axis will be adjusted automatically.

You can edit the Trace in two ways:

Method 1:

1. Select **Cursor Select**. The Trace changes to green and all points appear on the trace as green.

The pick-caliper will be on the first or the last Trace point depending on the user cursor select forward or backward. The message "Set the point" displays at the top of the screen.

NOTE: The pick-caliper is used to select and move the Trace points.

NOTE: Pressing **Clear** at this time removes all points and the Trace graphic.

2. Move the pick-caliper to the desired position and press **Set**. The point is fixed.
3. After performing a Single Edit on one point of the Trace (the Trace will stay in green), single-click to select any other point on the Trace and drag to a desired target position.
4. Click outside the Trace to end the Trace.

NOTE: To remove a point, press **Delete Point** once the point is selected.

Method 2:

1. Hover the cursor near a finished Trace until it turns green, then double-click and drag the Trace to a desired target position.
2. After performing a Step 1 (the Trace will stay in green), single-click to select any other point on the Trace and drag to a desired target position.
3. Click outside the Trace to end the Trace.

Measurement result table

The display of the *Measurement result* table can be minimized and moved to prevent the table obscuring parts of the ultrasound image.

Minimizing the Measurement result table

1. Select  on the heading of the *Measurement result* table. The *Measurement result* table is minimized to the heading bar. Repeat step 1 to maximize the *Measurement result* table.

Moving the Measurement result table

1. To move the *Measurement result* table around the screen, select . Move the measurement result table to a new location, preset Set.

Deleting measurements

1. Select the measurement to delete in the *Measurement result* table.
2. Select **Delete measurement** in the context menu.

Worksheet

The worksheet function enables the user to review, edit, delete or print data independently of a report. All measurements and calculations taken during the examination can be viewed at any time using the worksheet.

Overview

Height	Weight			BSA					BP			Page 1/1	
Parameter	Value	Mth	m1	m2	m3	m4	m5	m6	m7	m8	m9	m10	m11
Biplane	1												
A4C													
LVLd A4C	5.1 cm	Av		5.1									
LVEDV MOD A4C	47 ml	Av		47									
LVLd A2C													
LVEDV MOD A4C	3	5		4									
LVEF MOD A4C	26 %			26									
SV MOD A4C	12 ml			12									
A2C													
LVLd A2C	5.6 cm	Av		5.6									
LVEDV MOD A2C	62 ml	Av		62									

1. Measurement type

2. Measurement parameter

3. Value calculated according to the value type selected.
4. Measured / calculated values

5. Value type: Averaging, Max, Min or Last

Figure 8-82. Worksheet screen

Using the Worksheet

1. Press **Worksheet**.

2. Select the Measurement type.

3. To browse through the measurements, select **Page Up** or **Page Down**.

To select a type of value

1. Select the relevant cell in the *Mth (Method)* column.
A pop-up menu is displayed showing the different options available.

1. Average of the measurements taken
2. Maximum measurement
3. Minimum measurement
4. Last measurement that was taken



Figure 8-83. Value options

2. Select the required option.
The value is updated accordingly.

To delete measurements

1. Place the cursor over the measurement to delete.
2. Press **Set**.
3. Select **Delete Measurement**.

Measurement accuracy

General

When using the Measurement and Analysis (M&A) package, it is important to keep in mind the different aspects that affect the accuracy of the measurements. These include acoustical properties, patient echogenicity, measurement tools and algorithms, scanner setup (especially Field-of-view or Range settings), probe type used, and operator inputs.

Sources of error

Image Quality

The accuracy of each measurement is highly dependent on image quality. Image quality is highly dependent on system design, operator variability, and patient echogenicity. The operator variability and patient echogenicity are independent of the ultrasound system.

Operator Variability

One of the largest potential sources of error is operator variability. A skilled operator can reduce this by optimizing the image quality for each type of measurement. Clear identification of structures, good probe alignment and correct cursor placement is important. Because of pixel resolution, the accuracy of a measurement decreases with decreasing distance on screen. Therefore it is important when scaling the object on the screen to avoid measuring objects that are too small.

NOTE: See also 'Optimizing Measurement Accuracy' on page 8-241 for recommended techniques.

Image measurement

The accuracy in lateral direction is limited by the beam width and the beam positioning. The radial accuracy is mainly limited by the acoustic pulse length.

Doppler alignment

Errors in velocity measurements increase with the cosine of the angle between the measured flow and the ultrasound beam. For example, an alignment error of 20 degrees, will give a 6% under-estimation of the velocities, while an error of 40 degrees will cause the under-estimation to be 24%. It is highly recommended to optimize transducer position to align the ultrasound beam with the flow direction.

NOTE: If alignment is not possible, you may use the Angle Correction control to compensate if the flow direction is known.

Screen pixel resolution

The display screen is composed of an array of square picture elements (pixels). The smallest resolvable unit is +/- 1pixel. This pixel error is only significant when measuring short distances on the screen. By observing good scanning practices, the settings of the field of view should be such that the measured distance is significant with respect to the full size of the screen. When such scaling is impossible, the pixel error may come into play. The pixel error is +/- 0.2% of the full ultrasound area in the User Screen.

Algorithms

Some formulae used in clinical calculations are based on assumptions or approximations. For example the volume calculations from 2D or M mode assume a certain, 'ideal' shape of the heart chamber, while the actual shape can vary quite much between individuals. Also, formulae taking several "raw" measurements as inputs are prone to increased errors, depending on the combination of input variable accuracies. For example, the Cardiac Output formula from Doppler is sensitive to errors in the entered Diameter, since this parameter will be squared in the formula.

Speed of Sound in Tissue

The average speed of sound value of 1540 meters / second is used for all calculations. Depending on the tissue structures, this generalization may give errors from 2% (typical) to 5% (much fatty tissue layers present).

Optimizing Measurement Accuracy

Probe selection

Select a transducer appropriate for the application, and optimize the transducer frequencies used. Higher imaging frequencies provide better resolution, but less penetration than lower frequencies. Lower Doppler frequencies can measure higher max velocities, and at greater depths, but with less velocity resolution than higher Doppler frequencies.

Field of View

All display modes should be adjusted so that the area of interest covers as large portion of the display as possible. Use **Depth**, **Angle**, **Zoom**, **Horizontal Sweep** and **Velocity** controls to optimize the different modes.

Cursor Placement

All measurements are dependent on the accuracy of their “input” data. Consistency and precision in placing cursors and drawing traces correctly on the images are important.

NOTE: *Avoid placement of the cursor near the top of the image, close to the transducer, when using convex or linear probes.*

Measurement Uncertainties

The accuracy percentages reported below are based on data taken with optimum control settings, using calibrated phantoms and test equipment.

The calibration was done for the basic measurable parameters: Distance, Time and Velocity.

Independent sources of uncertainty contribute to a total uncertainty by a RMS (Root Mean Square) combination of the sources. Refer to the discussions above regarding measurement accuracy and sources of error when reading the table below.

NOTE: *In Cardiac, several Doppler measurements have an auto feature (CAD – Cardiac AutoDoppler). Cardiac AutoDoppler uses automatic algorithms to analyze a Doppler spectrum over multiple heart cycles, and then displays a set of suggested landmarks. Adjust – if needed – and approve these landmarks before they are extracted and used for initialization of existing manual Doppler measurement tools. These Doppler tools then calculate and deliver numeric results, using exactly the same calculations as when landmarks are defined by purely manual user input. Be aware that due to potential variations in the automatically placed landmarks when using Cardiac AutoDoppler, any calculation based on unadjusted landmarks may give a deviation in numeric results - typically up to 10% compared to when the landmarks are optimized and placed manually.*



The AFI, AFI LA, AFI RV, and AutoEF tools use automated algorithms to do segmentation and speckle tracking. There is an inherent risk that these algorithms may sometimes provide suboptimal or incorrect results. Please verify the correctness of the displayed points and traces before approving them.

Measurement Uncertainties (continued)



WARNING

4D Auto AVQ and 4D Auto MVQ tools use automated segmentation algorithms to initiate 3D models that the tool measurements are calculated from. There is an inherent risk that these automated segmentation algorithms may give inaccurate 3D models.



WARNING

The AI Auto Measure - 2D measurements use computer algorithms for estimating the caliper end points. There is an inherent risk that these algorithms may sometimes give suboptimal or incorrect results.

NOTE: *Values reported in the Accuracy column in the table below are based on measurements where the user has, if necessary, edited the 3D model before approval of the results. As recommended in the user manual, the result should not be approved without review, and, if necessary, editing of the 3D model. If the tools are used without review and editing, the expected accuracy will be negatively affected. The expected accuracy of measurements when the 3D tools are used without review and editing are added in the Comments column below labeled as "Accuracy w/o editing"..*

Measurement	Range	Accuracy	Comments
2D Calipers			
Depth	-	5 mm	
Vertical distance	-	5.0%	
Horizontal distance	-	5.0%	
Area	-	5%	
Circumference	-	10%	
M-mode Calipers			
dt	-	5.0%	With optimal sweep speed setting
4D Slice Image Calipers			
Depth	30 - 105 mm	max (5.0%, 1.0 mm)	
Vertical distance	10 - 110 mm	max (5.0%, 1.0 mm)	
Horizontal distance	10 - 110 mm	max (5.0%, 1.0 mm)	
4D Rendering Image Calipers			

Measurement	Range	Accuracy	Comments
Distance	10 - 60 mm	max (5.0%, 1.0 mm)	
Area	5 - 110 cm ²	10%	
Circumference	5 - 30 cm	10%	
Spectrum Calipers			
Velocity	-	From 0~100cm/s relative error (RE) <=15%	With optimal sweep speed setting
	-	From 100~130cm/s relative error (RE) <=10%	
dt	-	5.0%	
Spectrum Doppler AutoCalc			
Velocity	5 - 110 cm/s	10%	
dt	10 - 200 ms	max (2%, 4 ms)	
Acceleration	250 - 1300 cm/s ²	12%	
Volume Flow	60 - 1600 ml/min	20%	
Heart Rate	55 - 115 bpm	10%	
ECG Caliper/Heart Rate			
Heart Rate	-	HR Refer Peripheral VTP <=5%	The heart rate displayed on screen while scanning, estimated based on the eight last heart beats acquired by ECG.
2D AutoEF			
EF (single view)	25 – 65%	15 percentage points	The given Range and Accuracy has been validated both for DICOM and raw data formats (raw data with ECG), as well as for 3rd party DICOM data from Philips and Siemens, but no other vendors.
ESV (single view)	19 – 140 ml	40 ml	
EDV (single view)	65 – 240 ml	40 ml	
Ls and Ld	5 – 9 cm	2 cm	
EF_BiP	25 –65%	15 percentage points	Note that separate table sections are provided for 2D Auto EF on Adult TTE raw data with ECG and 2D AutoEF on Adult TTE raw data without ECG.
ESV_BiP	19 – 140 ml	20 ml	
EDV_BiP	65 – 240 ml	20 ml	

Measurement	Range	Accuracy	Comments
2D AutoEF when Adult TTE raw data with ECG (see 'accuracy w/o editing' for Easy AutoEF)			
EF (single view)	25 – 65%	15 percentage points	Accuracy w/o editing: 15 percentage points (within 95% confidence interval)
ESV (single view)	19 – 140 ml	40 ml	Accuracy w/o editing: 50 ml (within 95% confidence interval)
EDV (single view)	65 – 240 ml	40 ml	Accuracy w/o editing: 50 ml (within 95% confidence interval)
Ls and Ld	5 – 9 cm	2 cm	Accuracy w/o editing: 2 cm (within 95% confidence interval)
EF_BiP	25 –65%	15 percentage points	Accuracy w/o editing: 15 percentage points (within 95% confidence interval)
ESV_BiP	19 – 140 ml	20 ml	Accuracy w/o editing: 50 ml (within 95% confidence interval)
EDV_BiP	65 – 240 ml	20 ml	Accuracy w/o editing: 50 ml (within 95% confidence interval)
2D AutoEF when Adult TTE raw data without ECG			
EF (single view)	25 – 65%	15 percentage points	Accuracy was calculated as maximum allowed difference between running tool on recording with ECG and with ECG removed.
ESV (single view)	19 – 140 ml	40 ml	
EDV (single view)	65 – 240 ml	40 ml	
Ls and Ld	5 – 9 cm	2 cm	
EF_BiP	25 –65%	15 percentage points	
ESV_BiP	19 – 140 ml	20 ml	
EDV_BiP	65 – 240 ml	20 ml	
Heart Rate	47 – 111 bpm	8 bpm	
AFI/Triplane AFI/2D Strain			

Measurement	Range	Accuracy	Comments
Global Longitudinal Strain	-22 – -5%	3 percentage points	Accuracy for Global Longitudinal Strain is 5 percentage points for TEE probes The given Range and Accuracy has been validated both for DICOM and raw data formats, as well as for 3rd party DICOM data from Philips and Siemens, but no other vendors. Note that a separate table section is provided specifically for AFI when Adult TTE raw data as this data type allows more automation.
Regional Longitudinal Strain	-22 – +2%	9 percentage points	
2D Strain Regional Circumferential Strain	-25 – -2%	9 percentage points	
2D Strain Regional Radial	4 – 44%	9 percentage points	
2D Strain Longitudinal Endocardial strain	-25 – -2%	9 percentage points	
2D Strain Longitudinal Epicardial strain	-10 – -2%	9 percentage points	
2D Strain Circumferential Endocardial strain	-40 – -4%	9 percentage points	
2D Strain Circumferential Epicardial strain	-18 – 0%	9 percentage points	
AFI/Triplane AFI when Adult TTE Raw data (see ‘accuracy w/o editing’ for Easy AFI LV)			
Global Longitudinal Strain	-22 – -5%	3 percentage points	Accuracy w/o editing: 3 percentage points (within 95% confidence interval)
Regional Longitudinal Strain	-22 – +2%	9 percentage points	Accuracy w/o editing: 9 percentage points (within 95% confidence interval)
AFI on the Right Ventricle			
G peak SL Full/Endo (A4C_RV)	-23 – -5%	3 percentage points	Accuracy 5 percentage points for TEE probes
G peak SL Full/Endo (A4C_RVFW)	-29 – -10%	6 percentage points	
Apical/ Mid/ Basal FW/IVS PSSL Full/Endo	-29 – -5%	9 percentage points	
TAPSE	17 – 24mm	≤ 5 mm	
AFI on the Left Atrium			
LASr R-Wave/P-Wave (A4C/A2C/Avg)	5 – 31%	5 percentage points	
LAScd R-Wave/P-Wave (A4C/A2C/Avg)	-18 – -5%	5 percentage points	
LASct R-Wave/P-Wave (A4C/A2C/Avg)	-15 – 0%	5 percentage points	
LA Vmax (A2C/A4C)	19 – 131 ml	≤ 25 ml	

Measurement	Range	Accuracy	Comments
LA Vmin (A2C/A4C)	6 – 80 ml	$\leq$ 20 ml	
LA VpreA (A2C/A4C)	11 – 98 ml	$\leq$ 23 ml	
LA Vmax (BiP)	19 – 131 ml	$\leq$ 20 ml	
LA Vmin (BiP)	6 – 80 ml	$\leq$ 15 ml	
LA VpreA (BiP)	15 – 300 ml	$\leq$ 18 ml	
AI Auto Measure – 2D			
IVSd	5 – 130 mm	max (5.0%, 1.0 mm)	Range, Accuracy w/o editing (mean absolute difference to reference): 5 – 12 mm, 16%. Algorithm will refuse to provide estimates in 12% of PLAX images.
LVIDd	5 – 130 mm	max (5.0%, 1.0 mm)	Range, Accuracy w/o editing (mean absolute difference to reference): 33 – 77 mm, 5%. Algorithm will refuse to provide estimates in 12% of PLAX images.
LVPWd	5 – 130 mm	max (5.0%, 1.0 mm)	Range, Accuracy w/o editing (mean absolute difference to reference): 5 – 13 mm, 18%. Algorithm will refuse to provide estimates in 12% of PLAX images.
IVSs	5 – 130 mm	max (5.0%, 1.0 mm)	Range, Accuracy w/o editing (mean absolute difference to reference): 7 – 17 mm, 11%. Algorithm will refuse to provide estimates in 12% of PLAX images.
LVIDs	5 – 130 mm	max (5.0%, 1.0 mm)	Range, Accuracy w/o editing (mean absolute difference to reference): 23 – 72 mm, 6%. Algorithm will refuse to provide estimates in 12% of PLAX images.

Measurement	Range	Accuracy	Comments
LVPWs	5 – 130 mm	max (5.0%, 1.0 mm)	Range, Accuracy w/o editing (mean absolute difference to reference): 8 – 17 mm, 15%. Algorithm will refuse to provide estimates in 12% of PLAX images.
4D Auto LVQ			
Volumes (EDV, ESV)	65 – 210 ml	15 ml	The tool should not be used on collapsing ventricles
ED Mass	80 – 130 g	20 g	
ES Mass	80 – 130 g	20 g	
Sphericity Index	0.79 – 0.98	0.2	
4D Strain Segmental strain (Longitudinal, Circumferential, Area, Radial)	-35 – +45%	9 percentage points	
Rotation	2.1 – 12.4°	5°	
4D Auto MVQ			
Annulus Area 2D	4.1 – 22.8 cm ²	10%	Accuracy w/o editing: 15%
Annulus Area 3D	4.6 – 25.3 cm ²	10%	Accuracy w/o editing: 15%
Annulus Height / MV Annulus Height	1.7 – 10.5 mm	max (10%, 3 mm)	Accuracy w/o editing: 5 mm
Annulus perimeter / MV Annulus Perimeter	7.8 – 17.7 cm	10%	Accuracy w/o editing: 15%
Anterior/Posterior Leaflet Billowing	0.0 – 7.8 mm	max (10%, 3 mm)	Accuracy w/o editing: 5 mm
Anterior Closure Line Length 3D	2.6 – 5.9 cm	20%	Accuracy w/o editing: 25%
Anterior Leaflet Angle	4 – 30°	10°	Accuracy w/o editing: 15°
Anterior Leaflet Area	2.5 – 12.1 cm ²	max (10%, 1.0 cm ²)	Accuracy w/o editing: 20%
Anterior Leaflet Length / MV Ant Leaflet Len	1.4 – 3.6 cm	max (10%, 3 mm)	Accuracy w/o editing: 20%
A-P Diameter / MV A-P Diam	1.8 – 5.0 cm	10%	Accuracy w/o editing: 15%

Measurement	Range	Accuracy	Comments
Commissural Diameter	2.9 – 5.7 cm	10%	Accuracy w/o editing: 15%
Inter-Trigonal Distance / Inter-Trigonal Dist	1.9 – 4.1 cm	10%	Accuracy w/o editing: 20%
Mitral Annular Excursion	1.9 – 14.1 mm	max (10%, 3 mm)	Accuracy w/o editing: 5 mm
Mitral-Aortic Angle	120 – 139°	10%	Accuracy w/o editing: 20°
Non-Planar Angle	126 – 171°	10%	Accuracy w/o editing: 20°
Orifice Area	0.0 – 1.4 cm ²	max (10%, 0.2 cm ²)	Accuracy w/o editing: 1.0 cm ²
PM-AL Diameter / MV PM-AL Diam	2.9 – 5.9 cm	10%	Accuracy w/o editing: 15%
Posterior Closure Line Length 3D	2.6 – 6.4 cm	20%	Accuracy w/o editing: 25%
Posterior Leaflet Angle	5 – 56°	10°	Accuracy w/o editing: 15°
Posterior Leaflet Area	2.6 – 16.7 cm ²	max (10%, 1.0 cm ²)	Accuracy w/o editing: 20%
Posterior Leaflet Length / MV Post Leaflet Len	0.8 – 2.5 cm	max (10%, 3 mm)	Accuracy w/o editing: 20%
Tenting Area	0.3 – 4.1 cm ²	max (10%, 0.5 cm ²)	Accuracy w/o editing: 1.0 cm ²
Tenting Height / MV Tenting Height	0.2 – 1.4 cm	max (10%, 3 mm)	Accuracy w/o editing: 5 mm
Tenting Volume	0.2 – 11.1 ml	max (10%, 1 ml)	Accuracy w/o editing: 1.5 ml
4D Auto AVQ (Aortic Annulus)			
Area	3.3 – 5.2 cm ²	10%	Accuracy w/o editing: 30%
Diameter	2.1 – 2.7 cm	10%	Accuracy w/o editing: 15%
IMT			
Distance	0.35 – 1.2 mm	0.20 mm	

Chapter 9

Quantitative Analysis

This chapter describes:

‘Q Analysis overview’ on page 9-3

‘Using Q Analysis’ on page 9-9.

Introduction

The quantitative analysis (Q Analysis) software package is designed for analysis of TVI related (Tissue Tracking, Strain, Strain rate, TSI) and Contrast related raw data.



Q Analysis is only recommended for adult cardiac images acquired with the following probes: M5Sc-RS, 6Tc-RS, 3Sc-RS, or 6VT-D. The measurement accuracies of the quantitative values reported in the Reference manual are verified with these probes.

The main features of these options are:

- Multiple Time-mode specific trace display from selected points in the myocardium.
- Arbitrary Curved anatomical M-Mode

Q Analysis overview

Starting Q Analysis

Q Analysis is not available for Vivid *iq* Standard package.

Starting Q Analysis in replay mode

1. Open an examination and select a TVI or a contrast loop.
2. Press **Q Analysis**.

The *Quantitative Analysis* screen is displayed (see Figure 9-1).

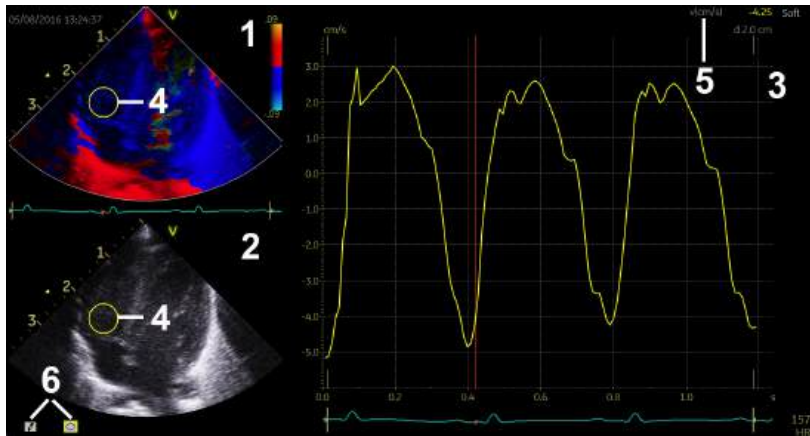
Starting Q Analysis in live

1. Press **Freeze**.
2. Press **Q Analysis**.

The *Quantitative Analysis* screen is displayed (see Figure 9-1).

Q Analysis screen

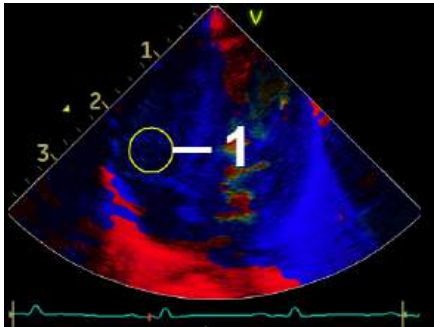
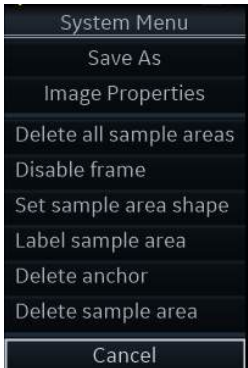
Overview



1. Color cineloop window
2. Tissue cineloop window
3. Analysis window
4. Sample area
5. Time and velocity at cursor position
6. Sample area tools

Figure 9-1. Quantitative analysis window (here with TVI data)

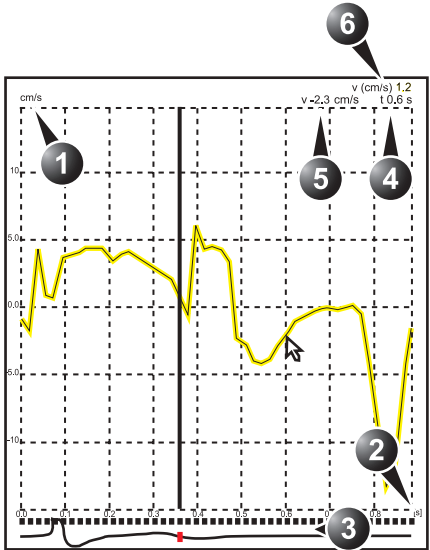
The Color cineloop window

	Displays TVI, Tissue Tracking, Strain, Strain rate or Angio color-coded data. Sample area (1): Indicates sampling position of the velocity (TVI), displacement (Tissue Tracking), percent deformation (Strain), deformation rate (Strain rate) or intensity (Contrast) trace. The sample area is color-coded: the first sample area is yellow, the second blue...etc.
 a) Shown only when a sample area is selected (pointed at). b) With Contrast data only. c) Shown only when pointing at an anchored sample area.	The cineloop windows system menu This menu is displayed by pressing Update/Menu when the cursor is placed over a sample volume in one of the <i>Cineloop</i> windows. • Delete all Sample areas: removes all traces at once. • Disable frame^b: the current frame is excluded from the cineloop display. • Set Sample area Shape^a: enables resizing of a selected sample area by setting height, width and tilt angle. The trackpad marker must be pointed at an anchored sample area. • Label Sample area...^a: sets a descriptive name to the sample area. The label is useful for identification of the sample area when exporting data. • Delete Sample area^c: deletes the selected sample area. • Delete anchor^c: removes anchoring from a dynamic sample area (see also page 9-9 and page 9-11). • Cancel: exits the <i>System</i> menu.

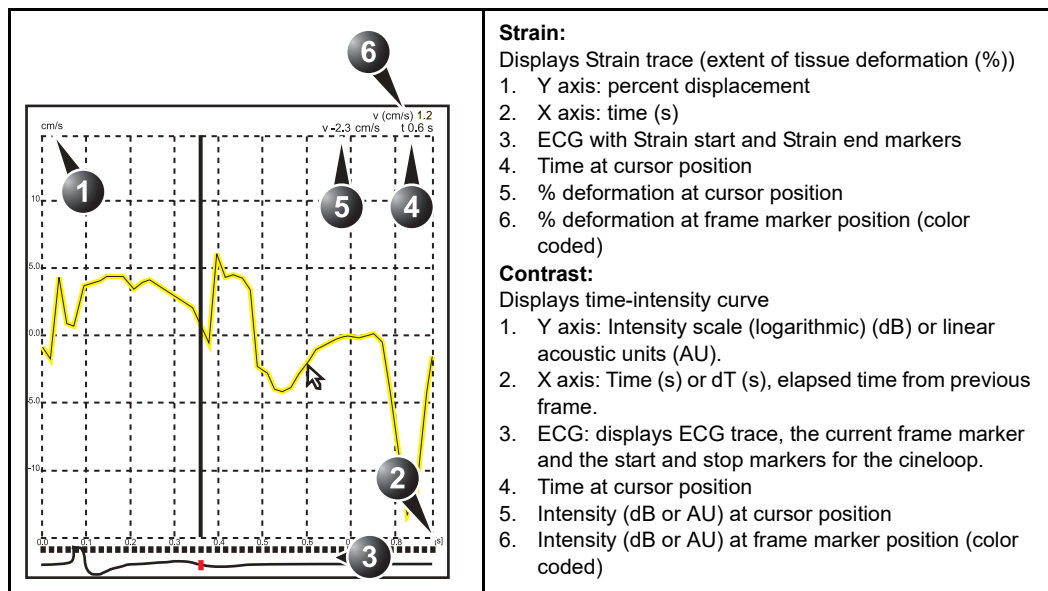
The Tissue cineloop window

	Displays 2D data Sample area (1): Indicates sampling position of the velocity (TVI), displacement (Tissue Tracking), percent deformation (Strain), deformation rate (Strain rate) or intensity (Contrast) trace. The sample area is color-coded: the first sample area is yellow, the second blue...etc.
	Sample area tools: : creates a sample area based on freehand drawing. : creates a sample area with a pre-defined circular/elliptic shape (configurable)

The analysis window

	TVI: Displays velocity trace - Y axis: velocity scale (cm/s) - X axis: Time (s) - ECG - Time at cursor position - Velocity at cursor position - Velocity at frame marker position (color coded) Tissue Tracking: Displays tissue displacement trace - Y axis: displacement scale (mm) - X axis: time (s) - ECG with Tracking start and Tracking end markers - Time at cursor position - Displacement at cursor position - Displacement at frame marker position (color coded) Strain rate: Displays Strain rate trace (rate of deformation (s^{-1})) - Y axis: s^{-1} - X axis: time (s) - ECG - Time at cursor position - Strain rate at cursor position - Strain rate at frame marker position

The analysis window (continued)

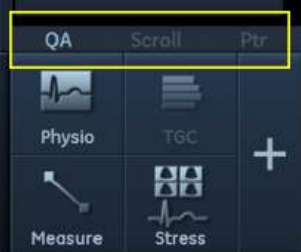


a) With contrast data only.
b) Shown only in zoom mode.

The analysis window System menu:
This menu is displayed by pressing **Update menu** when the cursor is in the Analysis window.

- **Delete all Sample areas:** removes all traces at once.
- **Analysis signal:** toggles trace display between velocity, displacement, strain rate, stain or greyscale intensity curves.
- **Drift compensation:** compensates drifting of strain or Tissue Tracking curves by either resetting the curve to zero at the tracking start point (cycle resetting) or by linear compensation throughout the cycle (linear compensation)
- **Vertical auto-scaling:** selects between full unit range or a range according to the maximum and minimum values of the displayed trace(s).
- **Vertical unit^a:** toggles between logarithmic (dB) and linear acoustical units (AU).
- **Line style:** selects between solid line only or solid line with square markers at each data point.
- **Smoothing:** smooths the trace displayed by applying a filter over a defined time window. Both the filter type and time window are user-selectable. The type of filter available is depending on the analysis signal displayed.
- **Export traces:** saves trace data in ASCII format, readable in spreadsheet programs. If present, trace data for physiological traces are also exported.
- **Curve fitting^a:** toggles between Wash-in, Wash-out and off.
- **Unzoom^b:** restores full analysis window display when in zoom mode.
- **Cancel:** exits the *System* menu.

The trackpad assignments

	QA: Pointing tool in Quantitative analysis mode. Scroll: • When the cineloop is stopped, enables scrolling through the cineloop. • When the cineloop is running, enables control of the cine replay speed. Press the Trackpad key to toggle the trackpad assignment between QA and Scroll.

Using Q Analysis

Generation of a trace

Up to eight traces can be generated.

About the sample area

The sample area can be in three different states:

- **Free sample area:** freely moving sample area (QA cursor) before anchoring.
- **Static sample area:** the free sample area is anchored by pressing **Set**.
- **Dynamic anchored sample area:** the sample area is anchored in two or more frames (see Manual tracking below). In these particular frames, the sample area is displayed with an anchor. The sample area moves smoothly between the anchored positions when playing/scrolling the cineloop.

NOTE: The free sample area disappears when the QA cursor is moved over a static sample area.

To generate a trace

Trace from a pre-defined sample area

The shape of the pre-defined sample area is configurable.

1. If the Trackpad assignment is not on QA, press **Trackpad** until **QA** is highlighted.
2. If necessary, select the sample area **Shape button** .
3. Place the cursor in one of the *Cineloop* windows.
The cursor is changed to a sample area (white circle).
A preview of the trace is displayed in the *Analysis* window.
4. Press **Set** to anchor the sample area.

In this frame the sample area is marked with an anchor.

If the cineloop has more than one heart cycle a sample area will also be anchored in the corresponding frame in the next heart cycles.

The trace is updated accordingly in the *Analysis* window.

NOTE: *The trace and sample area are color-coded. First generated trace is yellow, second blue...etc.*

The Strain cursor

In Strain and Strain rate modes, the sample area displays a Strain cursor showing the segment along the beam direction that is used for Strain and Strain rate calculations. Make sure that the Strain cursor is within the myocardium when anchoring the sample area.

Trace from a freehand sample area

1. Select the **Pencil button** .
2. Place the cursor in one of the *Cineloop* windows.
The cursor is changed to a cross.
3. Press and hold down **Set** while drawing a sample area with the trackpad.
4. Release **Set**.

The sample area is automatically closed.

The trace is updated accordingly in the *Analysis* window.

Manual tracking of the sample area (dynamic anchored sample area)

The sample area can be moved within the loop to ensure that data in the trace is generated from the same anatomical location during the cyclic motion of the heart.

1. Freeze the image and set a sample area over a region of interest.

Note the anatomical location of the sample area.

2. Press **Trackpad** until the **Scroll** trackpad assignment is selected. Select a new frame.
3. Press **Trackpad** until the **QA** trackpad assignment is selected.
4. Drag the sample area to the corresponding anatomical location in the new frame.

When the sample area is anchored in more than one frame, linear interpolation is performed, so that the sample area is smoothly moved between the anchored positions in the selected frames when running the cineloop.

NOTE:

In the original frame and this particular frame the sample area is marked with an anchor.

5. Press **Trackpad** until the **Scroll** trackpad assignment is selected.
6. Scroll through the cineloop and control that the sample area follows the moving anatomical structure.
7. Add anchored sample areas in several frames to obtain a more accurate displacement of the sample area.

To move a dynamic anchored sample area

1. Freeze the image.
2. Press **Trackpad** until the **Scroll** trackpad assignment is selected.
3. Scroll through the cineloop to display one of the frames where the sample area was anchored.

NOTE: In these frames the sample area is marked with an anchor.

4. Press **Trackpad** until the **QA** trackpad assignment is selected.
5. Place the cursor on the sample area to move, in one of the *Cineloop* windows.
6. Press **Set**.
The sample area is unanchored.
7. Drag the sample area to a new location.
8. Press **Set** to anchor the sample area to the new location.

Zooming in the Analysis window

1. In the *Analysis* window, press and hold down the **Set** key while dragging the trackpad cursor to define the zooming area.
2. Release the **Set** key.

The selected area is displayed in the *Analysis* window.

To unzoom

1. In the *Analysis* window, press **Update/Menu**.
The *System* menu is displayed.
2. Select **Unzoom**.

Deletion of a trace

The user can delete all traces at once or one at a time.

To delete all traces

1. If necessary, press **Trackpad** until the **QA** trackpad assignment is selected.
2. With the cursor in one of the *Cineloop* windows, press **Update/Menu**.
The *System* menu is displayed.
3. Select **Delete all sample areas**.

To delete one specific trace

1. If necessary, press **Trackpad** until the **QA** trackpad assignment is selected.
2. Place the cursor on the sample area to delete.
3. Press **Update/Menu**.
The *System* menu is displayed.
4. Select **Delete sample area**.

Saving/retrieving Q Analysis

1. Press **Store** to save the quantitative analysis session.
2. To recall the Quantitative analysis session, select the icon on the clipboard, and press **Q Analysis**.

Frame disabling

Frame disabling excludes the actual frame from the cineloop display. Frame disabling is available only with contrast data.

Disabling frames

1. Place the cursor on the frame marker of the frame to disable beneath the *Analysis* window.
2. Press **Set** to disable the frame.

The frame marker turns red.

NOTE: *To re-enable a frame: Press **Set** on the corresponding frame marker.*

Disabling successive frames at a time

1. Press and hold down **Set** while dragging the cursor over the frame markers of the frames to disable.

The frame markers turn red.

*NOTE: To re-enable successive frames: press and hold down **Set** while dragging the cursor over the frame markers.*

ECG triggered frame disabling

In a multi-cycle acquisition, the user may deselect all frames in all heart cycles but a selected one. This function can be used for example to select a particular systolic frame for each heart cycle.

1. Scroll through the cineloop to identify the cardiac phase to analyze or identify the cardiac phase on the ECG trace.
2. Place the cursor on the frame marker of the frame of interest in one of the heart cycles (see Figure 9-2).
3. Press **Update/Menu**.
The *System* menu is displayed.
4. Select **ECG triggering**.

All frames in all heart cycles are disabled except for the selected and corresponding frames in the other heart cycles.

Re-enabling all frames

1. Place the cursor on the *Frame marker axis*.
2. Press **Update/Menu** in the trackpad area on the control panel.

The *System* menu is displayed.

3. Select **Enable all frames**.

All previously disabled frames are re-enabled.

1. Analysis window
2. Frame marker axis
3. Enabled frame (green marker)
4. Disabled frame (red marker)
5. ECG
6. Current frame

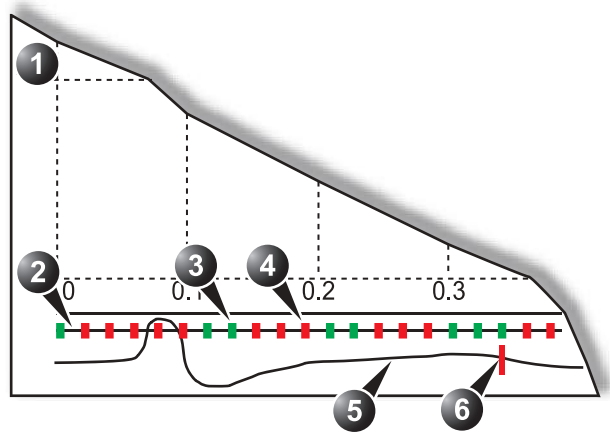


Figure 9-2. Frame disabling

Optimization

Optimizing the sample area

The sample area can be reshaped and labelled.

Reshaping a sample area

1. If necessary, press **Trackpad** until the **QA** trackpad assignment is selected.
2. Place the cursor on the sample area to reshape.
3. Press **Update/Menu**.

The *System* menu is displayed.

4. Select **Set Sample area shape**.

A *Dialogue* window is displayed where the user can adjust the height, the width and the angle of the sample area (see Figure 9-3).

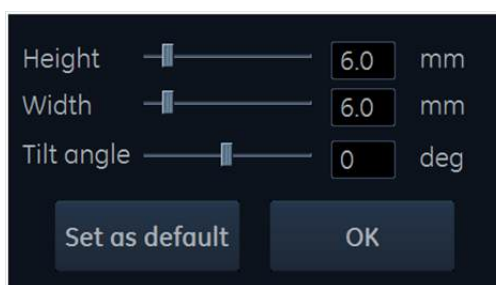


Figure 9-3. The sample area reshaping window

5. Drag the sliders to adjust the shape of the sample area as desired.
6. Press **OK** to return to the *Quantitative analysis* window and use the settings for the current analysis only.

OR

Press **Set as default** to return to the *Quantitative analysis* screen and keep the settings as default.

NOTE: *The sample area can also be reshaped using the **Sample Width**, **Sample Height** and **Sample Angle** controls.*

Labelling a sample area

The sample area label is used to identify data associated to the sample area when exporting to a spreadsheet program.

1. If necessary, press **Trackpad** until the **QA** trackpad assignment is selected.
2. Place the cursor on the sample area to label.
3. Press **Update/Menu**.

The *System* menu is displayed.

4. Select **Label Sample area**.

A *Dialogue* window with a free text field is displayed (see Figure 9-4).

5. Type a name for the sample area.
6. Press **OK** to return to the *Quantitative analysis* screen.



Figure 9-4. The sample area labelling window

Trace display

Y-axis

Auto-scaling

The system can be configured to display the full unit range or a range according to the maximum and minimum values of the displayed trace(s) (auto-scaling function). In addition, the auto-scaling function can be set to be live update (updates while the sample area is moved) or delayed (updated when the sample area is anchored).

1. If necessary, press **Trackpad** until the **QA** trackpad assignment is selected.
2. With the cursor in the *Analysis* window, press **Update/Menu**.

The *System* menu is displayed.

3. Select **Vertical auto-scaling**.

The *Vertical auto-scaling* menu is displayed.

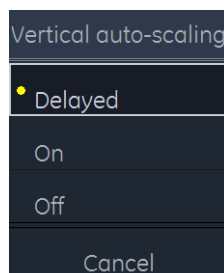


Figure 9-5. The Vertical Auto-scaling menu

4. Select the desired option:
 - **Delayed:** auto-scaling takes place after anchoring the sample area.
 - **On:** auto-scaling while moving the sample area.
 - **Off:** displays full scale.

Vertical units

When analyzing contrast data, the Y-axis can be set to display either logarithmic scale (dB) or linear, acoustical units (AU) for both tissue intensity (2D) or Angio intensity data.

1. If necessary, press **Trackpad** until the **QA** trackpad assignment is selected.
2. With the cursor in the *Analysis* window, press **Update/Menu**.
The *System* menu is displayed.
3. Select **Vertical unit**.
The *Vertical unit* menu is displayed.

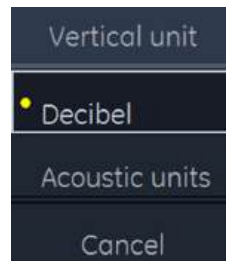


Figure 9-6. The Vertical unit menu

4. Select the desired option.

Trace smoothing

The system can smooth the traces displayed by applying a filter over a defined time window. The type of filter available is depending on the analysis signal displayed.

1. If necessary, press **Trackpad** until the **QA** trackpad assignment is selected.
2. With the cursor in the *Analysis* window, press **Update/Menu**.
The *System* menu is displayed.
3. Select **Smoothing**.
The *Smoothing* menu is displayed.
4. Select a smoothing filter.
The trace display is updated.

Cine compound

Cine compound calculates and displays cineloops generated from a temporal averaging of multiple consecutive heart cycles. The number of averaged cycles is displayed on the top left corner.

To apply cine compound:

1. Adjust **Cine compound** to set the number of heart cycles to average.

The traces are updated showing averaged data. The number of heart cycles averaged is displayed on the top left corner.

2. Press **CC Zoom** to display the last recorded heart cycle.
3. Press **CC Zoom** again to unzoom.

Switching modes or traces

The user can toggle between TVI, Tissue Tracking, Strain rate or Strain modes to access to the mode specific controls or display alternative traces from within a selected mode.

To switch mode

1. Select the desired mode (TVI, Tissue Tracking, Strain rate, Strain or TSI).

The *Analysis* window is updated with the corresponding trace.

Curve fitting analysis

Curve fitting analysis is used to estimate local myocardial contrast agent concentration rate.

The analysis is based on two algorithms:

- **Wash-in curve fitting:** find and estimate local contrast agent concentration rate.

Exponential wash-in is described by the function:

$y(t) = A[1 - e^{-kt}] + B$, where:

- **A** (dB or AU) is the intensity from the contrast agent.
- **B** (dB or AU) is the intensity at time $t = 0$ (defined as the time of left marker). This corresponds to the tissue (baseline) signal if no contrast is present at the selected starting point.

Note that $A+B$ = contrast + tissue = plateau level.

- **k** (1/s) is a time constant.

- **Wash-out curve fitting:** find and estimate the wash-out rate of contrast agent locally (e.g. LV or myocardium).

Exponential wash-out is described by the function:

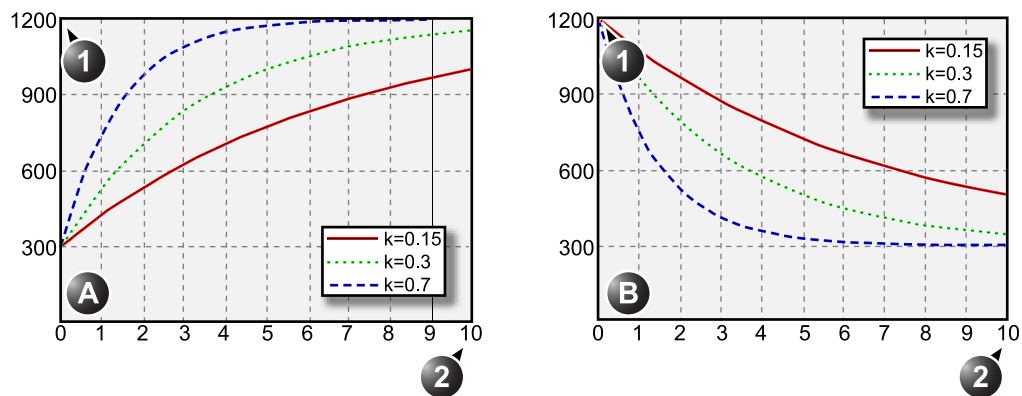
$y(t) = Ae^{-kt} + B$, where:

- **A** (dB or AU) is the intensity from the contrast agent.
- **B** (dB or AU) is the intensity from the tissue = baseline signal.

Note that $A+B$ is the initial intensity level.

- **k** (1/s) is a time constant.

Curve fitting analysis (continued)



- 1. Intensity (AU)
- 2. Time (s)

Figure 9-7. Curve fitting examples, A) wash-in, B) wash-out A=900 AU, B=300 AU for all curves

Wash-in curve fitting analysis

Overview

The purpose of wash-in curve fitting analysis is to find and estimate local contrast agent concentration rate. This can be achieved by using the M5Sc-RS and 3Sc-RS LV Contrast applications with low transmit power (MI 0.1). Applying **Flash** will destroy most or all contrast within the imaging plane. The period of low power imaging immediately following the flash will contain the information on how fast contrast agent washes into different segments of the myocardium. By storing data 5 to 10 seconds after Flash and performing curve fitting to this data set, the user can explore myocardial contrast agent concentration rate.

NOTE: Contrast curve fitting analysis is intended for clinical research only. Diagnosis must not be based solely on the obtained results.

Performing wash-in curve fit

From a contrast examination in Quantitative analysis:

1. Disable frames that are significantly different (i.e. because of respiration or probe movements), see page 9-15.
2. Place the sample area over the myocardium in one of the *Cineloop* windows.

NOTE: *Up to eight different sample areas may be generated in the myocardium.*

3. If desired, reshape the sample area as described on page 9-18.
4. Because of heart motion, the sample area in each frame has to be adjusted manually to be located inside the myocardium (Manual tracking of the sample area).

The signals originating from the heart cavities are typically 10 to 20 times stronger than the signals from the myocardium, and will have a major effect on the averaging of signals in the sample area.

NOTE: *Refer to 'Manual tracking of the sample area (dynamic anchored sample area)' on page 9-11 for further details*

Performing wash-in curve fit (continued)

5. Browse through the cineloop to ensure that the sample area is in the same anatomical position in all frames.
6. Adjust **Horizontal sweep** and scroll through the cineloop to visualize a specific part of the data, typically the region immediately after Flash.
7. Adjust **Left marker** and **Right marker** to apply curve fitting to a specific region.
8. With the cursor in the *Analysis* window, press **Update menu**.

The *System* menu is displayed.

9. Select **Curve fitting**.

The *Curve fitting* menu is displayed.

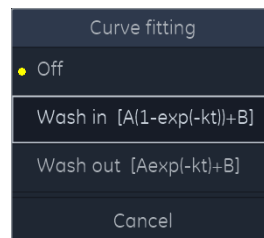
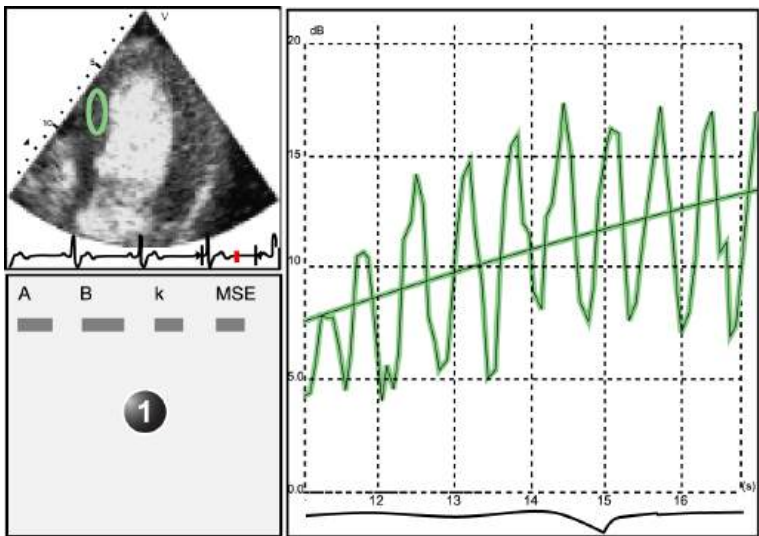


Figure 9-8. The Curve fitting menu

10. Select **Wash-in**.

The Wash-in curve is displayed in the *Analysis* window (see Figure 9-9).

Performing wash-in curve fit (continued)



1. Parameter window

Figure 9-9. Wash-in curve fitting

Wash-in curve fitting using varying triggering intervals

If the data set contains frames with uneven time intervals, e.g. triggered images with increasing triggering intervals, it is possible to plot the data using the time interval (dt) on the X-axis.

1. Disable unwanted frames. Curve fitting will be performed using all enabled frames.

NOTE: The frame disabling procedure is explained on page 9-15.

2. Place the sample area over the myocardium in one of the Cineloop windows.

3. Repeat step 2 if other sample areas are desired.

NOTE: Up to eight different sample areas may be generated in the myocardium.

4. If desired, reshape the sample area as described on page 9-18.

5. Perform **manual tracking** of the sample areas on all frames to ensure that the sample area is inside the myocardium.

NOTE: See page 9-11 for more information on sample area manual tracking.

Wash-in curve fitting using varying triggering intervals (continued)

6. With the cursor in the *Analysis* window, press **Update menu**.

The *System* menu is displayed.

7. Select **Horizontal scale**.

The *Horizontal scale* menu is displayed.

8. Select **dT scaling**.

The X-axis in the *Analysis* window is updated accordingly.

9. With the cursor in the *Analysis* window, press **Update menu** again.

The *System* menu is displayed.

10. Select **Curve fitting**.

The *Curve fitting* menu is displayed.

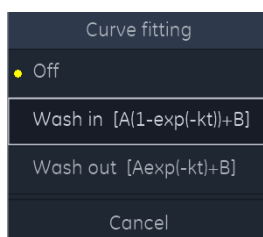
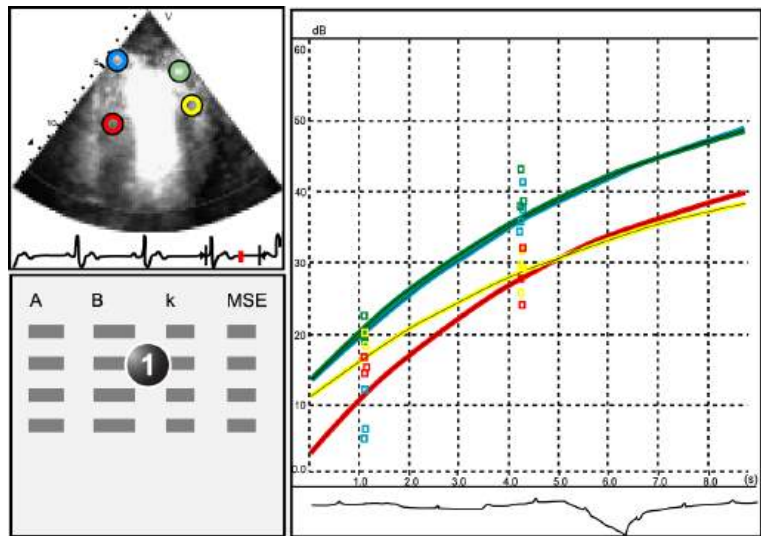


Figure 9-10. The Curve fitting menu

11. Select **Wash-in**.

The Wash-in curve is displayed in the *Analysis* window.

Wash-in curve fitting using varying triggering intervals (continued)



1. Parameter window

Figure 9-11. Wash-in curve fitting after varying triggering interval

Wash-out curve fitting analysis

Overview

The purpose of wash-out curve fitting analysis is to find and estimate a local wash-out rate. The analysis may be used for wash-out of contrast from LV or myocardium.

NOTE: *Contrast curve fitting analysis is intended for clinical research only. Diagnosis must not be based solely on the obtained results.*

Performing wash-out curve fitting

From a contrast examination in Quantitative analysis:

1. Disable frames that are significantly different (i.e. because of respiration or probe movements), see page 9-15.
2. Place the sample area over the myocardium in one of the *Cineloop* windows.

NOTE: *Up to eight different sample areas may be generated in the myocardium.*

3. If desired, reshape the sample area as described on page 9-18.
4. Because of heart motion, the sample area in each frame has to be adjusted manually to be located inside the myocardium (Manual tracking of the sample area).

NOTE: *Refer to 'Manual tracking of the sample area (dynamic anchored sample area)' on page 9-11 for further details.*

The signals originating from the heart cavities are typically 10 to 20 times stronger than the signals from the myocardium, and will have a major effect on the averaging of signals in the sample area.

Performing wash-out curve fitting (continued)

5. Browse through the cineloop to ensure that the sample area is in the same anatomical position in all frames.
6. Adjust **Horizontal sweep** and scroll through the cineloop to visualize a specific part of the data.
7. Adjust **Left marker** and **Right marker** to apply curve fitting to a specific region.
8. With the cursor in the *Analysis* window, press **Update menu**.

The *System* menu is displayed.

9. Select **Curve fitting**.

The *Curve fitting* menu is displayed.

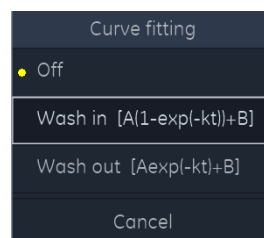


Figure 9-12. The Curve fitting menu

10. Select **Wash-out**.

The Wash-out curve is displayed in the *Analysis* window (see Figure 9-13).

Performing wash-out curve fitting (continued)

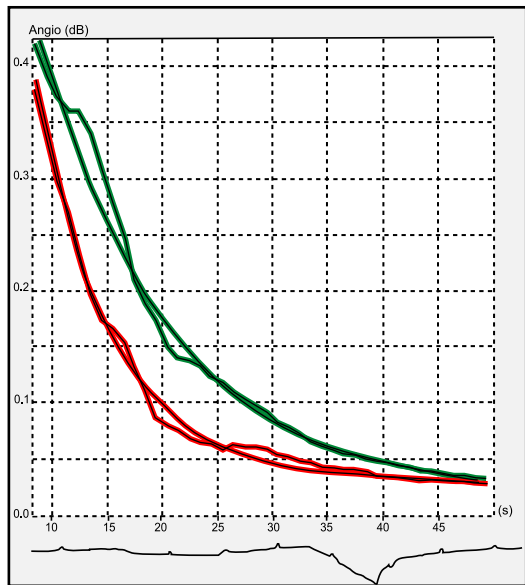


Figure 9-13. Wash-out curve fit of two sample regions in an in-vitro experiment

Anatomical M-Mode

Introduction

M-Mode applied to TVI, Tissue Tracking, Strain rate, Strain or intensity data (Contrast) calculates and color/codes data accordingly along a path drawn by the operator.

Using Anatomical M-Mode

1. Press **Curved AMM**.
2. In one of the *Cineloop* windows, place the first point of the path.
3. Move the cursor to the location for the next anchoring point of the path and press **Set**.

A path with two anchor points will give a straight anatomical M-Mode profile. By creating more than two anchor points, the user can bend the path and obtain a curved anatomical M-Mode profile.

NOTE: To edit a path under construction, move the cursor backward and retrace the path.

4. To end the trace press **Set** twice (double clicking).

The color-coded display of the corresponding data calculated along the path is shown in the *Analysis* window.

*NOTE: Adjust **Horiz. Sweep** and scroll through the cineloop to optimize the display to the portion of interest.*

Optimizing Anatomical M-Mode

Edition of the curve

The drawn Anatomical M-Mode path can be edited by moving the anchor points.

To move an anchor point

1. Select the anchor point to move.
2. Move the anchor point to a new position.
3. Press **Set** to anchor the point to its new location.

Chapter 10

Archiving

This chapter describes:

‘The Dataflow Concept’ on page 10-3

‘Storing Images and Cineloops’ on page 10-7

‘Retrieving and Editing Archived Information’ on page 10-17

‘Review Images in Archive’ on page 10-35

‘Connectivity’ on page 10-43

‘Transfer of Patient Records/Examinations’ on page 10-82

‘Disk Management’ on page 10-91

‘Data Backup and Restore’ on page 10-101

‘Tricefy Uplink’ on page 10-110

‘Archive’ on page 10-123.

Introduction

During an examination, the operator stores data, images and cineloops for immediate purposes. The Vivid *iq* ultrasound unit includes an integrated patient archiving system for data and image storage.

The Vivid *iq* ultrasound unit enables also storing of data and images to external databases (Network Server, removable media).

The Dataflow Concept

Communication between the Vivid *iq* ultrasound unit and other information providers on the network takes the form of dataflows. Each dataflow defines the transfer of patient information and images from an input source to the unit, and from the unit to one or several output sources.

A dataflow is a set of pre-configured settings. Selecting a dataflow will automatically customize the unit to work according to the settings associated with this dataflow.

Dataflows available

A set of pre-defined dataflows is available on the unit as listed in the table below.

NOTE: *Not all dataflow listed below are visible by default.*

NOTE: *The list of dataflow available is configurable (see 'Dataflow adjustments' on page 10-125).*

Dataflow	Description
LocalArchive	The local database is used for patient archiving. Images are stored to internal harddrive.
LocalArchive / DICOM Server	The local archive is used for patient archiving. Images are stored to the internal hard drive and to a DICOM server. Some of the measurements are stored if DICOM SR is turned on (see page 10-72 for more information about DICOM SR and supported measurements).
EchoPAC Archive / DICOM Storage Image Vault Archive / DICOM Storage	A remote database (either on EchoPAC Software Only or a server) is used for patient archiving. Images are stored to a network image volume (either internal HD on EchoPAC Software Only or a server).

Dataflow	Description
EchoPAC Archive / DICOM Storage	A remote database is used for patient archiving. Images are stored to a network image volume and to a DICOM server. Some of the measurements are stored if DICOM SR is turned on (see page 10-72 for more information about DICOM SR and supported measurements).
Worklist / LocalArchive / DICOM Storage	Search in a DICOM Modality Worklist, the patient found is copied into local database. The patient information and the examination results are stored to the local database. Images are stored to a DICOM server and to an image volume on the local harddrive. Some of the measurements are stored if DICOM SR is turned on (see page 10-72 for more information about DICOM SR and supported measurements).
Worklist / LocalArchive / DICOM Storage Worklist / Image Vault Archive / DICOM Storage	Search in a DICOM Modality Worklist, the patient found is copied into a remote database. The patient information and the examination results are stored to a remote database. Images are stored to a DICOM server and to an image network volume. Some of the measurements are stored if DICOM SR is turned on (see page 10-72 for more information about DICOM SR and supported measurements).
Worklist / Local Archive	Search in a DICOM Modality Worklist, the patient found is copied into the local database. The patient information and the examination results are stored to the local database. Images are stored to an image volume on the local harddrive.
Worklist / Image Vault Archive	Search in a DICOM Modality Worklist, the patient found is copied into a remote database. The patient information and the examination results are stored to a remote database. Images are stored to an image network volume.
DICOM DVD Read only	Read DICOM images from the CD/DVD-drive. Read only dataflow, no data can be stored.
DICOM Storage	Store pure DICOM images to a DICOM device. Raw data may also be saved depending on the dataflow configuration. Some of the measurements are stored if DICOM SR is turned on (see page 10-72 for more information about DICOM SR and supported measurements).
DICOM Query Retrieve	Retrieve images from a DICOM server based on query parameters.

Dataflow	Description
Worklist - DICOM Storage	Search in the DICOM Modality Worklist. Images are stored to a DICOM Server. Some of the measurements are stored if DICOM SR is turned on (see page 10-72).
DICOM Query Retrieve / DICOM Storage	Retrieve images from a DICOM server based on query parameters. Images are stored to a DICOM server. Some of the measurements are stored if DICOM SR is turned on (see page 10-72 for more information about DICOM SR and supported measurements).
Worklist/DICOM Query Retrieve - DICOM Storage	Search in a DICOM Modality Worklist, retrieve images from a DICOM server based on query parameters. Images are stored to a DICOM server. Some of the measurements are stored if DICOM SR is turned on (see page 10-72 for more information about DICOM SR and supported measurements)
DICOM USB Read Only	Read DICOM data from an USB device. Read only dataflow, no data can be stored.
No Archive	Enables to perform an examination without storing the data to any archive.
Local Archive / Tricefy Store	The local archive is used for patient archiving. Images are stored to the local archive and to Tricefy. If DICOM SR is enabled, measurements are also sent to Tricefy.
Tricefy Store	Store images to Tricefy. If DICOM SR is enabled, measurements are also sent to Tricefy.
Local Archive - Tricefy Patient Share	The local archive is used for patient archiving. Images are stored to the local archive and to Tricefy. Images are also shared with the patient. If DICOM SR is enabled, measurements are also sent to Tricefy.
Tricefy Patient Share	Store images to Tricefy and share them with the patient. If DICOM SR is enabled, measurements are also sent to Tricefy.
Tricefy QR / Tricefy Store	Search in Tricefy patients and examinations. Retrieve images from Tricefy. Images are stored to Tricefy. If DICOM SR is enabled, measurements are also sent to Tricefy.
Tricefy QR / Tricefy Patient Share	Search in Tricefy patients and examinations. Retrieve images from Tricefy. Images are stored to Tricefy and shared with the patient. If DICOM SR is enabled, measurements are also sent to Tricefy.

Dataflow	Description
Worklist/Tricefy QR - Tricefy Store	Search in a DICOM Modality Worklist, retrieve images from Tricefy. Images are stored to Tricefy. If DICOM SR is enabled, measurements are also sent to Tricefy.
Worklist/Local Archive - Tricefy Store	Search in a DICOM Modality Worklist, the patient found is copied into the local archive. The patient information and the examination results are stored to the local database. Images are stored to Tricefy and to the local archive. If DICOM SR is enabled, measurements are also sent to Tricefy.

Transfer sources and destinations available

Dataflow	Description
DICOM USB	USB device defaulted to store DICOM data, but can also be configured to include raw data images as well as DICOM SR. No support for inclusion of other patient data.
DICOM DVD	DVD (or CD) device defaulted to store DICOM data, but can also be configured to include raw data images as well as DICOM SR. No support for inclusion of other patient data.
Export as XML	Media or remote path support from transfer of measurements and other parameters in XML format.
DICOM Print	Support for printing of images on a DICOM printer
Raw Data USB	USB device defaulted to store raw data but can also be configured to include DICOM images as well as DICOM SR. Support for inclusion of other patient data included for database transfer.
Raw Data DVD	DVD (or CD) device defaulted to store raw data but can also be configured to include DICOM images as well as DICOM SR. Support for inclusion of other patient data included for database transfer.

Storing Images and Cineloops

Images and cineloops that are stored during a current examination are displayed as thumbnails on the clipboard. When an image is stored, all the additional information that is displayed is saved with it (e.i. probe and application selected, image setting, annotations or measurements).

The image archive is set by the dataflow selected (see page 10-3 about available dataflows).



Do not use the internal harddrive for long-term image storage. External storage media or network-based server solution is recommended for image long-term archive.



If working off-line with a dataflow pointing to a DICOM server, the images stored during the examination may have to be manually resent in the DICOM spooler when reconnecting the unit. Resend all jobs that are failed or on hold.

In addition, stored images and cineloops can be saved to a removable media in the standard formats JPEG, MP4, and DICOM (see page 10-12).

Storing an image

Images are displayed chronologically on the clipboard.

1. While scanning in any mode, press **Freeze**.
2. With the trackpad, scroll through the cineloop and select the required image.
3. Press **Store**.

The image is stored and a thumbnail is displayed on the clipboard.

Storing a cineloop

A cineloop is a sequence of images recorded over a certain time frame. The time frame can be adjusted to cover one or more heart cycles. The stored cineloops are displayed chronologically on the clipboard. Cineloops can be stored at any time during the scanning session.

The system can be configured to perform either

- Retrospective storage: while scanning press **Store** to store the last elapsed defined number of cycles/seconds.
- Prospective storage: while scanning press **Store** to start storage of the forthcoming defined number of cycles/seconds.

The user can also configure the system to preview the cineloop before storage or save the cineloop directly as described in the sections below.

See 'Global imaging settings' on *page 5-88* for configuration of cineloop storage.

Storing a cineloop (continued)

During data transfer, when the USB is unplugged accidentally, an error message will pop up, and the transferring process fails.

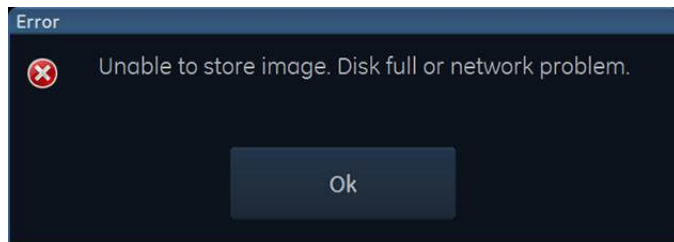


Figure 10-1. Data transfer error

Direct storage of a cineloop

Depending on whether the system has been configured to enable or disable the **Preview Loop before store** function (see 'Configuration – Imaging' on *page 5-88*), the following procedures enable the cineloop to be stored directly.

Storing cineloop without preview

The function **Preview Loop before store** is disabled (see page 5-88).

1. In live mode, press **Timespan** in the operation panel to define the seconds to store.

In freeze mode, press **Num Cycles** in the operation panel to define the number of cycles.

2. While scanning, press **Store**.
 - If **Retrospective storage** is selected (see page 5-88), the last elapsed defined number of cycles/seconds are stored.
 - If **Prospective storage** is selected (see page 5-88), the forthcoming defined number of cycles/seconds are stored.

A thumbnail is displayed on the clipboard and scanning resumes immediately.

NOTE: *Cineloop storage can be configured to store heart cycles with additional time before and after the R-wave (see 'Global imaging settings' on page 5-88).*

Storing cineloop with preview

The function **Preview Loop before store** is enabled (see page 5-88).

1. In live mode, press **Timespan** in the operation panel to define the seconds to store.
In freeze mode, press **Num Cycles** in the operation panel to define the number of cycles.
2. While scanning, press **Store**.
 - If **Retrospective storage** is selected (see page 5-88), the last elapsed defined number of cycles/seconds are displayed on the screen (but not stored).
 - If **Prospective storage** is selected (see page 5-88), the forthcoming defined number of cycles/seconds are displayed on the screen (but not stored).
3. If desired, select and adjust the cineloop to store using the cineloop controls (see 'Cineloop' on page 4-28).
4. Press **Store** to save the cineloop.
A thumbnail is displayed on the clipboard and scanning resumes immediately.

Saving images and cineloops to a standard format

Images and cineloops can be saved to a removable media or a shared network folder in the following standard formats:

- **Still images:** JPEG, MP4, DICOM and RawDICOM (Raw data + DICOM)
- **Cineloops:** MP4, DICOM and RawDICOM (Raw data + DICOM)

1. In live: press **Freeze**.
In replay: select an image thumbnail on the clipboard.
2. Press **Update/Menu** on the Control panel.
The System menu is displayed.

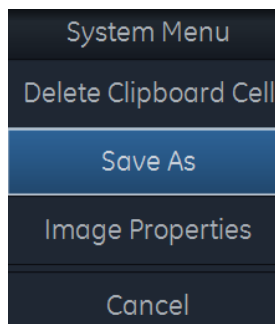


Figure 10-2. The System menu

3. Select **Save as**.

Saving images and cine loops to a standard format (continued)

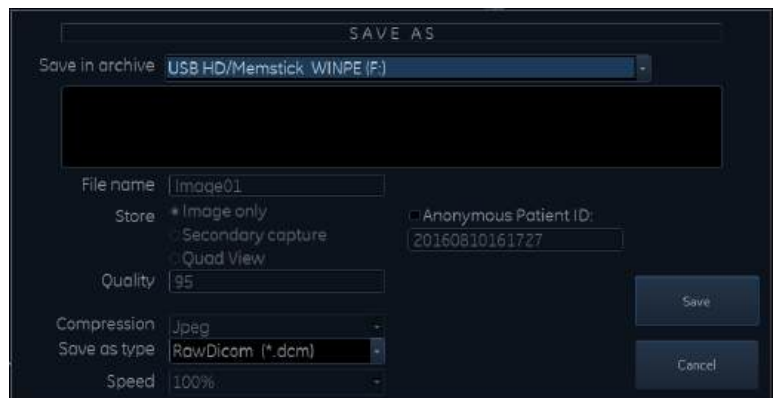


Figure 10-3. The Save as window

4. Select the desired destination from the *Destination* pull-down menu.
5. Select the File type.
 - **RawDICOM:** saves the still image or cine loop in both GE raw format and DICOM format.
 - **DICOM:** saves the still image or cine loop in pure DICOM format.
 - **JPEG:** saves a still image in JPEG format.
 - **MP4:** saves the still image or cine loop in MP4 format.
6. Press **Save**.
A file is saved in the selected archive.

DICOM Viewer

This feature is an option that enables to export a self-contained DICOM viewer to a removable media along with the selected images when transferring images to a DICOM removable media.

NOTE: *This viewer is NOT intended to be a diagnostic tool. It is only meant to be used for reference. See further explanation in the “DICOM Viewer Instructions for Use.”*

Details of DICOM Viewer

When the Vivid *iq* system includes the DICOM Viewer option, it allows the user to transfer examinations to DICOM removable media together with a DICOM viewer.

Placing the media in any PC automatically starts-up the DICOM viewer to allow users to view images and loops contained in the examinations available on that media. There is no need to perform any installation on the viewing PC station, as the DICOM viewer is self-contained on the inserted media.

NOTE: *Minimal requirements for the Viewing PC are Windows 10.*

The self-contained DICOM viewer contains a built-in Instructions for Use. Read this instruction to learn more about the different functions of the viewer. Translations of the instruction to different languages are available to the user.

Refer to DICOM Viewer Instructions for Use to set User Interface in different languages.

Configuring the DICOM Viewer

The user can configure the system to enable or disable the embedding of the DICOM viewer on the media.

1. Make sure the DICOM Viewer option is installed.
2. Press **Config**.
3. Select the **Connectivity** category and the **Transfer** subgroup.

The *Transfer* sheet is displayed.

4. Select a dataflow for a DICOM removable media (i.e DICOM DVD, DICOM USB)

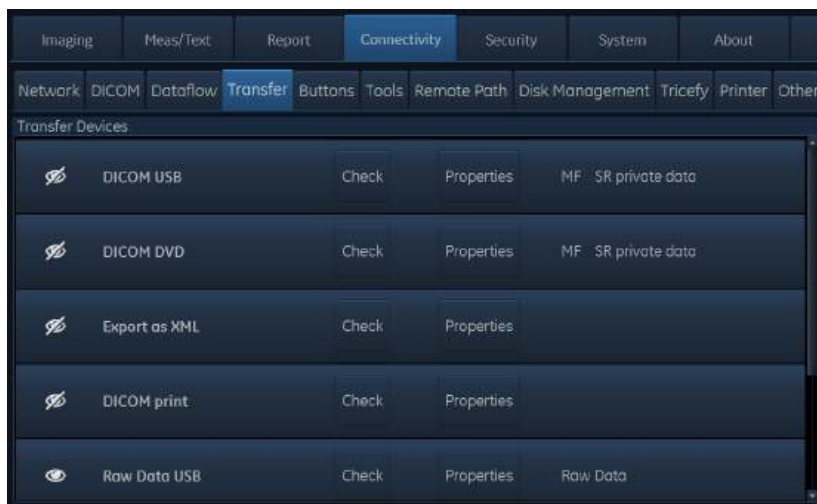


Figure 10-4. The Transfer Devices sheet

Configuring the DICOM Viewer (continued)

5. Select a transfer device and press **Properties**.
The *DICOM Media Properties* window is displayed.
6. Check the option **Add DICOM Viewer**.

The DICOM Viewer will be exported when transferring examination to the corresponding DICOM removable media.

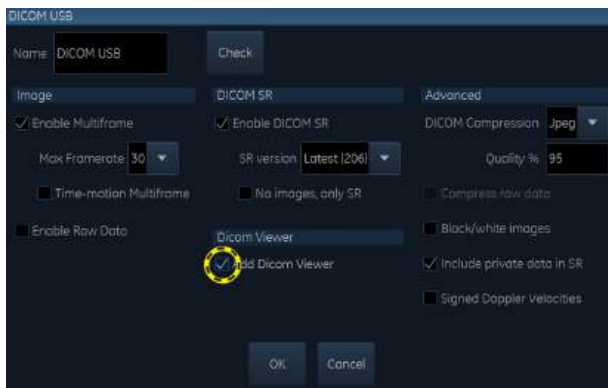


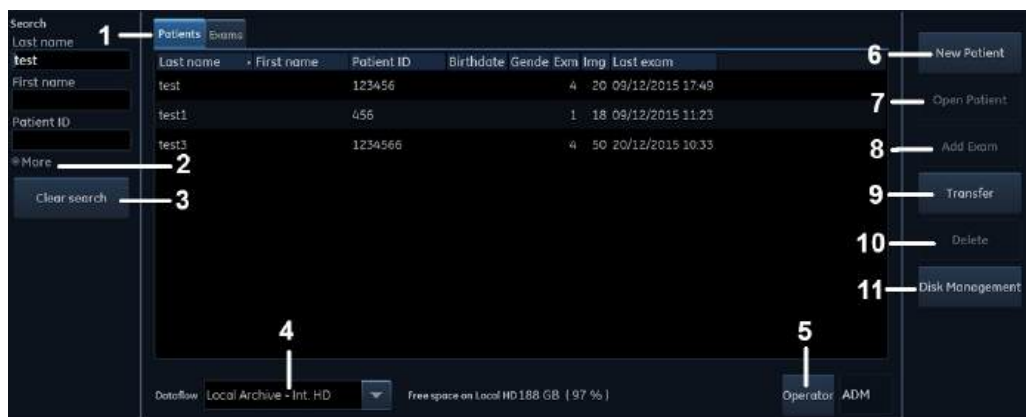
Figure 10-5. DICOM Media Properties window

Retrieving and Editing Archived Information

Searching for a patient record

1. Press **Patient** on the Shortcut Bar.
If required, log on by typing the user ID and password.
The *Archive* screen is displayed (Figure 10-6).
2. In the *Archive* screen select the desired dataflow.
3. Type the **Patient Name**, and/or **ID** or another query that identifies the patient.
When default configured, the system automatically searches to see if the patient is already in the archive. The result of this search is displayed in the *Patients* list.
4. Select the **Exams** tab to display a list of examinations instead of the patient records.
5. Press **Open Patient**.
The *Patient info and exam* screen for the actual patient is displayed (refer to Figure 10-8).

Searching for a patient record (continued)



1. Display either patient or examination list.
2. Advanced search filters
3. Clear current search criteria
4. Select archive and other pre-defined services.
5. Change user.
6. Create new patient record
7. Open the selected patient record.
8. Load patient record and start new examination.
9. Transfer patient records between archives (see page 10-82)
10. Delete selected patient record or examination (see page 10-30).
11. Manage hard disk space (see page 10-91)

Figure 10-6. The Archive screen

Advanced search

To restrain the search to a specific patient group, one or more additional filters may be applied to the search. The table below shows the filters available from the *Patient* list and *Exam* list.

NOTE: *Filters available are dependent of the dataflow selected. Search criteria for DICOM Worklist or Query/Retrieve dataflows are set when configuring the DICOM device (see 'Adjusting the Search Criteria' on page 10-69).*

Advanced searching filters	
Patient list	Exam list
Last name	Last name
First name	First name
Patient ID	Patient ID
Date of birth	Category
Born before and/or after	Today's examinations
Gender	Diagnosis codes
	Examination before and/or after
	Stress
	No reports
	Images
	Diagnosing physician
	Exam ID
	Exam description
	Location

Editing data in the archive

After selecting a patient record and pressing **Open Patient**, the *Patient info and exam* screen is displayed (Figure 10-8) showing patient information, examinations and diagnosis information for the selected patient.

From this screen the user can enter or modify the patient information, examination results and diagnostic codes using the alphanumeric keyboard and pre-defined text input tools.

Once done a window is displayed asking the user to save the information entered.

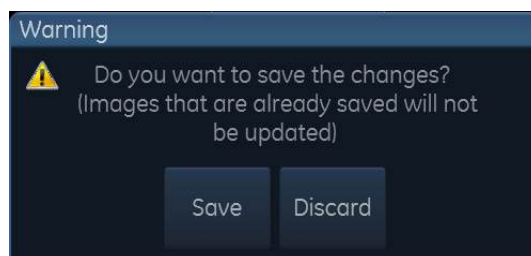


Figure 10-7. Save patient data window



CAUTION

The user is responsible for patient demographic data, diagnostic information or any other patient related information entered in the database.

Editing data in the archive (continued)



1. Patient information.
2. List of examinations.
3. Examination information.
4. Create a new examination.
5. Delete the selected examination.
6. Close the patient record and display the *Archive* screen.
7. End current examination and display the *Archive* screen.
8. Review images in the selected examination.
9. Image Manager: Review images in the selected patient record.
10. Create a report.
11. List of available information to display on screen.
12. Clipboard with images for the selected examination.

Figure 10-8. The Patient info and exam screen

Additional Patient ID

The Vivid *iq* system supports an additional field for Patient ID number.

To create/remove an additional Patient ID

1. In the *Patient info and exam* screen, press **Customize** in the Side bar to make sure that the option **Additional info** is checked in order to display the *Patient IDs* field.

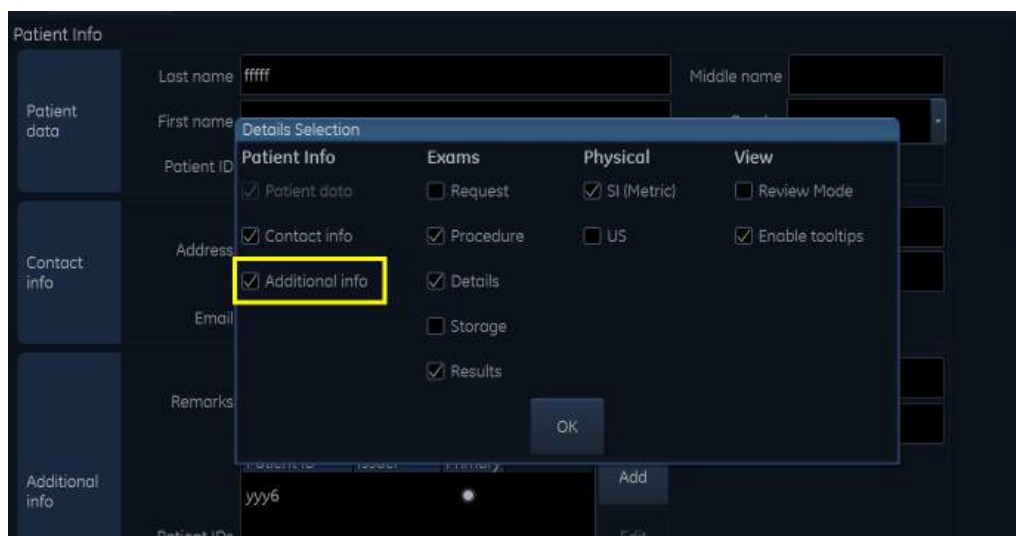


Figure 10-9. Check Additional Info

To create/remove an additional Patient ID (continued)



Figure 10-10. The Patient IDs field

2. To create an additional Patient ID, press **Add**.
The *Add Patient ID* window is displayed.
3. Enter a Patient ID and your identifier as issuer and press **OK**.
The new Patient ID is displayed in the *Patient IDs* field.
To make this new Patient ID the primary ID, select the **Primary** radio button next to the ID. A confirmation window is displayed. Press **OK** to confirm.
4. To remove an additional Patient ID, select the Patient ID and press **Remove**. A confirmation window is displayed. Press **OK** to confirm.

NOTE: A *Primary Patient ID* cannot be removed.

Editing Referral reasons, Comments and Diagnosis information

The user can edit the actual text in the *Patient info and exam* screen using the alphanumeric keyboard and by inserting pre-defined text input.

Editing text

1. In the *Patient info and exam* screen (Figure 10-8), place the cursor in the required field.
2. Using the alphanumeric keyboard, edit the information.

Inserting pre-defined text input

1. In the *Patient info and exam* screen, press  next to the field to edit.

The *Insert text* window is displayed (see Figure 10-11).

The pre-defined text list is organized in a three level hierarchy. Selecting one item in the first column displays pre-defined text entries related to the selected text in the second and third columns.

2. Navigate through the pre-defined text list by selecting items in the columns and double-click on the desired pre-defined text to be inserted. If an entry in the third column is inserted, the selected text in the second column is also inserted.

Press **More>>** to display the full text for the selected entry.

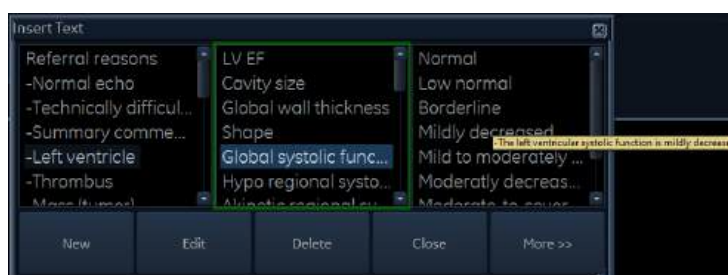


Figure 10-11. The Insert text window

Creating, editing and deleting text input

1. Press **Config** to access the configuration package.
2. In the Configuration package, select the category **Report** and the Tab sheet **Comment texts**.

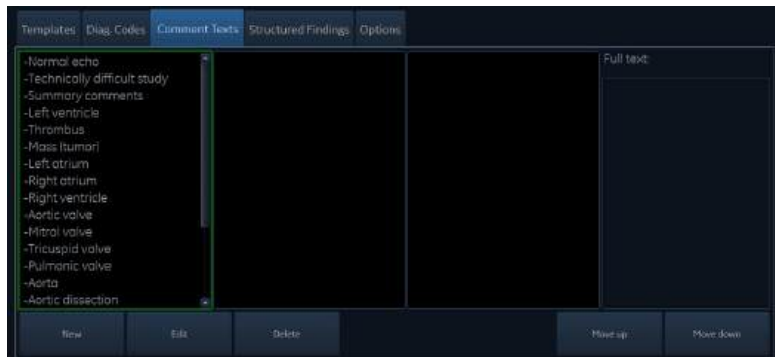


Figure 10-12. The Comment texts sheet

The pre-defined text list is organized in a three level hierarchy. Selecting one item in the first column displays pre-defined text entries related to the selected text in the second and third column.

To create a new text input in the first level:

1. Select the first level and press **New**.
The *Enter new text* window is displayed.

Creating, editing and deleting text input (continued)

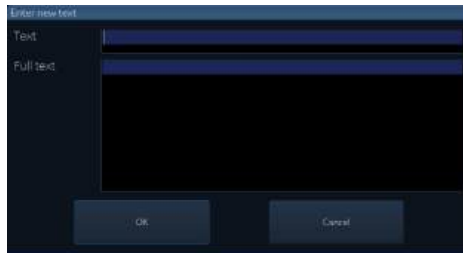


Figure 10-13. The Enter new text window

2. Enter a title in the *Text* field and a pre-defined text in the *Full text* field.
3. Select **OK**.

To create a new text input in the second and third level:

1. Select an item in the first column, then select either the second or third column and press **New**.
The *Enter new text* window is displayed.
The pre-defined text input to be created in the second and third column will be related to this selection only.
2. Enter a title in the *Text* field and a pre-defined text in the *Full text* field.
3. Press **OK**.

To edit a pre-defined text input:

1. Select the term to edit in one of the columns.
2. Press **Edit**.
The *Edit text* window is displayed.
3. Edit the text in both the *Text* and *Full text* fields.
4. Press **OK**.

Creating, editing and deleting text input (continued)

To delete a pre-defined text input:

1. Select the item to delete in one of the columns.
2. Press **Delete**.
A *Confirmation* window is displayed.
3. Press **Yes**.

The selected text input is deleted including the belonging text inputs in the sub-levels.

Diagnosis code

Adding Diagnosis codes

1. In the *Patient info and exam* screen, press  next to the *Code* field.
The *Code* list is displayed.
2. Select the codes to enter.

The codes selected are displayed in the *Patient info and exam* screen.

Removing entered Diagnosis codes

1. In the *Patient info and exam* screen, press  next to the *Code* field.
The *Code* list is displayed.
2. Uncheck the codes to remove.

Creating a Diagnosis code

1. In the *Patient info and exam* screen, press  next to the *Code* field.
The *Code* list is displayed.
2. Select **New code**.
The *New code* window is displayed.
3. Enter the new code.
4. Press **OK** to exit.

Diagnostic codes can also be created and deleted from the configuration package:

1. Press **Config** to access the configuration package.
2. In the Configuration package, select the category **Report** and the Tab sheet **Diag. Codes**.

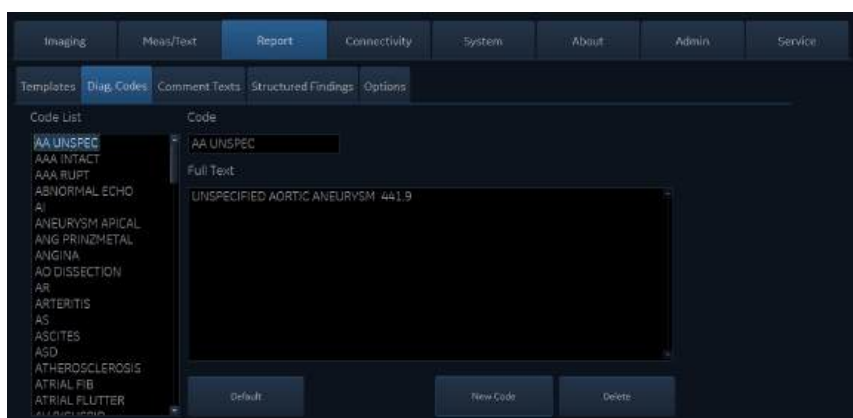


Figure 10-14. The Diagnostic codes sheet

Creating a Diagnosis code (continued)

To create a diagnostic code:

1. Select **New code**.
2. In the *Code* field, enter a name for the diagnostic code.
3. In the *Full text* field, enter the code text.

To delete a diagnostic code:

1. In the *Code list* field, select the diagnostic code to delete.
2. Select **Delete**.

Editing patient information

Patient information (name, contact information and patient IDs) can be edited from the *Patient info and exam* screen.

1. Select a patient record and press **Open patient**.
The *Patient info and exam* screen is displayed (refer to Figure 10-8 on page 10-21).
2. Edit the patient information using the alphanumeric keyboard.



CAUTION

Do NOT use '\' or '^' in patient information fields, as these characters might cause problems with some DICOM devices.

Deleting archived information

Only users belonging to the user groups Cardiologist, Sys Admin and GE admin are allowed to delete patient records or examinations (see 'System Users' on page 4-61 for further information).

To delete a patient record

1. Press **Patient** on the Shortcut Bar.
The *Archive* screen is displayed (Figure 10-6 on page 10-18).
2. Search and highlight the patient record to delete.
NOTE: Press **Shift** or **Ctrl**, select several patient records.
3. Press **Delete** on the screen.
A message is displayed asking the user to confirm the action to perform.
4. Select **OK**.

To delete an examination

1. Press **Patient**.
The *Archive* screen is displayed (Figure 10-6 on page 10-18).
2. Search and highlight the patient record with the examination to delete.
3. Press **Open patient** on the screen.
The *Patient info and exam* screen is displayed (Figure 10-8 on page 10-21).
4. Highlight the examination to delete.
5. Press **Delete exam** to delete the examination.
A message is displayed asking the user to confirm the action to perform.
6. Select **OK**.
The examination is deleted.

NOTE: Examinations can also be deleted from the Archive screen when displaying the Exam list. Search and highlight the examination(s) to delete and press **Delete**.

To delete an image

1. Press **Patient**.
The *Archive* screen is displayed (Figure 10-6 on page 10-18).
2. Search and highlight the patient record with the image to delete.
3. Press **Open Patient** on the screen.
The *Patient info and exam* screen is displayed (Figure 10-8 on page 10-21).
4. Highlight the examination with the image to delete and press **Review**.
The images for the selected examination are displayed on the *Review screen* (Figure 10-17 on page 10-36).
5. Select the image to delete.
6. Press **Delete**.
A message is displayed asking the user to confirm the action to perform.
7. Select **Yes**.

To delete an image from the clipboard

1. Select the image you want to delete in the clipboard.
2. Press **ImageMgr** in the shortcut bar.
3. Select the image you want to delete again.
4. Press **Delete** in the side bar.
5. There will be a confirmation message for your action. Press **OK**.

Moving examinations

An examination can be moved from one patient record to another. This feature should only be used if an examination was performed and stored to a wrong patient record.

1. In the *Archive* screen select the **Exam** tab to display the examination list (see Figure 10-6 on page 10-18).
2. Search for the examination to move.
3. Move the cursor over the examination to move and press **Update/Menu** on the Control panel.
4. Select **Move Exam From Patient** in the context menu.

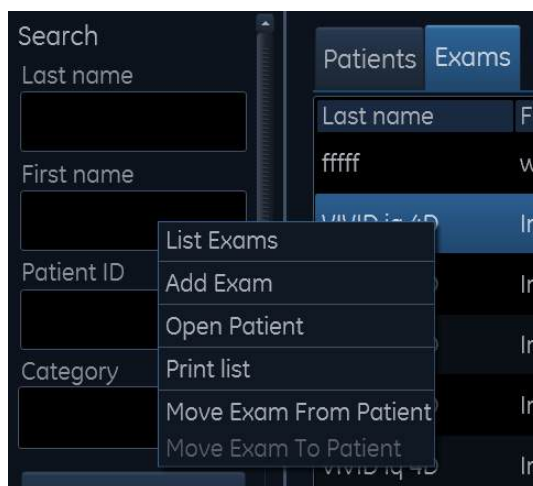


Figure 10-15. Context menu - Move exam from patient

5. Select the **Patient** tab to display the patient list.
6. Search the target patient record.
7. Move the cursor over the target patient record and press **Update/Menu** on the Control panel.

Moving examinations (continued)

8. Select **Move Exam To Patient** in the context menu.



Figure 10-16. Context menu - Move exam to patient

A message is displayed asking the user to confirm the action to perform.

9. Select **OK**.

Review Images in Archive

There are two ways to review archived images:

- Review the images from a selected examination.
- Review images from a selected patient record, enabling the analysis of images belonging to different examinations for the selected patient record.

Review the images from a selected examination

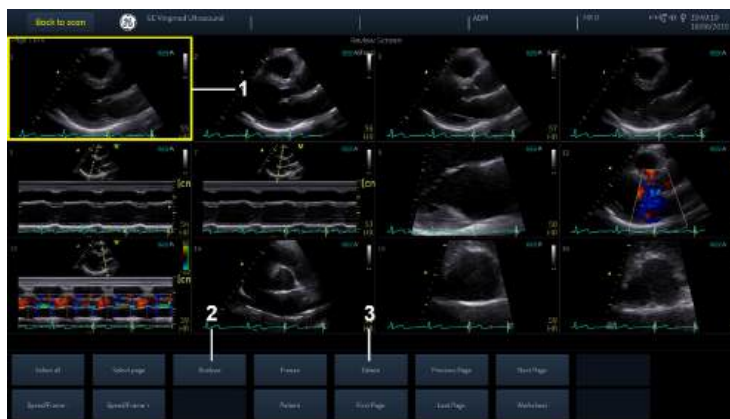
1. In the *Patient info and exam* screen (see Figure 10-8 on page 10-21), highlight the examination with images to review.
2. Press **Review**.

The stored images for the selected examination are displayed in the *Review* screen (see Figure 10-17).

To analyze images:

1. Select the images to analyze.
2. Press **Analyze**.

Review the images from a selected examination (continued)



1. Selected image.
2. Start analysis of selected images.
3. Delete selected images.

Figure 10-17. The Review screen

Review images from a selected patient record

The procedure described below enables the analysis of images belonging to different examinations for a selected patient record. If images are stored on multiple removable media, they have to be restored to the local hard drive prior to review as described below.

1. While in the *Patient info and exam* screen, press **Image manager** on the Side bar.

The *Image manager* is displayed on the Side bar showing thumbnails for the stored images sorted by examination for the actual patient record (see Figure 10-20).

If the images are stored on a removable media that is not mounted, the image thumbnail is replaced by a symbol.

2. Select the images to analyze or press **Analyze** to review all images.
 - If all images are available the images are displayed for review.
 - If some of the images are not available locally the *Restore images* window is displayed.

Review images from a selected patient record (continued)



Figure 10-18. The Restore images window

3. Select between:
 - **Restore only the selected images:** only selected images that are not available locally are restored.
 - **Restore all images of the selected exam:** all images that are not available locally in the exams where an image was selected are restored.
 - **Restore current patient:** restores all images in all examinations.
4. Press **OK**.

The *Insert media* window is displayed.

Review images from a selected patient record (continued)

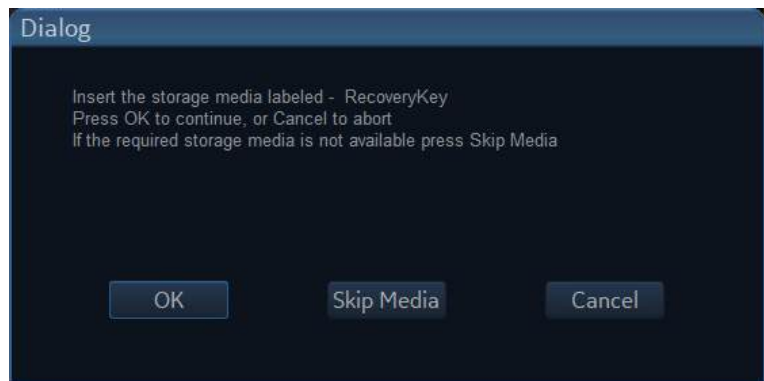


Figure 10-19. The Insert media window

5. Insert the required media.
6. Select between:
 - **OK:** the images on the mounted media are restored on the local hard drive. If not all the required images are on the inserted media, the user is prompted to insert another media until all required images are restored on the hard drive.
 - **Skip media:** the images stored on the inserted media are not restored. If not all the required images are on the inserted media, the user is prompted to insert another media until all required images are restored on the hard drive.
 - **Cancel:** no images are restored.

Review images from a selected patient record (continued)



1. Each examination is displayed on a tab.
The tab for the active examination is marked with a pencil symbol.
2. Touch an image thumbnail to select/deselect an image. Selected images are marked with a blue frame. Images can be selected from multiple examinations.
The number of images selected and the total number of images in the examination is displayed on the tab.
3. Press **Image list** to toggle the display of examinations as a list or as tabs.
4. Press **Analyze** to display up to four selected images on the main screen.
5. Press **Send to** to save images to a removable media.
6. Press **Delete** to delete the selected image.
7. Adjust **Layout** to change the number of image thumbnails to display.
8. Image selection tool: select/deselect all images from an examination or all images from the patient record.
9. Play/Pause cineloops

Figure 10-20. The Image manager

Additional features for the Image manager

Change the active examination

The active examination is identified by a pencil symbol on the examination tab in the *Image manager*. To make another examination active, follow the steps below:

1. In the *Image manager*, select the examination tab to make the active one.
2. Press **Activate exam**.

The examination tab is marked with a pen symbol.



1. Active examination (marked with a pen symbol).
2. Displayed examination.
3. Press **Activate exam** to make the displayed examination the active one.

Figure 10-21. The active exam

Save image to a standard format

1. Connect a removable media to the system
2. Select images in the *Image manager* and press **Send to** (see Figure 10-20 on page 10-40).

The *Send images to external device* window is displayed.

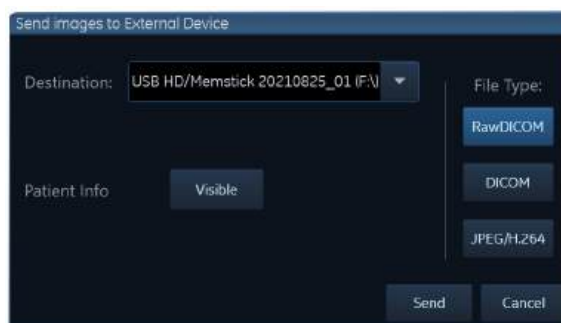


Figure 10-22. The Send images to external device window

3. Select the **Destination** and **File type**.
The folder name for DICOM files is by default called GEMS_IMG (cannot be changed).
The folder name for all other files is by default the current date (YYYYMMDD). The folder name can be changed.
4. To anonymize the images, press **Visible**.

Connectivity

Introduction

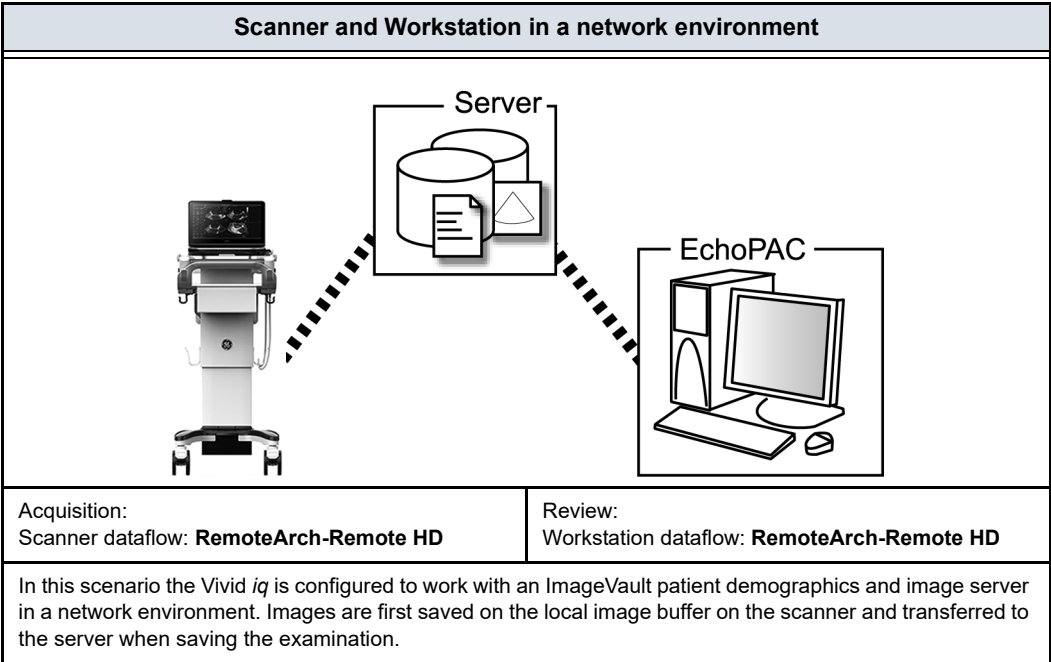
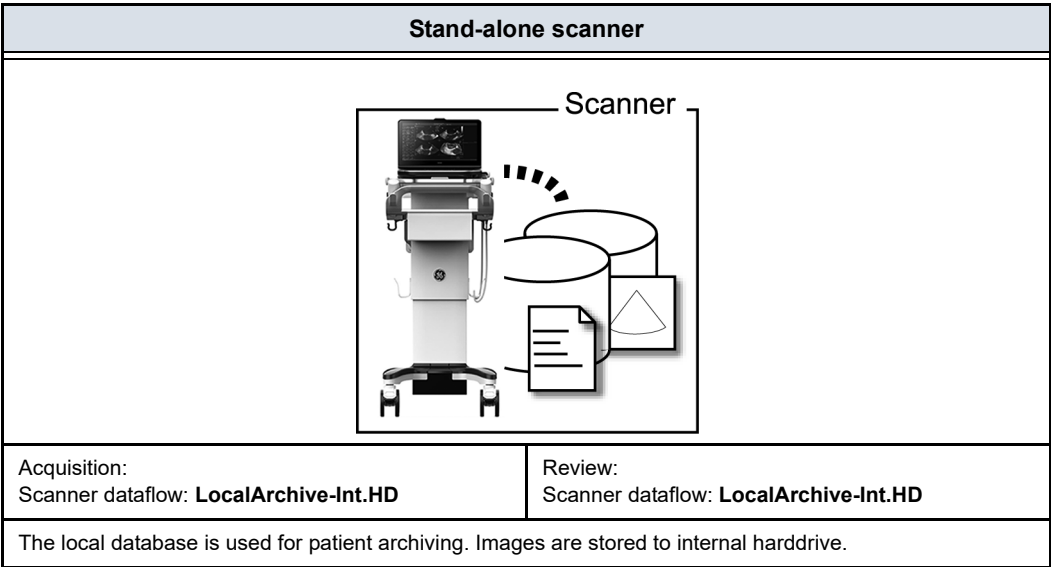
This section describes the communication and connection options for the Vivid *iq* ultrasound unit with other devices in the hospital information system. This section covers the procedures for configuration and optimal data management from a Vivid *iq* in the following scenarios:

- A stand-alone Vivid *iq*
- A scanner and workstation in a network
- A scanner and a DICOM server in a network.
- A scanner and an EchoPAC Software Only in a direct connect environment. Only available with EchoPAC Software Only software version 202 or later.

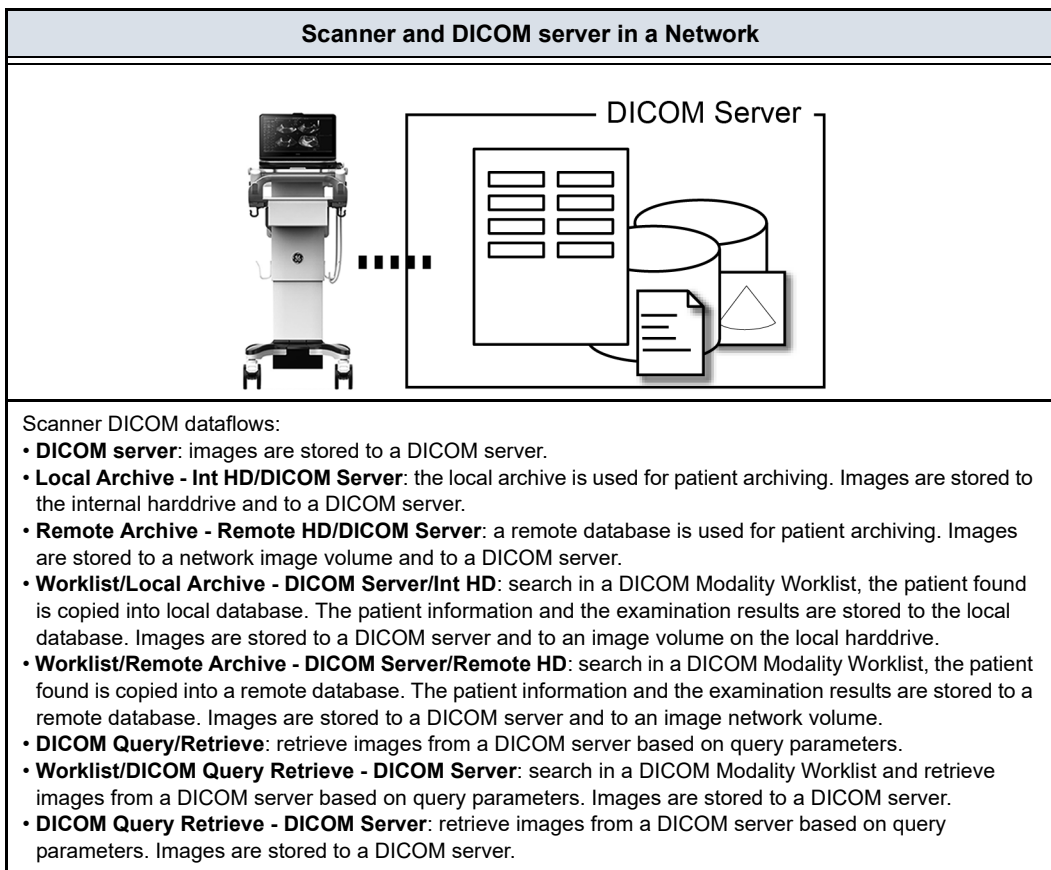
The dataflow concept

Communication between the Vivid *iq* ultrasound unit and other information providers on the network takes the form of dataflows. Selecting a dataflow will automatically customize the ultrasound unit to work according to the services associated with this dataflow. Each dataflow defines the location and format of patient information. Patient information can include demographic data and images, as well as reports, measurement and analysis data. By utilizing dataflows, the user can configure the Vivid *iq* ultrasound unit to optimally meet the connectivity needs of the facility, while keeping the user interface unchanged. The dataflow concept allows the flexibility of data to be obtained from various sources and allows data to flow to various output sources.

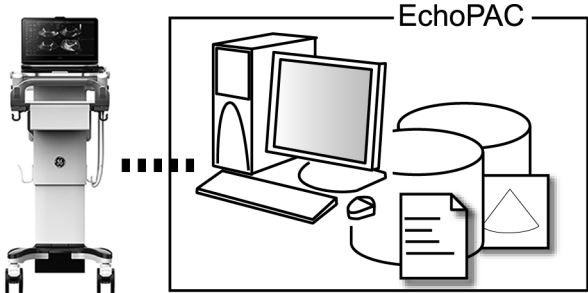
Dataflow examples



Dataflow examples (continued)



Dataflow examples (continued)

Scanner and EchoPAC Software Only in a direct connect environment	
	
Acquisition: Scanner dataflow: RemoteArch-Remote HD	Review: Workstation dataflow: LocalArchive-Int.HD Share
In this scenario the data is transferred from the Vivid <i>iq</i> to a dedicated EchoPAC Software Only workstation over the Ethernet (either in a peer-to-peer connection with a crossover cable, or in a network). The database from the EchoPAC Software Only is used as the master and images are stored directly to the EchoPAC Software Only internal harddrive. In this configuration the scanner is just an intermediate acquisition unit which after completion of a study, will not contain any patient information, measurements or images. Up to three scanners can be connected to one EchoPAC Software Only if the workstation has the EchoPAC Share option enabled.	

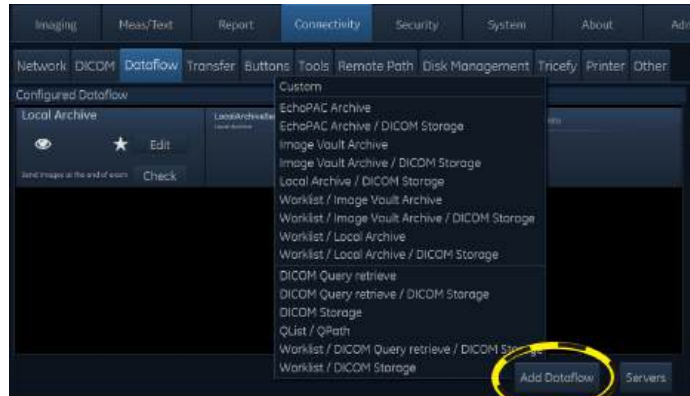
Dataflow selection

Select a dataflow from the *Archive* screen (see Figure 10-6 on page 10-18) or configure the system with a **default** dataflow from the Configuration management package as described below.

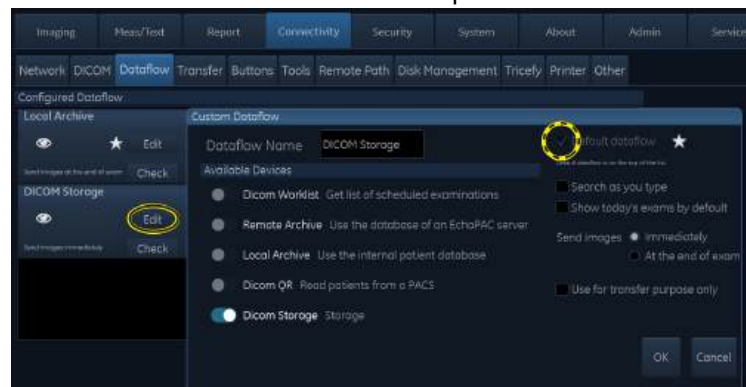
Default dataflow selection

1. Press **Config** and log on as administrator if required.
2. Select the **Connectivity** category and **Dataflow** subgroup.
The *Configured Dataflow* sheet is displayed.
3. Press **Add Dataflow** button and select the desired dataflow in the pull-down menu.

The selected dataflow is displayed in the 'Configured Dataflow' list.

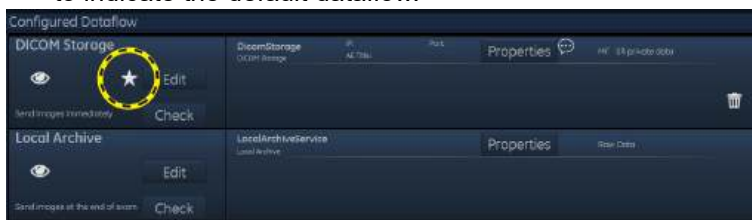


4. Press **Edit** button and check the option **Default**.



Default dataflow selection (continued)

5. Press **OK** to close the window and there will be a star mark to indicate the default dataflow.



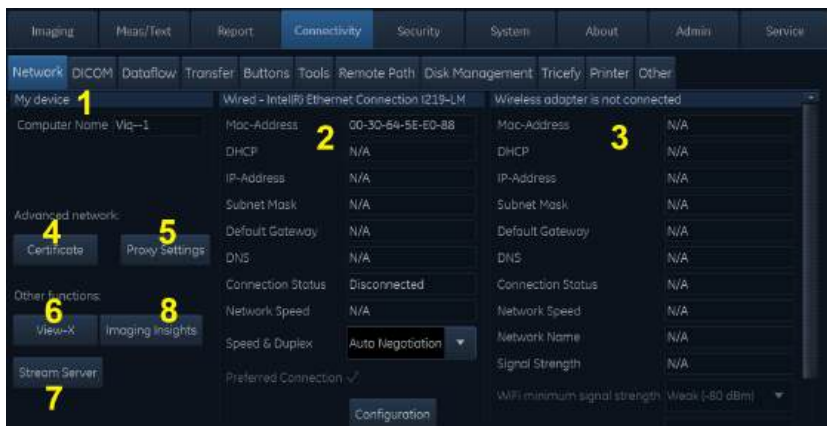
Scanner connectivity configuration

System in a network environment

To be able to use the network functions when connected to a hospital network, the scanner must have a proper network address. Typically source for this information is the network administrator.

System's Network settings

1. Press **Config** and log on as administrator.
2. Select the **Connectivity** category and **Network** subgroup.
The *Network subgroup* is displayed.



1. Section - **My Device**
Computer name: is shown but not editable
2. Section - **Wired** network adapter. Fields are automatically populated from the network adapter settings. In order to change them, press the **Configuration** button (3) in Windows. Speed and Duplex can be selected on this page.
3. Section - **Wireless** network adapter. Fields are automatically populated from the network adapter settings. In order to changes them, press the **Configuration** button (5).
Note that both Wi-Fi minimal strength and strength warning can be selected on this page.
Note that the **Preferred Connection** method (wired/wireless) can be selected by checking a box.
4. Certificate: Click this button to be able to enter certificates.
5. Proxy Settings: Configure network proxy settings.
6. View-X: Configure streaming source for View-X.
7. Streaming Server (Option): Configure streaming of live ultrasound image data.
8. Imaging Insights: Configure connection to the **Imaging Insights** server by providing device usage information.

Figure 10-23. Network subgroup

System's Network settings (continued)

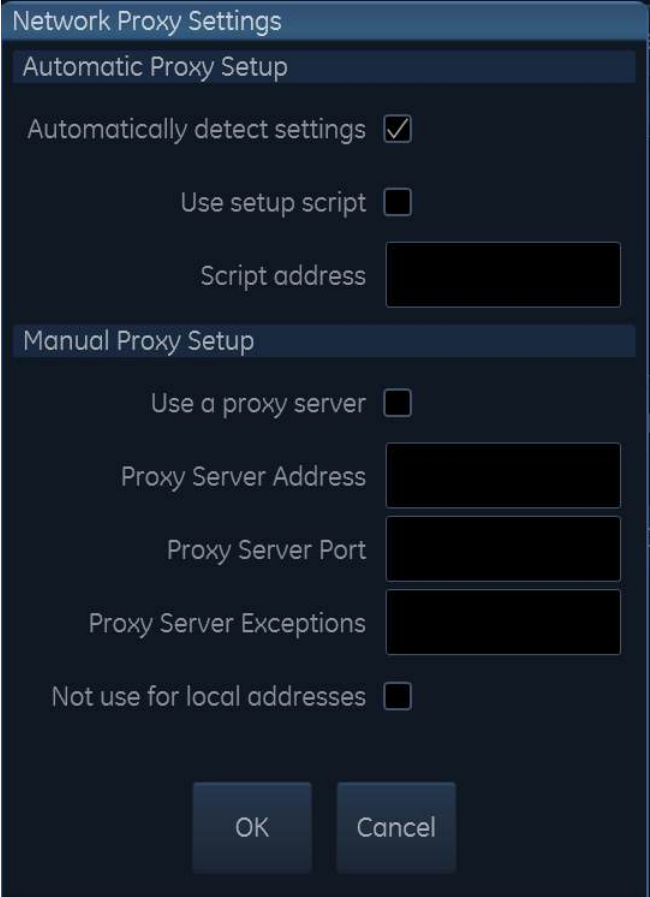
3. Select **Configuration** (in the Wired network section) to configure:
 - The IP address for the system
 - The subnet mask for the system
 - The IP address for the Default Gateway

This is done at the Windows level.

Network Proxy Settings

How to setup Network Proxy Settings

Press the **Proxy Settings** button on the **Connectivity > Network** configuration screen to show Network Proxy Settings dialog.



The image shows a 'Network Proxy Settings' dialog box with a dark blue header and a dark grey body. It is divided into two sections: 'Automatic Proxy Setup' and 'Manual Proxy Setup'. In the 'Automatic Proxy Setup' section, 'Automatically detect settings' is checked, 'Use setup script' is unchecked, and there is an empty text field for 'Script address'. In the 'Manual Proxy Setup' section, 'Use a proxy server' is unchecked, and there are empty text fields for 'Proxy Server Address', 'Proxy Server Port', and 'Proxy Server Exceptions'. At the bottom, there is an unchecked checkbox for 'Not use for local addresses' and two buttons labeled 'OK' and 'Cancel'.

Network Proxy Settings

Automatic Proxy Setup

Automatically detect settings ☒

Use setup script ☐

Script address

Manual Proxy Setup

Use a proxy server ☐

Proxy Server Address

Proxy Server Port

Proxy Server Exceptions

Not use for local addresses ☐

OK Cancel

Figure 10-24. Network Proxy Settings window

Automatic Proxy Setup

Enable the *Automatically detect settings* option to use Web Proxy Auto-Discovery Protocol (WPAD) for detecting proxy settings. If the connected network requires a proxy and it provides that proxy via WPAD, the proxy will be automatically configured and used.

Enable the *User setup script* option and insert the network address of the script into the Script address box to setup script for your proxy configuration. This script may also be referred to as a .PAC file.

Manual proxy setup

Enable the *Use a proxy server* option to manually configure the proxy server. The manual configuration of a proxy requires you to have a specific IP address and port for the server that you want to use. This information should be entered in the *Proxy Server Address* and *Proxy Server Port* fields.

For addresses you do not want the system to use the proxy server on, enter web or IP addresses separated with a semicolon (;) in the *Proxy Server Exceptions* field.

Enable the *Not use for local addresses* option to bypass the proxy server when you connect to resources on your local network or intranet.

Click **OK** to save and apply network proxy settings or click **Cancel** to ignore the recent changes.

Wireless setup

In order to configure the Wireless adapter (if used), click the Configuration box in the Wireless section. This is done at windows level, but both *Wi-Fi Minimum Signal Strength* and *Wi-Fi Signal Strength Warning* can be configured directly on the Connectivity – Network page.

See 'Wireless Network Configuration' on *page 4-50* for details on how to set up wireless connection.

Imaging Insights

Imaging Insights automatically collects DICOM data from GE and other vendors' ultrasound equipment or equipment fleet and displays system utilization and operator usage insights in a plotted dashboard. Operational insights include exam volumes, first and last exam time, probes utilization, exam type; operator usage data includes length of exam, scan mode, probes, and exam type. It helps optimize system and probe fleet investment plans, identify staff assignment and training needs, and monitor variability of staff usage patterns.

1. Press **Config** and log on as administrator.
2. Select the **Connectivity** category and the **Network** subgroup.
The *Network* sheet is displayed.
3. Press **Imaging Insights** button and a window will pop up.



Figure 10-25. Imaging Insights button

Imaging Insights (continued)

4. Configure the server information from the pop-up window and then click **Check**.

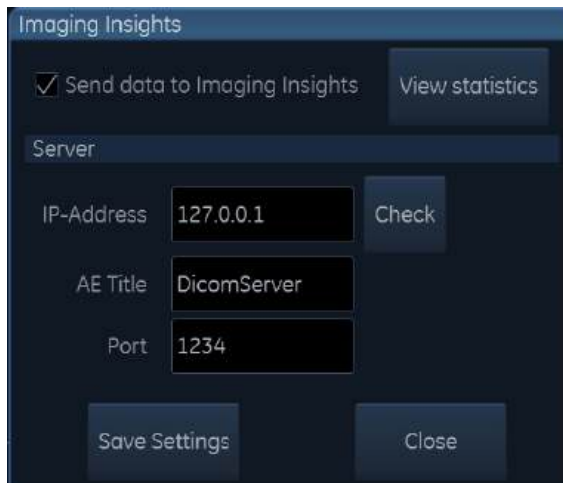


Figure 10-26. Server Configuration

- If the network connection to the server is OK, it will be illustrated by the “Pass” sign, a green check mark . The “Fail” sign  indicates that the network connection is failing.

Typical causes:

- Network cable not connected
 - Configuration error(s)
5. Check **Send data to Imaging Insights** check box, then the data of this scanner will be sent to the Imaging Insights server.

NOTE: *If the doctor is doing the exam with patient information created, the data will be sent to server immediately when click **End Exam**: If the doctor is doing emergency scanning without creating patient information, the data will be sent to the server every two hours before system shutdown.*

NOTE: *User can press **View statistics** button to check whether the data is sent successfully or not.*

System in a network environment with a DICOM server

The system's network settings must be configured as described in 'System's Network settings' on *page 10-49*.

In addition, to work against the DICOM server the following information has to be entered in the scanner:

- The DICOM server IP address
- The DICOM server port number
- The DICOM server AE title (the server's name)

NOTE: *Changing the DICOM server AE title requires a reboot of the system to take effect.*

Typically source for this information is the network administrator.

Create or modify a DICOM server IP address

Follow the steps below if the IP address settings for the DICOM server need to be modified or created:

1. Press **Config** and log on as administrator.
2. Select the **Dataflow** category and press the **Servers** button in the lower right corner.

Create or modify a DICOM server IP address (continued)

3. Click **Add** to add a new server or **Modify** to change an existing one. To remove one, highlight the server and click **Remove**.

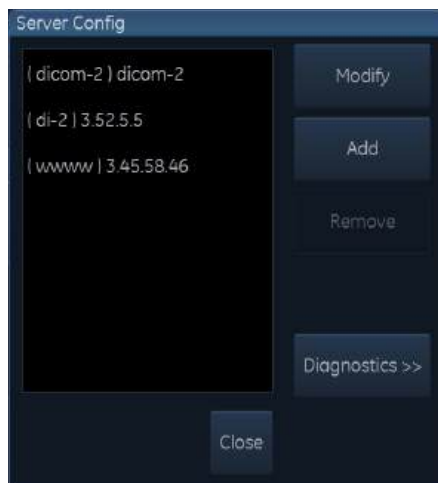


Figure 10-27. Dataflow sheet - Server config section

4. Enter the name of the server, and typically deselect Automatic and enter the IP address manually.

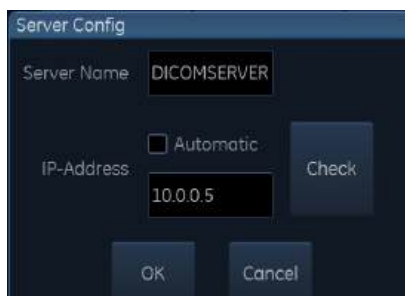


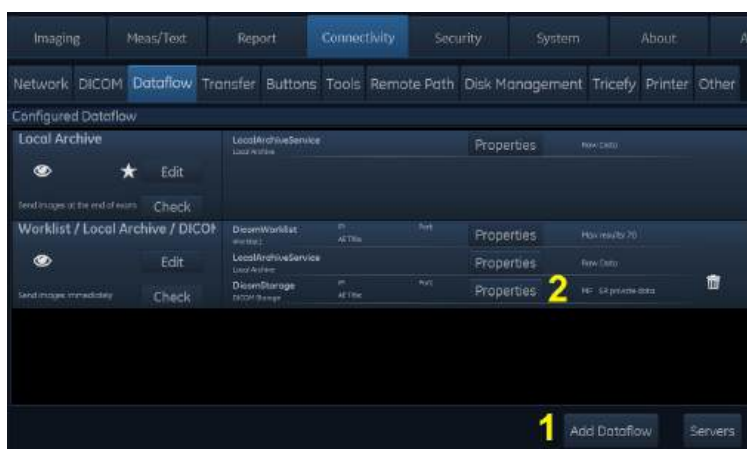
Figure 10-28. The Server config window

5. Verify connection to the server by pressing the **Check** button.

DICOM devices configuration

Depending on the DICOM dataflow selected, one or several DICOM devices may have to be configured.

1. Press **Config** and log on as administrator.
2. Select the **Connectivity** category and **Dataflow** subgroup. The *Dataflow* sheet is displayed.
3. Select **Add Dataflow** (bottom right) to enter a new dataflow and choose from a factory template or create a Custom one from scratch.
4. In this example, the factory *Worklist / Local Archive / DICOM Storage* is used. The screen shows a list of what type of devices are used and various preference settings for the dataflow.
5. Click **OK** when completed.
6. Note that the different devices need to be set up next. Each device must be configured by clicking on the respective **Properties** buttons (see Figure 10-27).



1. Select a DICOM dataflow
2. Press Properties.

Figure 10-29. The Dataflow sheet

DICOM devices configuration (continued)

7. DICOM Storage Properties (see Figure 10-28):

In the *Properties* for DICOM Storage:

- Select the server previously defined from the pull-down menu in the IP address field.
- Enter the DICOM server **AE title**. This entry is case-sensitive and must match exactly.
- Enter the DICOM server **Port No.**

For some DICOM servers, the default **Timeout** setting may be too low.

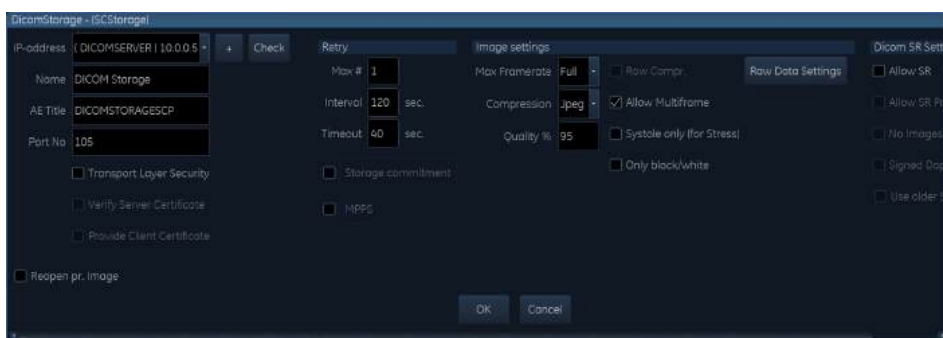


Figure 10-30. DICOM storage properties window

DICOM devices configuration (continued)

8. When configuring the DICOM storage device, the following image settings are recommended to enter in the *Properties* window (Figure 10-30):

- Check **Enable DICOM SR** if required (see 'DICOM SR' on page 10-72).
- Keep **Reopen pr. image** unchecked.
- Keep **Raw data disabled**.
- Set **Max Framerate** to 30.
- Keep **Black/white images** unchecked.
- Set **Compression** to JPEG.
- Set **Quality** to 95.
- Check **Allow Multiframe**.

Raw Data Settings gives you the ability to select which images to transfer in raw data format by mode:

Systole only (for Stress). When this setting is active, all stress images will be sent to the DICOM server showing only systole. The setting is selectable when transferring only multiframe (not raw data).

NOTE:

*Setting **Compression** to None may result in long transfer time and cineloop with more than 500 frames will be truncated. If **Compression** is set to None, set **Max frame rate** to either 25 or 30 frames per second to reduce the risk of truncating loops.*

DICOM TLS

To use TLS protocol for secure communication with the DICOM server, the 'Transport Layer Security' option must be checked off on the DICOM dataflow.

NOTE: *DICOM / TLS must be supported by the DICOM server as well.*

1. Open the **Properties** view for the DICOM dataflow, as described under 'DICOM devices configuration' on page 10-57.
2. Check off for '**Transport Layer Security**'.

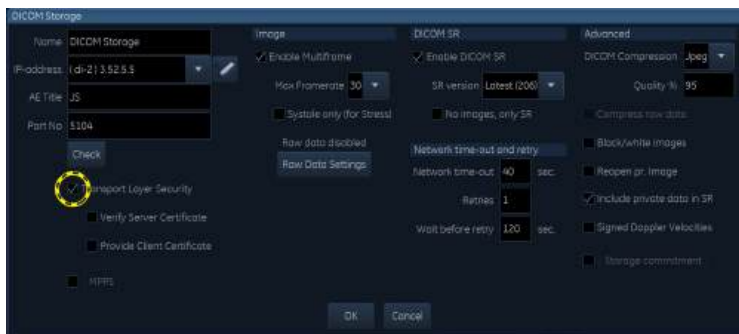


Figure 10-31. Check off for 'Transport Layer Security'

3. (Optional) Select '**Verify Server Certificate**' to ensure the connected DICOM server is trusted by the system.
4. (Optional) To add server or client certificate, open the Certificate utility accessible from **LDAP** config view, see 'Digital certificate' on page 10-61.
5. (Optional) To enable use of client certificate, check off for '**Provide Client Certificate**', see 'Select Client Certificate' on page 10-68.

NOTE: *The client certificate must be selected before the '**Provide Client Certificate**' check box can be checked off.*

Digital certificate

The digital certificates can be managed from the **LDAP** configuration.

Public certificates can be added to trust connected devices. While client certificates with a private key can be added for authenticating the system towards a connected device.

Import Certificate:

1. Press **Config** on the shortcut panel as administrator.
2. Select **Security** category and the **LDAP** subgroup.

The **LDAP** sub groups is displayed.

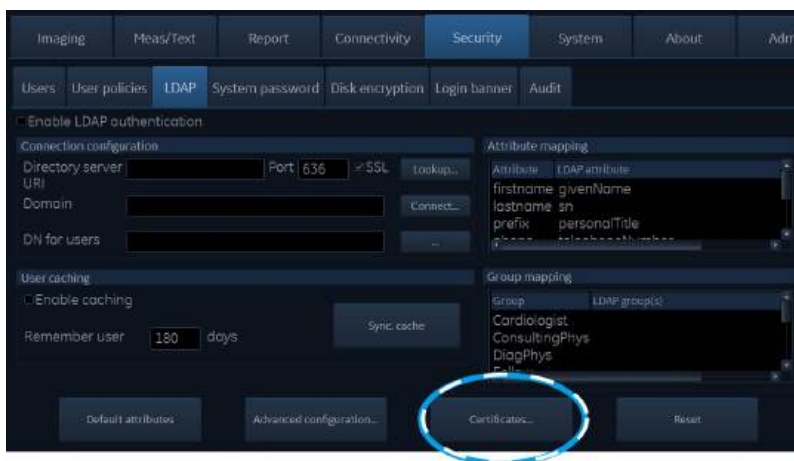


Figure 10-32. LDAP Subgroup

3. Click on the **Certificates** button.
The **Certificate Manager** window is displayed.
4. In the **Certificate Manager** window, select the folder where the certificate is to be imported to.
5. Click **Action. All Tasks** and then **Import...** from the drop-down menu.

Digital certificate (continued)

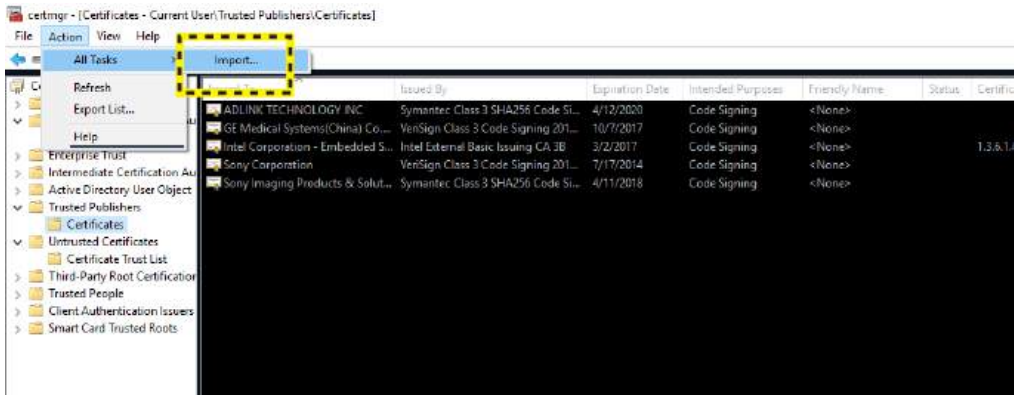


Figure 10-33. Import Certificate

- 6. Press **'Next'** button on the pop-up welcome window.



Figure 10-34. Certificate Import Wizard

- 7. Press **Browse** to find the certificate file to import.

Digital certificate (continued)

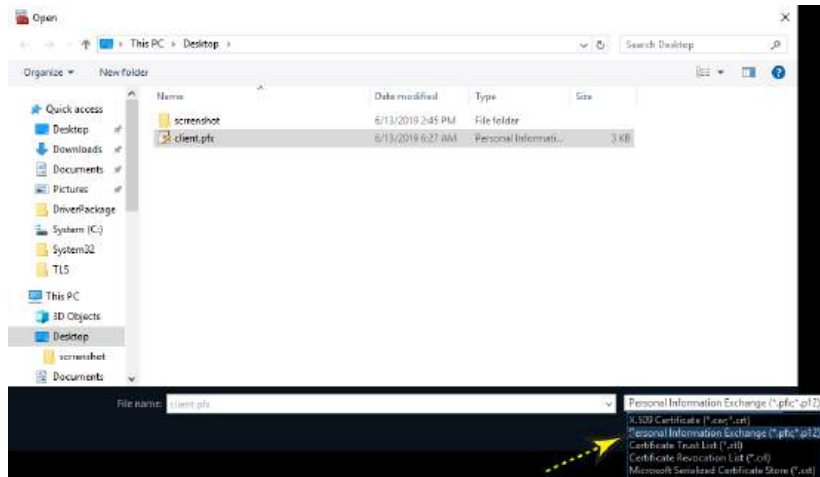


Figure 10-35. Import Certificate

NOTE: *If importing a Client Certificate including a private key (e.g. in case of importing a certificate used for authenticating towards the DICOM server, the 'Provide Client Certificate' option) choose the certificate type from the list on the right of the 'File Name' box. Only the '*.pfx' certificate is supported for Client certificates.*

8. Browse to the certificate file to import, select the file and press **'Next'** to confirm.
9. (Optional) Enter the password and make sure that the second checkbox is selected. Press the **'Next'** button to confirm the certificate import.

Digital certificate (continued)

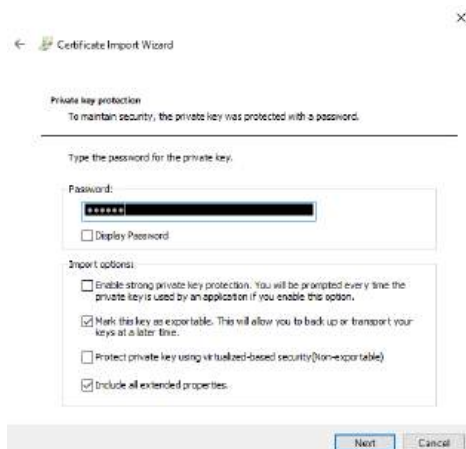


Figure 10-36. Import Options

10. Press the **'Next'** button to do the **Certificate Store**.

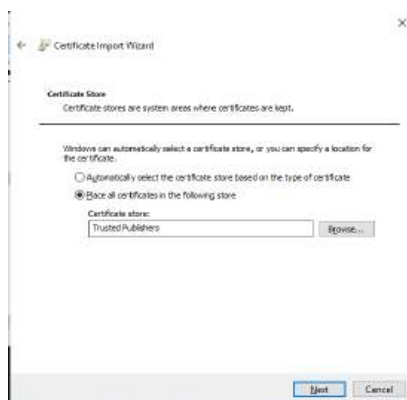


Figure 10-37. Certificate Store

11. Press the **'Finish'** button.

Digital certificate (continued)

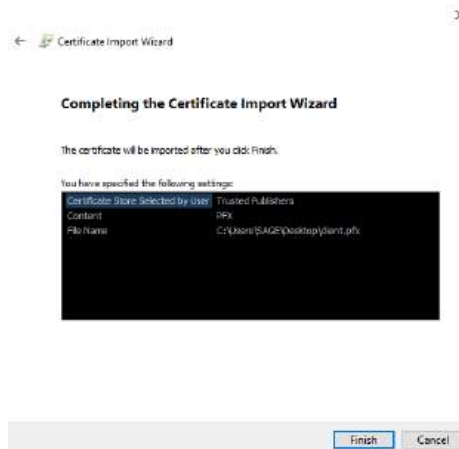


Figure 10-38. Completing the Certificate Import Wizard

12. A window is displayed to indicate the import was successful. Press **OK** to close the window.
13. Close the **Certificate Manager** window when finished.

Delete Certificate:

1. Press **Config** on the shortcut panel as administrator.
2. Select **Security** category and the **LDAP** subgroup.
The **LDAP** sub groups is displayed.

Digital certificate (continued)

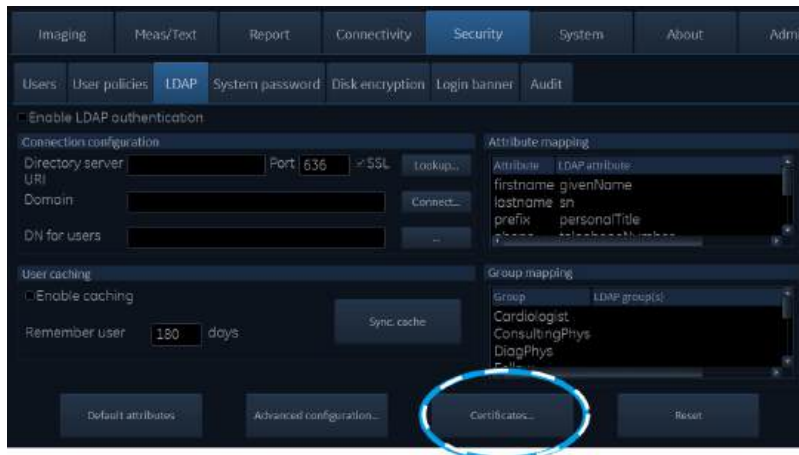


Figure 10-39. LDAP Subgroup

3. Click on the **Certificates** button.
The **Certificate Manager** window is displayed.
4. In the **Certificate Manager** window select the certificate to delete.
5. Select the **Delete** from the **Action** drop-down menu to delete the certificate.
6. Press **Yes** to finally delete the certificate or **No** to keep it.

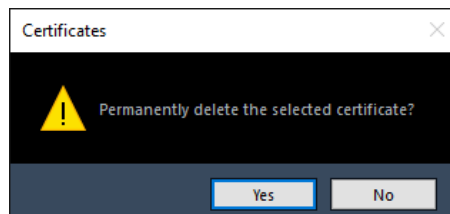


Figure 10-40. Delete the Certificate

Digital certificate (continued)

Select Client Certificate:

1. Press **Config** on the shortcut panel as administrator.
2. Select **Connectivity** category and the **DICOM** subgroup.
3. The **DICOM** sub group is displayed.

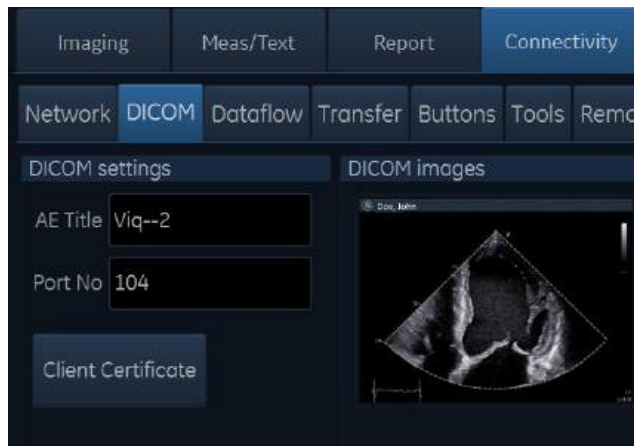
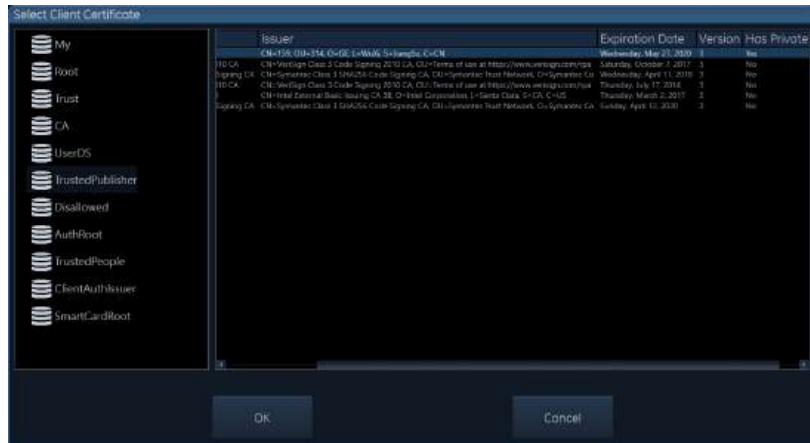


Figure 10-41. DICOM Subgroup

4. Click on the **Client Certificates**.
The **Select Client Certificate** window is displayed.



NOTE: *Only the certificate with a private key can be selected.*

5. Select a folder and a certificate.
6. Press **OK** and the certificated is selected as the client certificate to use.

Adjusting the Search Criteria

When selecting a DICOM Worklist dataflow or Query/Retrieve, search criteria can be set for the system to use when searching the database.

1. Press **Config** and log on as administrator.
2. Select the **Connectivity** category and **Dataflow** subgroup.
The *Dataflow* sheet is displayed.
3. Press **Add Dataflow** Button to select a DICOM Worklist dataflow or the Query/Retrieve dataflow.
4. Press **Properties** for for the DICOM Worklist or the Query/Retrieve device.
The *Properties* window for the selected DICOM device is displayed.

Adjusting the Search Criteria (continued)

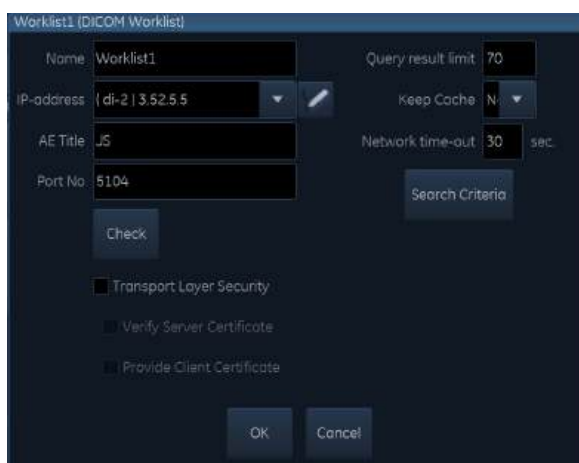
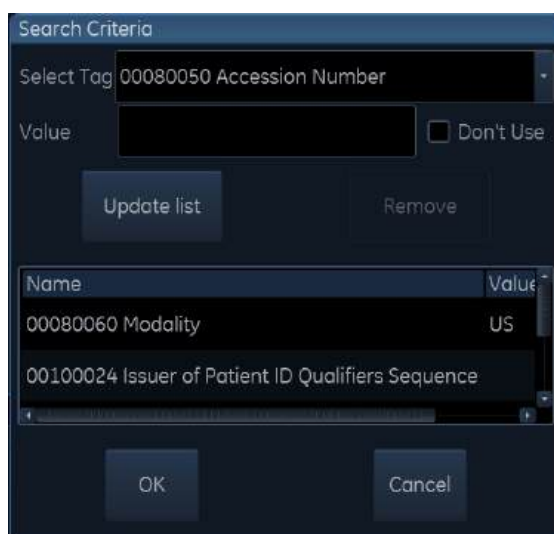


Figure 10-43. DICOM worklist properties window

NOTE: *By reducing **Max. Result** the performance might be improved, however all results might then not be shown.*

5. Press **Search criteria**.
The *Search criteria* window is displayed (Figure 10-44).
6. Select a Search criteria from the *Select tag* pull-down menu.
7. Enter a value if required or leave blank if not to be used.
This entry is case sensitive and must match exactly.
8. Press **Update list**.
9. Press **OK** to close the *Search criteria* window.

Adjusting the Search Criteria (continued)



The screenshot shows a 'Search Criteria' dialog box. At the top, there is a 'Select Tag' dropdown menu with '00080050 Accession Number' selected. Below it is a 'Value' text input field, which is currently empty, followed by a checkbox labeled 'Don't Use'. There are two buttons: 'Update list' and 'Remove'. Below these is a list box with two entries: '00080060 Modality' with a value of 'US', and '00100024 Issuer of Patient ID Qualifiers Sequence'. The list box has 'Name' and 'Value' column headers. At the bottom are 'OK' and 'Cancel' buttons.

Name	Value
00080060 Modality	US
00100024 Issuer of Patient ID Qualifiers Sequence	

Figure 10-44. The Search criteria window

DICOM SR

DICOM Structured Reporting (SR) is a standardized format for medical results. Vivid *iq* supports the specialized form for Echo Ultrasound ("TID 5200 Echocardiography Procedure Report"), Pediatric ("TID 5220 Pediatric Cardiac Ultrasound Report") and Vascular Ultrasound ("TID 5100 Vascular Ultrasound Procedure Report") for M&A results.

With the DICOM SR support, M&A for an exam can be sent at the end of the exam or when exported from local archive. The destination can be either a server on the network (Storage SCP) or a removable media (DICOM Media) depending on the DICOM dataflow selected.

NOTE: *In order for the patient's blood pressure to be populated in the DICOM SR file, the user needs to enter the patient's weight and height as well.*

"TID 5220 Pediatric Cardiac Ultrasound Procedure Report" is sent if the exam contains M&A from category Pediatric (Heart).

"TID 5200 Echocardiography Procedure Report" is sent if the exam contains M&A from category Cardiac and does not contain M&A from category Pediatric (Heart).

"TID 5100 Vascular Ultrasound Procedure Report" is sent if the exam contains M&A from category Vascular/Abdominal.

"TID 5200 Echocardiography Procedure Report" is sent per third-party application if the exam contains any measurements stored from third-party software. These measurements are now fully supported by all of the available dataflows. The measurements can be transferred and exported for DICOM

DICOM SR (continued)

Storage dataflow and they will be recorded to separate SR files, called TID 5200 “Echocardiography Procedure Report”. The workflow is similar to the Worksheet functionality where a single file stores all measurements for an application.

“TID 5200 Echocardiography Procedure Report”, “TID 5220 Pediatric Cardiac Ultrasound Report” and “TID 5100 Vascular Ultrasound Procedure Report” do not support all M&A results from Vivid *iq*. They are limited to the following:

- No unassigned measurement.
Refer to the Vivid *iq* Reference manual for a complete list of supported parameters.
- The following modes: 2D, M-mode, Color Flow, PW Doppler, CW Doppler, 3D and TDI.
- Not Modified Simpson method or Bullet methods.
Refer to the Vivid *iq* Reference manual for a complete list of supported methods.
- Basic derivations (Average, Last, Min and Max), no references between the derived measurements and the ones they were made from.
- Wall Motion Scoring: individual segment scores only according to 16-segment model, no graded Hypokinesis (only Hypokinesis is used).

DICOM SR must be activated for each DICOM device.

1. Press **Config** and log on as administrator.
2. Select the **Connectivity** category and **Dataflow** subgroup.
The *Dataflow* sheet is displayed.
3. Select the DICOM dataflow to configure in the *Add Dataflow* pull-down menu.
4. Press **Properties** for a DICOM storage device
The *Properties* window for the selected DICOM storage device is displayed.

DICOM SR (continued)

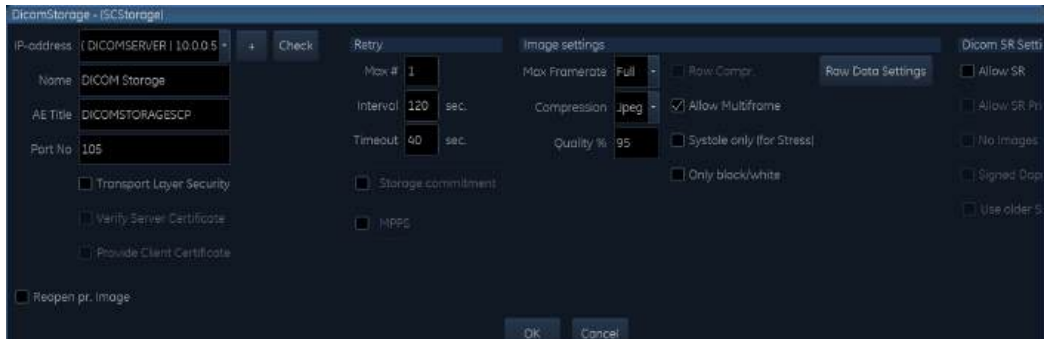


Figure 10-45. DICOM storage properties window

5. Check the option **Enable DICOM SR** to enable DICOM SR. The following additional options are available:

- **Allow SR private data:** include current exam data in a private format within DICOM SR to retain measurements and complete exam information when recalling an exam from a DICOM environment. This is especially important if EchoPAC Plug-in is used in the DICOM environment or if any exam at any later time is expected to be recalled to Vivid *iq* or EchoPAC Software Only using DICOM Query/Retrieve. If the DICOM server does not allow the private data format within DICOM SR files, this feature should be disabled.
- **No images:** no images are sent, only M&A.
- **Signed Doppler velocities:** send signed Doppler velocities.
- **Use older SR version:** when checked a *Use older SR version* pull-down menu is displayed. The current exam data will be sent in the same format as the selected SR version. Details about format and content of the SR version can be found in the corresponding user manual of the selected version.

These settings apply to both "TID 5200 Echocardiography Procedure Report" and "TID 5100 Vascular Ultrasound Procedure Report"

6. Select **OK**.

DICOM spooler

DICOM spooler displays the current DICOM output jobs. The jobs may be Storage, Print, Modality Performed Procedure Step or Storage Commitment. The DICOM spooler is used for checking the current job's status when a job is saved or when the total spooler status on the right of the *Archive* window displays an error.

From the DICOM spooler the user can also:

- **Delete** non-active jobs.
- **Resend** a job that has failed or is in hold.
- **Send** a job that has failed or is in hold, to a new destination.

The job's status displayed in the *DICOM spooler* window can be:

- **Pending:** the job is complete, waiting to be active.
- **Hold:** the job is complete, but suspended, waiting for an action from the user.
- **Append:** the job is incomplete, waiting for more images (Direct store function).
- **Active:** the job is complete and connected to the destination device.
- **Failed:** the job is complete but one or more images failed to transmit to the destination device.
- **Done:** the job is saved to the destination device. The jobs that are done are removed from the spooler after a few minutes.

DICOM spooler (continued)

To start the DICOM spooler:

1. Do one of the following:
 - Press **Spooler** on the Shortcut Bar
 - Press **F4** on the external alphanumeric keyboard
 - Press **Alt + S** on the external alphanumeric keyboard
 - Press the **Spooler** icon () in the top right corner of the status bar

The *DICOM spooler* window is displayed (see Figure 10-46).

The *DICOM spooler* window is automatically updated. Press **Refresh** to update the information displayed at any time.

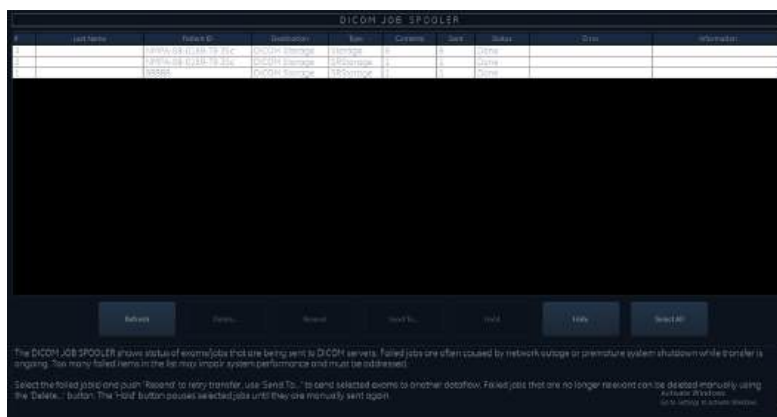


Figure 10-46. The DICOM job spooler window

The DICOM spooler window contains helpful troubleshooting information at the bottom of the screen.

To delete a job:

1. Select the job(s) to delete in the *DICOM job spooler* window.

DICOM spooler (continued)

NOTE: Only non-active jobs can be deleted.

2. Press **Delete**.

To resend a job:

1. Select the job(s) to re-send in the *DICOM job spooler* window.

NOTE: Only jobs that failed or are in hold can be resent.

2. Press **Resend**.

To send a job to a new destination:

This is typically used if the configuration of the server is changed.

1. Select the job(s) to send in the *DICOM job spooler* window.

NOTE: Only jobs that failed or are in hold can be sent to a new destination.

2. Press **Send to....**
A dialogue window is displayed.
3. Select the new destination from the *Destination* pull-down menu.
4. Press **Send**.

To hold a job:

1. Select the job(s) to hold in the *DICOM job spooler* window.

NOTE: Only inactive jobs can be set on hold.

2. Press **Hold**.
3. To undo hold, press **Resend**.

Spooler status icon:

A spooler icon is shown in the status bar (the right one below).



Figure 10-47. Spooler status bar

There are four different icons depending on the status of the data being transferred:

DICOM spooler (continued)

-  Transfer in progress. System connected to network.
-  Transfer paused or on hold. Transfer will resume automatically when network available.
-  Transfer completed successfully
-  Transfer failed. Please click spooler icon for more details.

Figure 10-48. Data transfer statuses

When hovering over the spooler icon the text shown above will be shown in the status bar.

Shutdown when data transferring from the DICOM Spooler:

Whenever there are images and/or measurements currently in the process of being transferred from the DICOM Spooler at the time the power button is pressed, this is indicated in the System Exit dialogue as shown below. A progress bar with a count-down timer gives an estimate for time remaining until transfer is completed.

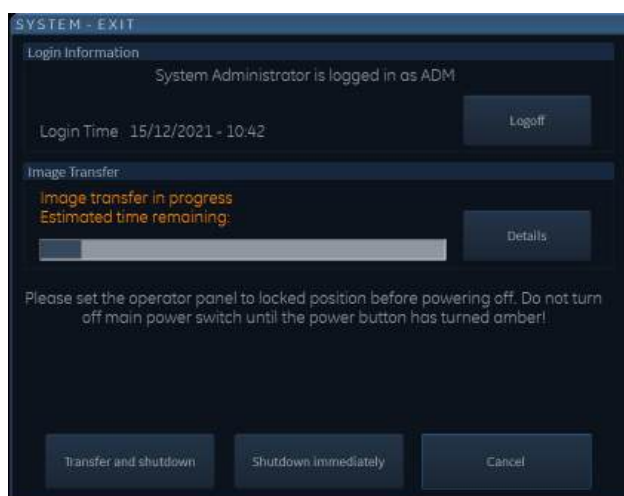


Figure 10-49. System Exit dialogue with data in DICOM Spooler

DICOM spooler (continued)

You can select the following options:

1. *Transfer and shutdown*

The system will complete transfer of data before shutdown is performed.

2. *Shutdown immediately*

Transfer of data will be aborted, and the system will shut down immediately. Unsent data will remain in the spooler and will have to be resent from the DICOM Spooler at a later time when the system is connected to the network.

3. *Details*

Pressing the Details button launches the DICOM Spooler screen, where further details on the image transfer process can be seen.

NOTE: *Pressing Details button aborts the shutdown process.*

4. *Cancel*

Pressing Cancel will abort the Shutdown process, while data transfer will continue.

DICOM images

To configure DICOM images:

1. Press **Config** on the Touch panel and log on as administrator.
2. Select the **Connectivity** category and **DICOM** subgroup. The *DICOM* sheet is displayed.

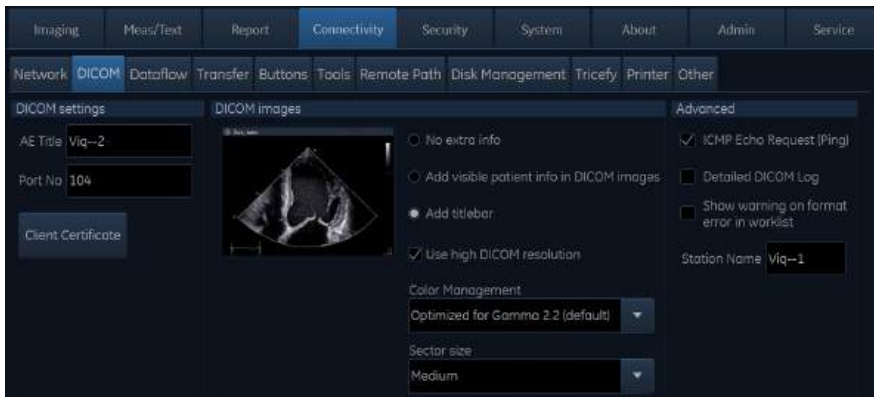


Figure 10-50. The DICOM sheet

From DICOM images the user can select between:

- **No extra info**
- **Add visible patient info in the DICOM images:** displays patient information (name, date of birth and ID) on DICOM images.
- **Add title bar:** adds the Title bar to the DICOM images. Must be enabled in order for images from the 4D Auto AVQ tool to contain traces, bullseye, 3D model and measurements as part of the stored DICOM Multiframe/Singleframe files when using a dataflow with RAW data disabled.

DICOM images (continued)

When **Use high DICOM resolution** is enabled, DICOM images are stored using a higher pixel density. Use this setting when exporting to systems accessed by high definition DICOM viewing stations.

NOTE: Using high DICOM resolution will double the file size of the DICOM data when using standard compression settings. Such files will consume more disk space and also slow down storage, recall and transfer of files.

Color management provides a selection of gamma settings for optimized representation of the Vivid images on DICOM workstations.

Transfer of Patient Records/ Examinations

Introduction

The Transfer function on Vivid *iq* enables transfer of patient records/examinations between archives as listed below:

Transfer			
	From	To	Note
1.	Local archive	Removable media	Perform transfer 1 and 2 to transfer data between systems via a removable media (CD/DVD or USB device).
2.	Removable media	Local archive	
3.	Local archive	Image Vault Archive or EchoPAC Archive, or DICOM server	Transfer data from the local archive to an ImageVault server, a DICOM server or EchoPAC Software Only
4.	Image Vault Archive or EchoPAC Archive or DICOM server	Local archive	Transfer data from an ImageVault server, a DICOM server or EchoPAC Software Only to the local archive.
5.	Image Vault Archive or EchoPAC Archive or DICOM server	Removable media	Transfer data from an ImageVault server, a DICOM server or EchoPAC Software Only to a removable media (CD/DVD or USB storage device).
6.	Removable media	Image Vault Archive or EchoPAC Archive or DICOM server	Transfer data from a removable media (CD/DVD or USB storage device) to an ImageVault server, a DICOM server or EchoPAC Software Only.
7.	Image Vault Archive or EchoPAC Archive or DICOM server	Image Vault Archive or EchoPAC Archive or DICOM server	Transfer data between remote archives (ImageVault server, DICOM server or EchoPAC)

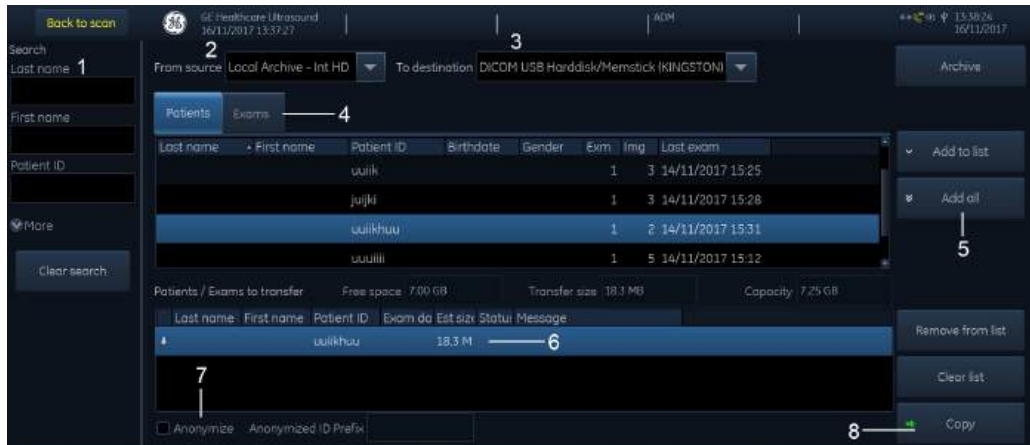


CAUTION

If an examination is opened, it must be closed before performing transfer of patient records/examinations.

Transferring patient records/examinations

1. If transferring data from/to a removable media, insert the media in the drive.
2. Press **Patient**.
The *Archive* screen is displayed (see Figure 10-6 on page 10-18).
3. Press **Transfer**.
The *Transfer* screen is displayed.



1. Search for the data to transfer.
2. Transfer from.
3. Transfer to.
4. Transfer either patient records or examinations.
5. Add selected/all items to the transfer list.
6. List of data to transfer.
7. Anonymize: remove patient information to the transferred items (only available for DICOM data transfer to removable media).
8. Perform data transfer.

Figure 10-51. The Transfer screen

Transferring patient records/examinations (continued)

4. If a search for patient records or examinations was performed in the *Archive* screen before entering the *Transfer* screen, the found items are displayed in the *Transfer* screen.

If no search was performed before entering the *Transfer* screen, select a source archive from the *Source* drop-down menu and search for the patients records or examinations to transfer.

NOTE: *Note that both sources and destinations can be hidden from showing up in the Transfer screen. This can be changed in the **Dataflow** and **Transfer** tab in **Connectivity** configuration by clicking on the "Eye" icon to hide/unhide.*

The following source archives are available:

- **Local Archive:** Transfer data from the local archive.
- **EchoPAC Archive:** Transfer data from the configured remote archive.
- **DICOM DVD:** Transfer DICOM data only from a CD/DVD-R/W.
- **DICOM USB:** Transfer DICOM data from an USB storage device. Only available when an USB storage device is mounted.
- **DICOM Query retrieve:** Transfer DICOM data from a Query/Retrieve DICOM server.
- **Raw Data USB:** Transfer data from an USB storage device. Only available when an USB storage device is mounted.
- **Raw Data DVD:** Transfer data from a CD/DVD.
- **Tricefy QR:** Transfer images and SR files from Tricefy.

NOTE: *If the removable media contains data from various imaging sources, some data may not be available at first attempt. Use **Config > Connectivity > Tools > Repair DICOMDIR** on the correct media to fix availability of supported DICOM files. This process may require some time depending on the size of the data on the media.*

NOTE: *Repair DICOMDIR is only supported for media with a size less than 200GB.*

Transferring patient records/examinations (continued)

5. Select one of the following available destinations from the *Destination* drop-down menu:
 - **DICOM CD/DVD:** Transfer DICOM data only to a CD/DVD-R/W.
 - **DICOM USB Harddisk/Memstick:** Transfer DICOM data only to an USB device. Only available when an USB device is mounted.
 - **DICOM Print:** Prints images to a DICOM printer via DICOM spooler.
 - **DICOM Storage:** Transfer DICOM data only to a DICOM server via DICOM spooler.
 - **Export to XML:** Transfer demographics, measurements and reporting data to XML file. The export destination must be configured (see page 10-130).
 - **Remote Archive - Remote HD:** Transfer raw and DICOM data to an ImageVault server or EchoPAC Software Only.
 - **USB Harddisk/Memstick:** Transfer data to an USB device.
 - **CD/DVD Archive:** Transfer data to a CD/DVD.

Transferring patient records/examinations (continued)

6. The following situations may occur if the destination media is a CD/DVD:
 - If the destination media needs to be formatted the following window is displayed asking the user whether to format the media.

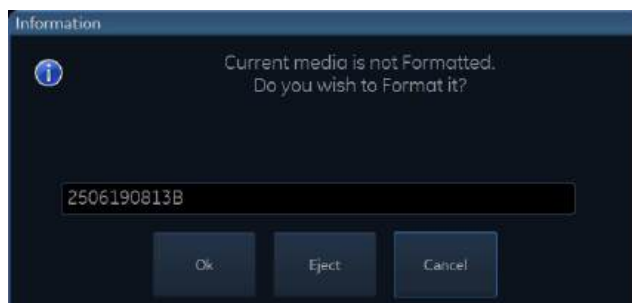


Figure 10-52. Media formatting window

Enter a new label and select **OK**.

NOTE:

Only the following characters and signs can be used when labelling a media: A - Z, a - z, 0 - 9, “_” and “-”. Do not use more than 11 characters or signs. Do not use space.

The media is formatted and ready to use.

Transferring patient records/examinations (continued)

- If the CD/DVD is not empty, the *Add files* window is displayed.

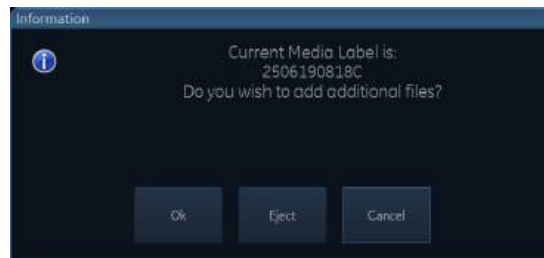


Figure 10-53. Add files windows

Select **OK**.

The system is preparing the media to allow addition of new files.

NOTE:

*If **Eject** is selected, the user is prompted to insert another media. If **No** is selected, the Transfer window is displayed (Figure 10-51), where the user can select another destination.*

7. Press **Add to list** to make the selected items ready for transfer, or press **Add all** to make all available items ready for transfer.
8. Press **Copy**.

NOTE:

*If **Delete after copy** is selected the user will be asked to confirm the action.*

Transferring patient records/examinations (continued)

9. If one or more patient records or examinations are already present in the destination archive, the *Matching patient/exam data* window is displayed.

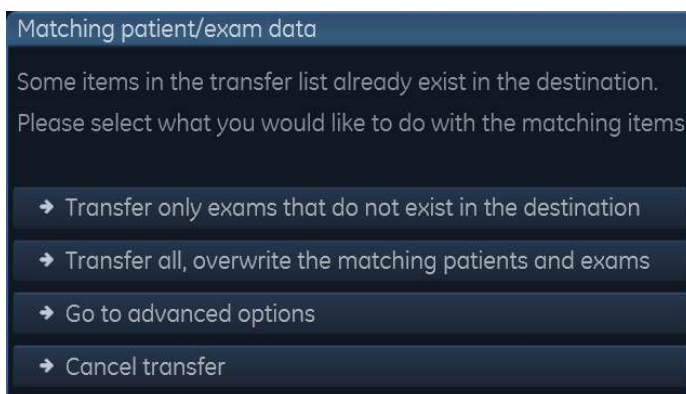


Figure 10-54. The Matching patient/exam data window

10. Select between:
 - **Transfer only exams that are not in the destination.**
 - **Transfer all, overwrite the matching patients and exams.**
 - **Go to advanced options.**
 - **Cancel transfer**

Transferring patient records/examinations (continued)

The *Advanced option* window is displayed.

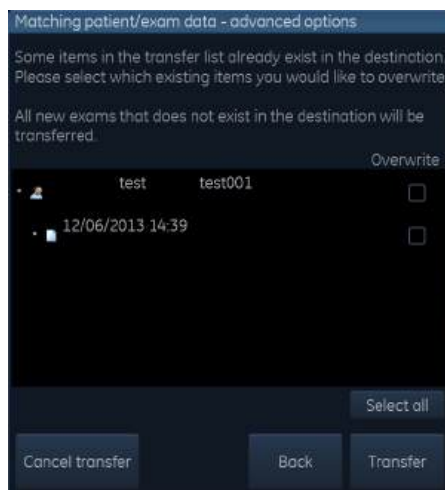


Figure 10-55. The Advanced option window

Press **Transfer**.

The transfer operation is started. The *Copying patients* window is displayed showing the progression of the transfer.

Transferring patient records/examinations (continued)

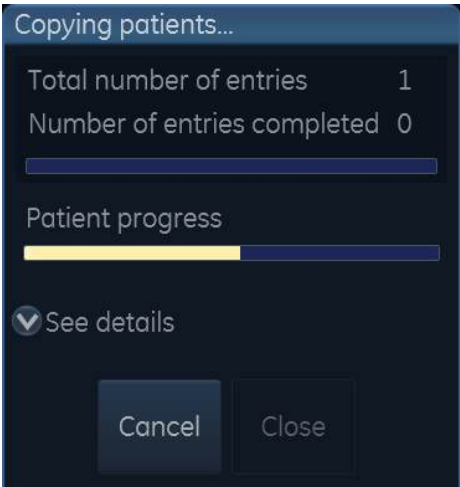


Figure 10-56. The Copying patients window

Each successfully transferred item is marked with a check mark in the transfer list.

	First name	Last name	Patient ID	Exam date	Est size	Status
	John	Doe	123		9.03 MB	✓
		TVI	v110b213		27.5 MB	✓

Figure 10-57. List of transferred items

NOTE: Press **Clear transferred** to clear the list of transferred items.

11. Press **Close** to return to the *Archive* screen.

Disk Management

Introduction

The Disk management function allows the user to manage hard disk space while maintaining the patient database on the system. The Disk management function can be used to move, copy or delete images and move or copy reports from the oldest patient records. The Disk management function has also an auto-purge feature that will automatically delete images and reports that have already been copied if the local hard disk is getting full.

Three different disk management scenarios are possible depending on the system configuration:

- Disk management is set to **move** files: the user runs the Disk management function on a regular basis to move images and reports from older patient records to removable media or to a network volume. Using this setting, moved images and reports are deleted from the local hard drive and copied to the specified destination. This scenario prevents the local disk to fill up and keeps images and reports from the most recent patient records on the local disk. Using this scenario, the user can control what should remain on the system while keeping the disk free space at an operational level.
- Disk management is set to **copy** files: the user runs the Disk management function on a regular basis to copy images and reports from older patient records to removable media or to a network volume. To prevent the local disk to fill up, the auto-purge function automatically deletes files that were previously copied when the disk free space has reached the minimum allowed limit. This scenario lets the system automatically manage the disk space on the system.

Introduction (continued)

NOTE: *When using this setting, the original images will be retrieved from the local hard drive as long as they are available there. When the images are deleted from the local hard drive by the auto-purge function, the copied images will be retrieved.*

- Disk management is set to **delete** files: the user runs the Disk management function on a regular basis to delete images from older patient records.

NOTE: *Ensure that you have established a data management protocol for your office/institution. The user **MUST** manage the removable media used when running Disk management by keeping a log and by creating a media filing system.*

A person should be in charge of performing the process. The Disk management system can be set up so that a reminder is displayed at regular intervals.

It is always highly recommended to take a backup of moved/copied files, which is the responsibility of the customer. The unit does not offer functionality for taking backup of images and reports saved on long-term storage media.

NOTE: *It is recommended that users should do data management in a specific time interval.*

Configuring the Disk management function

Configuration of the Disk management system can only be done by user with administration rights.

1. Press **Config**.
If required log on as administrator.
2. Select the category **Connectivity**.
3. In the *Connectivity* category, select the sheet **Disk management**.

Configuring the Disk management function (continued)

The screenshot shows the 'Connectivity' tab selected in the top navigation bar. Below it, the 'Tools' tab is selected in the sub-navigation bar. The main configuration area is divided into five numbered sections:

- 1** Reminder interval: 4 Weeks
- 2** Manage files older than: Today (all files)
- 3** Operation: ☒ Copy, ☐ Move, ☐ Delete
- 4** Destination device: USB/HD
- 5** Run button

1. Sets the reminder time interval for running Disk management.
2. Sets the files to be managed based on the examination dates.
3. Sets the Disk management to copy, move or delete images.
4. Sets the destination device.
5. Starts Disk management.

Figure 10-58. The Disk management sheet

Disk management schedule setting

1. Next to **Reminder interval**, specify the number of days/weeks you want the system to prompt you to perform disk management.
This setting should be set based on the activity of your office/institution.

Data management settings

1. Select a number of days, weeks or months next to **Manage files older than**. Only files older than the specified setting will be copied, moved or deleted.
If **Today (all files)** is selected, all files will be copied or moved.
2. Next to **Operation** check:
 - **Copy**: the images and reports from the examinations older than the specified setting defined in step 1 are copied to the specified destination. Using this setting, the files will exist in two locations, the local hard drive and the destination.
 - **Move**: the images and reports from the examinations older than the specified setting defined in step 1 are copied to the specified destination, verified and then deleted from the local hard drive. Using this setting, the files will exist in one location, the destination media. They are removed from the local hard drive.
 - **Delete**: the images from the examinations older than the specified setting defined in step 1 are deleted from the hard drive.

Destination device setting

1. Next to **Destination device**, select a removable media or a network share folder.

NOTE: *When a network share folder is selected the path to the folder must be entered. Press **Check** to verify the connection.*



CAUTION

If using removable media, it is recommended to use dedicated media to the Disk management process. Removable media used for data backup must not be used when performing Disk management.

Do not use the same removable media on several systems.

Running the Disk management function

The Disk management function can be run at any time. In addition, the user may be prompted to run Disk management if the time since the last Disk management operation performed has reached the setting for the Reminder interval (see page 10-93), or if the local hard drive is about to be full.

Disk management can be run from the *Archive* screen (see below) or from **Config/Connectivity/Disk management** (Figure 10-58 on page 10-93).

Manual start of Disk management

1. Press **Patient**.
The *Archive* screen is displayed.
2. Press **Disk management**.
The *Disk management* window is displayed (Figure 10-54).

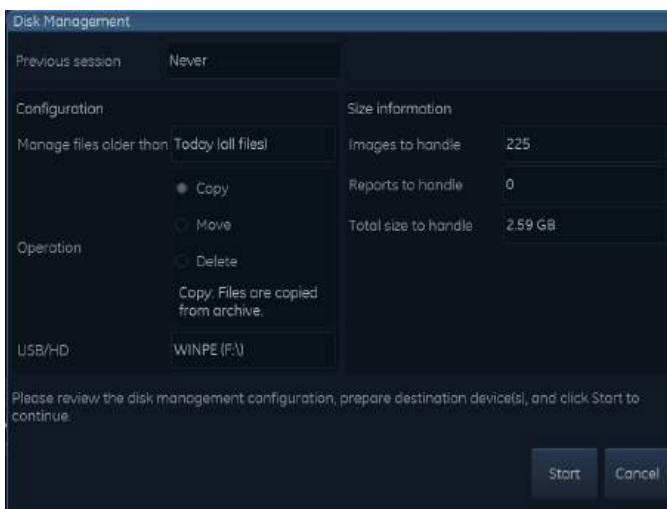


Figure 10-59. The Disk management window

Manual start of Disk management (continued)

The Disk management operation will either copy, remove or delete files from the local archives depending on the Disk management configuration (see page 10-92). Make sure the correct configuration is set.

Prepare the destination device(s). If a connected USB device is used, make sure the correct device is selected.

If using CD/DVD, the operation may require several disks as specified in the *Disk management* window. Make sure that the specified number of disks are available.

NOTE: *CD/DVD do not need to be formatted.*

3. Press **Start**.

The *Disk management processing files* window is displayed showing progression of the process (Figure 10-60).

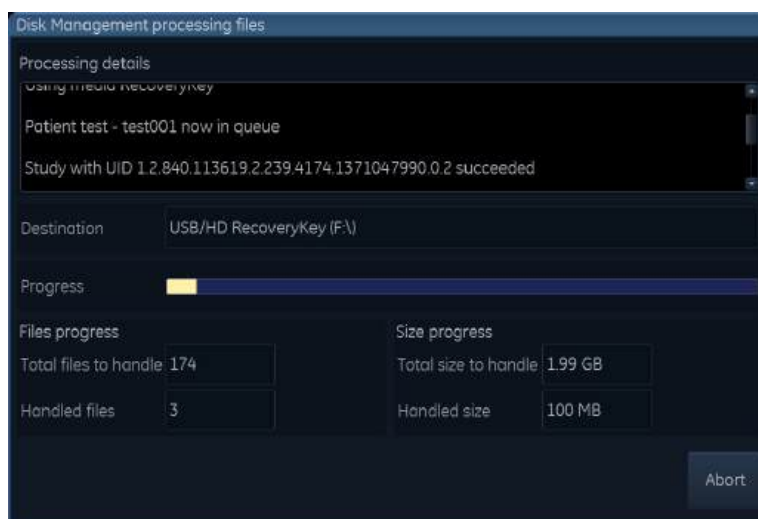


Figure 10-60. The Copying files window

Manual start of Disk management (continued)

If using CD/DVD as destination device, the system automatically formats the disks if required. If the media is formatted the user will be asked to enter a label for the media.

NOTE: *The media label should have an identification of the system the Disk management is run from.*

NOTE: *Disk management is aborted if the destination device contains a database backup or exported patient data.*

The information displayed on the *Disk management processing files* window is updated while the files are being copied.

4. If more than one media is necessary a dialogue window is displayed asking the user to insert a new media.
Press **OK** after the new media is inserted.
The operation is resumed.
5. When all the files are copied, the *Disk management completed* window is displayed (Figure 10-61), showing the list of processed examinations, the media used and a detailed log.

Manual start of Disk management (continued)

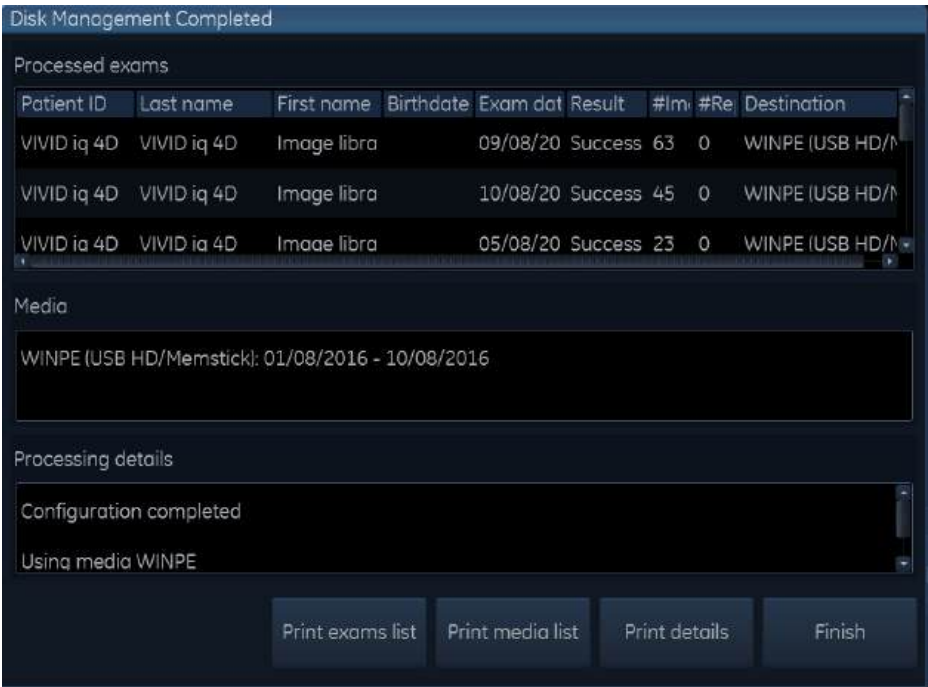


Figure 10-61. The Disk management completed window

Manual start of Disk management (continued)

- Select **Print exam list** to print the list of processed examinations.
 - Select **Print media list** to print the list of media.
 - Select **Print details** to print the detailed log.
6. Make sure that all media are physically labelled according to the list displayed in the *Disk management completed* window. The media label should also have an identification of the system the Disk management was run from.
 7. Press **Finish** to complete the Disk management operation and file the media.
A backup reminder window is displayed.



Figure 10-62. The Backup reminder window

8. Press OK.
See page 10-101 to perform a database backup.

Data Backup and Restore

Introduction

The Backup/Restore function enables the user to:

- Copy/Restore the patient archive.
- Copy/Restore the system configuration. The Copy/Restore system configuration feature enables the user to configure several units with identical presets, providing that the units have the same software version.

To minimize accidental loss of data, perform backup of the patient archive stored on the local harddrive at least **once a week**.



GE is not responsible for lost data if the suggested backup procedures are not followed and will not aid in the recovery of lost data.

There is no backup function for the images or reports (no creation of a safety copy). For long-term storage, images and reports should be moved to a USB HD or to a network shared folder using the Disk management procedure (see page 10-91).



DO NOT use the local harddrive for long-term image storage.

Only users with administration rights have access to the backup/Restore function.

Backup procedure

1. Press **Patient**.
2. In the *Archive* screen, select the dataflow **Local Archive - Int. HD**.
3. Press **Config**.
4. Select the category **Admin**.
5. Select the **Backup** sheet.

Data to backup	Result	Last successful backup
☐ Patient Archive ☐ Validate Patient Archive		No record
☐ System Configuration		No record

Destination Device:

Local Path:

Remote Path: Go to Remote Path tab to set up credentials if needed.

Start backup

Figure 10-63. The Backup sheet

6. In the *Backup* sheet select as needed:
 - **Patient archive** to backup the patient records.
 - **System configuration** to copy system settings and user presets.
7. Select a removable media or a shared network folder as destination.

NOTE: *To be able to select a network share folder, the path (of type: \\server-name\share-name) must have been entered in the Remote path field.*

Backup procedure (continued)

8. If the backup is done to a removable media, insert a dedicated media in the drive.
9. Select **Start backup**.

The following situations may occur:

- The system is checking that the removable media is inserted. If not, a dialogue window is displayed indicating media failure.

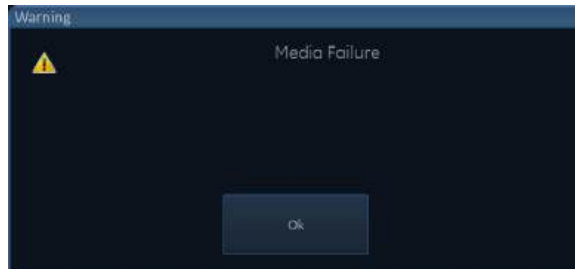


Figure 10-64. The Media Failure window

Insert the media and select **OK**.

Backup procedure (continued)

- If using a CD/DVD, the system is checking if the media needs to be formatted. If yes, a dialogue window is displayed prompting the user to enter a media label.



Figure 10-65. The Enter media label window

Type in a label for the media and select **OK**.

NOTE: *Only the following characters and signs can be used when labelling a media: A - Z, a - z, 0 - 9, “_” and “-”. Do not use more than 11 characters or signs. Do not use space.*

NOTE: *If you select **Eject** you can perform the backup using another removable media. If you select **Cancel** the backup operation is stopped.*

Backup procedure (continued)

- The system is checking if there is already a backup or a Disk management copy on the media. If the following error message is displayed, the disk is ejected and the user is asked to use a new media that does not contain any backup or Disk management data.

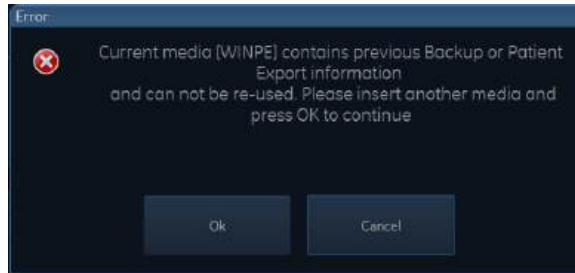


Figure 10-66. The Replace current media window

Insert a new media and select **OK**.

NOTE:

To reuse a Backup CD/DVD when performing a new archive backup, the media has to be re-formatted first.

10. During backup, progress windows are displayed showing the current operation being performed.



Figure 10-67. The Backup progress window

Backup procedure (continued)

11. At the end of the process, the *Backup completed* window is displayed.

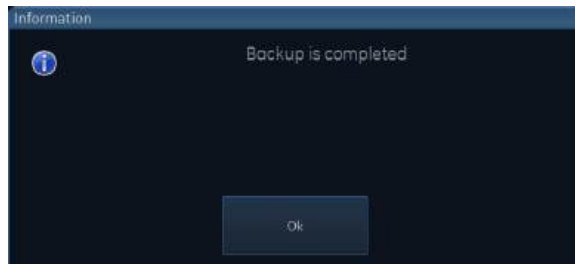


Figure 10-68. The Backup completed window

Select **OK**.

The Backup result is displayed on the *Backup* sheet.

12. Make sure to physically label the media. An identification of the system should also be noted on the media and a backup log should be kept.

File the media in a safe place.

Restore procedure

1. Press **Config**.
2. Select the category **Admin**.
3. Select the **Restore** sheet.

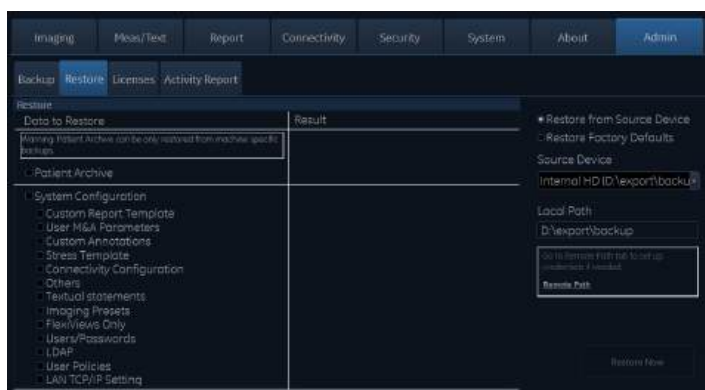


Figure 10-69. The Restore sheet

4. In the *Restore* sheet select as needed:
 - **Patient archive** to restore the patient archive.
 - **System configuration** to restore all system settings and user presets.

OR

 - One or several **system configuration items** to restore parts of the system settings and user presets (see Figure 10-69).
5. If restore is done from a backup on a removable media, insert the media in the drive. Make sure that **Restore from Source Device** is selected.
6. Select the appropriate **Source device**.



CAUTION

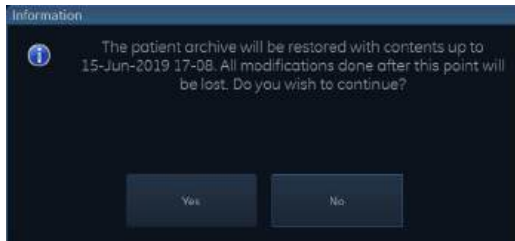
The Restore procedure will **OVERWRITE** the existing data on the local harddrive. Make sure to insert the correct media and select the correct source device.

Restore procedure (continued)

7. Select **Restore now**.

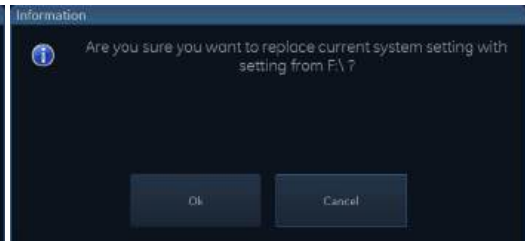
Depending on the selection of items to be restored, one or two restore confirmation windows are displayed:

A



a. Displayed if the patient archive is to be restored.

B



b. Displayed if any of the system settings are to be restored.

Figure 10-70. The Restore confirmation window

8. Ensure that the correct source is selected and select **OK**. The selected items are copied to the systems.
9. If connectivity configuration settings are restored the following information window is displayed.

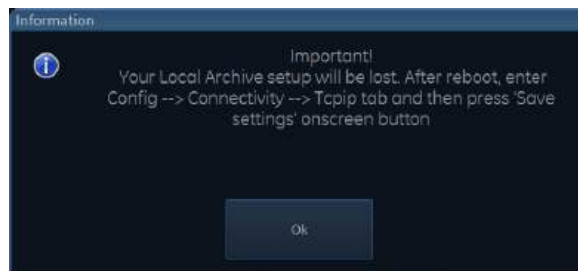


Figure 10-71. Information window

Restore procedure (continued)

10. Select **OK**.

The *System shutdown* window is displayed.

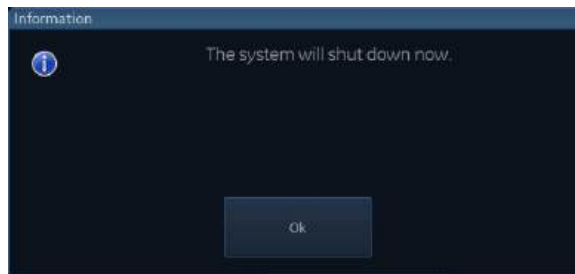


Figure 10-72. The System shutdown window

11. Select **OK** to shut down the system.

12. Restart the system.

If connectivity configuration settings have been restored, make sure to save the TCP/IP settings: select **Config/Connectivity/TCPIP** and select **Save settings**. The system needs to be restarted again.

NOTE: *The system is able to recover the database when corrupt.*

Tricefy Uplink

Tricefy Uplink, an online platform for sharing and distributing medical images, enables physicians to archive, collaborate and share exam data with patients and colleagues. After registration, the studies can be archived and viewed in the cloud.



1. Archive securely in the cloud.
2. Access anytime from any device.
3. Share with patients instantly
4. Collaborate with colleagues easily.

Figure 10-73. How the Tricefy server works

To register a Tricefy Uplink account

1. Press **Config** on the shortcut bar.
2. If required, log on to the system.
3. Select the **Connectivity** category and the **Tricefy** subgroup. The *Tricefy* screen is displayed (see Figure 10-74).
4. Check the button **Enable Tricefy**. A registration text field is displayed.
5. Type e-mail address and then press **Activate account**.
At first connection, a registration letter will be sent to the provided e-mail address. Follow the instructions to complete the Tricefy Uplink registration.
6. After the account is successfully registered, press the **Test Connection** button. The account information is displayed, indicating the account name, customer name and account status (see Figure 10-74).

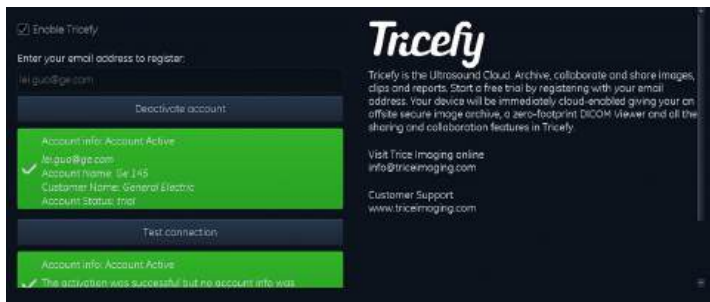


Figure 10-74. The Tricefy Screen

NOTE: An icon in the bottom left corner of the title bar shows the Tricefy connection status.

The icon  indicates that Tricefy Uplink is successfully connected.

The icon  indicates that registration is incomplete.

The icon  indicates that Tricefy Uplink is disconnected.

Configuration of Tricefy storage

The following dataflows are available for transferring images from the ultrasound system to the Tricefy cloud server:

Dataflow	Description
Local Archive / Tricefy Store	The local archive is used for patient archiving. Images are stored to the local archive and to Tricefy Uplink. If DICOM SR is enabled, measurements are also sent to Tricefy Uplink.
Tricefy Store	Store images to Tricefy Uplink. If DICOM SR is enabled, measurements are also sent to Tricefy Uplink.
Local Archive / Tricefy Patient Share	The local archive is used for patient archiving. Images are stored to the local archive and to Tricefy. Images are also shared with the patient. If DICOM SR is enabled, measurements are also sent to Tricefy Uplink.
Tricefy Patient Share	Store images to Tricefy and share them with the patient. If DICOM SR is enabled, measurements are also sent to Tricefy Uplink.
Tricefy QR / Tricefy Store	Search in Tricefy Uplink patients and examinations. Retrieve images from Tricefy Uplink. Images are stored to Tricefy Uplink. If DICOM SR is enabled, measurements are also sent to Tricefy Uplink.
Tricefy QR / Tricefy Patient Share	Search in Tricefy Uplink patients and examinations. Retrieve images from Tricefy Uplink. Images are stored to Tricefy Uplink and shared with the patient. If DICOM SR is enabled, measurements are also sent to Tricefy Uplink.
Worklist / Tricefy QR / Tricefy Store	Search in a DICOM Modality Worklist, retrieve images from Tricefy Uplink. Images are stored to Tricefy Uplink. If DICOM SR is enabled, measurements are also sent to Tricefy Uplink.
Worklist / Local Archive / Tricefy Store	Search in a DICOM Modality Worklist, the patient found is copied into the local archive. The patient information and the examination results are stored to the local database. Images are stored to Tricefy Uplink and to the local archive. If DICOM SR is enabled, measurements are also sent to Tricefy Uplink.

Configuration of Tricefy storage (continued)

Configure as follows before storing exams to Tricefy Uplink:

1. Press **Config** on the shortcut bar.
2. If required, log on to the system as **ADM**.
3. Select the **Connectivity** category and the **Dataflow** subgroup.

The *Dataflow sheet* is displayed (see Figure 10-75).

4. Select the dataflow **Local Archive - Tricefy Store**.

NOTE: *Dataflows listed in the above table can also be selected as needed.*

5. Uncheck the **Hidden** button.

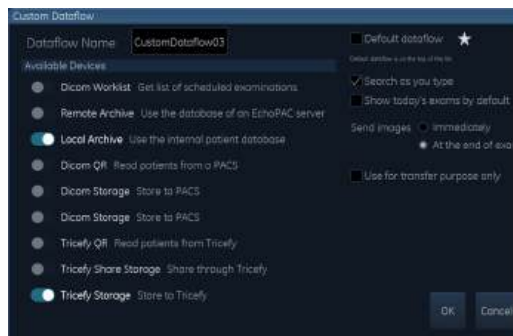


Figure 10-75. The Dataflow sheet

Storing an exam to Tricefy (Example 1)

1. In the *Patients/Exams* list, select dataflow **Local Archive - Tricefy Storage**.
2. Get back to scan and press **Store** key, the image is stored in the clipboard.
3. End the exam, the exam data will be sent to the Tricefy website (https://tricefy4.com/users/sign_in) in addition to the local archive.

Storing an exam to Tricefy (Example 2)

1. In the *Patients/Exams* list, select dataflow **Local Archive - TricefyPatientShare**.

NOTE: If TricefyPatientShare is selected as dataflow, the patient telephone number must be entered under patient data (see Figure 11-87) so that the patient will be informed automatically when images are uploaded to Tricefy Uplink.

NOTE: To share the exam results with more than one person, type several telephone numbers separated by semicolon.

2. Get back to scan and press **Store** key. The image is stored in the clipboard.
3. End the exam. The exam data will be sent to the Tricefy website (https://tricefy4.com/users/sign_in) in addition to the local archive.

*NOTE: If the **Direct Store** checkbox is checked in the Dataflow sheet, the selected image will be directly sent to the Tricefy website when pressing **Store** key.*

How to export an existing exam from local archive to Tricefy Uplink

1. Press **Transfer** from the Patients/Exams list (see Figure 10-76).
The *Transfer screen* is displayed (see Figure 10-76)
2. Select **Local Archive** from the *Source* drop-down menu.
Select **Tricefy Storage** from the *Destination* drop-down menu.
3. Press **Add to list** to make the selected items ready for transfer.
4. Press **Copy** (see Figure 10-77). The exam data is sent to the Tricefy website (https://tricefy4.com/users/sign_in).

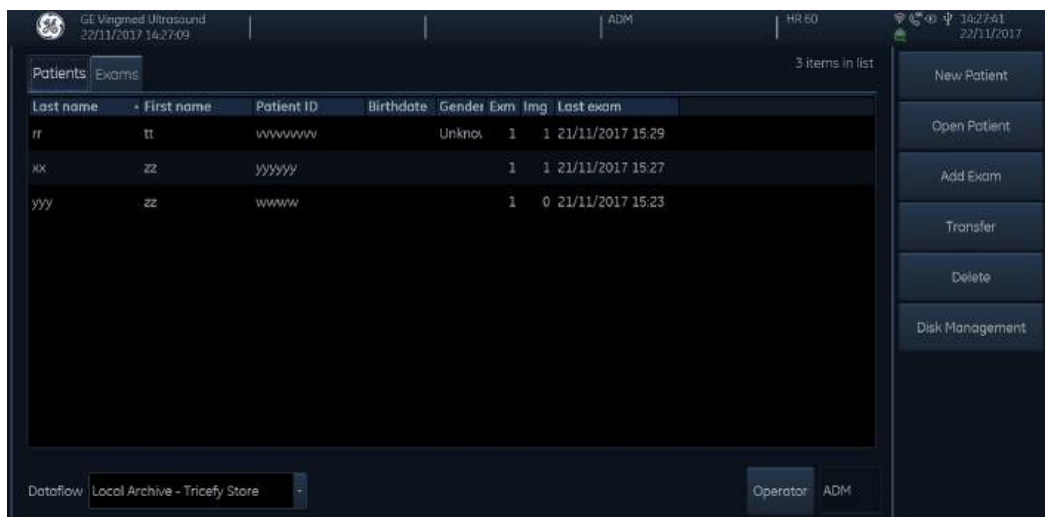


Figure 10-76. The Patients/Exams list

How to export an existing exam from local archive to Tricefy Uplink (continued)

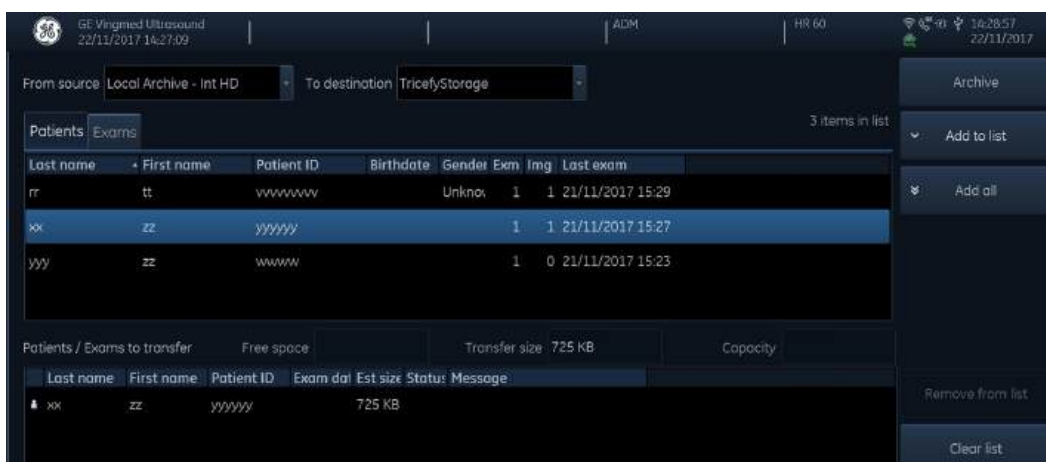


Figure 10-77. The Transfer screen

Accessing exams on the Tricefy web

Open the Tricefy web (https://tricefy4.com/users/sign_in). Log in with user credentials and access the exam results in the *Studies* tab.

Configuration of the P1 button

The P1 button can also be configured to store images directly to the Tricefy website. With this method one can send selected images instead of the whole exam, like shown in the two previous examples.

Configuring P1 button as TricefyStorage

1. Press **Config** on the shortcut bar.
2. If required, log on to the system.
3. Select the **Connectivity** category and the **Buttons** subgroup.
The *Buttons sheet* is displayed (see Figure 10-78)
4. In *Button* field, select **P1**.
5. Select **TricefyStorage** from the *Available output* field and press the **Right arrow** button to assign it to the *Selected Output* field.

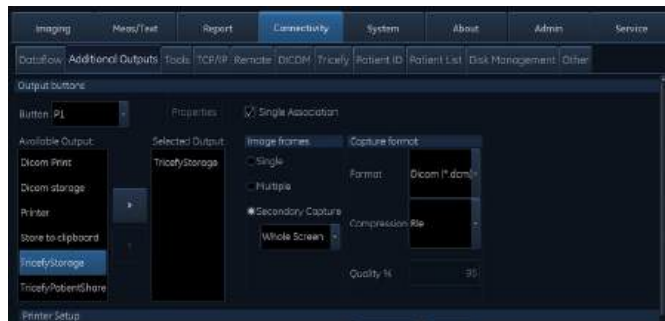


Figure 10-78. The Additional Outputs Sheet

6. Get back to scan and press **P1** button, the exam data will be sent to the spooler and kept there (press **Spooler** on the shortcut bar to see the data).

Configuring P1 button as TricefyStorage (continued)

7. End the exam. The exam data will be sent to the Tricefy website (https://tricefy4.com/users/sign_in).

NOTE: *If the **Single Association** button is unchecked in the Additional outputs sheet, the exam data will be directly uploaded to the Tricefy website when pressing P1 button, without being held on the spooler page.*

NOTE: *List of exam results sent to the Tricefy server will be displayed on the spooler page (press **Spooler** on the shortcut bar to see the data).*

Configuring P1 button as TricefyPatientShare

1. Press **Config** on the shortcut bar.
2. If required, log on to the system.
3. Select the **Connectivity** category and **Buttons** subgroup. The *Buttons output sheet* is displayed.
4. In the *Button* field select **P1**.
5. Select **TricefyPatientShare** from the *Available output* field and press the **Right arrow** button to assign it to the *Selected Output* field.

NOTE: *The patient telephone number must be entered under patient data so that the patient will be informed automatically when images are uploaded to Tricefy Uplink.*

NOTE: *To share the exam results with more than one person, type several telephone numbers seperated by semicolon.*

6. Get back to scan and press **P1** button. The exam data will be held on the spooler page.
7. End the exam. The exam data will be sent to the Tricefy website (https://tricefy4.com/users/sign_in).

Configuration of Tricefy QR

Tricefy QR, similar to DICOM Query Retrieve, enables users to check the exam results which are stored in the Tricefy website via scanner.

1. Log in to the Tricefy website (https://tricefy4.com/users/sign_in).
2. Enable Q/R for corresponding IP address matched with your ultrasound system from the *Uplinks* tab of the website.

NOTE: *Contact your Tricefy Uplink representative to get support for any Tricefy website questions.*

3. Press **Config** on the shortcut bar and log on to the system as **ADM**.
4. Select the **Connectivity** category and the **Dataflow** subgroup.
5. Select the dataflow **Tricefy QR -Tricefy Storage**.
6. Uncheck the **Eye** icon and connect with Internet.
7. Go to patient page and select **Tricefy QR -Tricefy Storage**.

The exam results stored in the Tricefy website will be displayed in the *Patients/Exams* list.

NOTE: *Disable Q/R on the Tricefy website to prevent exam data being used by any other person logging in to the system with the same IP address.*

Data streaming

NOTE: The **StreamServer** option key should be installed to enable streaming live ultrasound data.

The system has the capability to stream live ultrasound image data (both 2D and 3D) over the network connection to enabled devices. The data stream will contain gray scale and color data, geometry and physio traces. No patient information will be transferred with the streamed data. To configure this capability, see 'Data Streaming' on *page 4-56*.

Streaming in process

The streaming is initiated and terminated from an enabled device (e.g. a smart phone / tablet or PC connected to the same network – capable of receiving the streamed data over a custom protocol). An enabled device can only receive data when streaming has been enabled on the system, see ‘Enable data streaming’ on *page 4-56*.

Active streaming is marked with a red label: *STREAMING*.

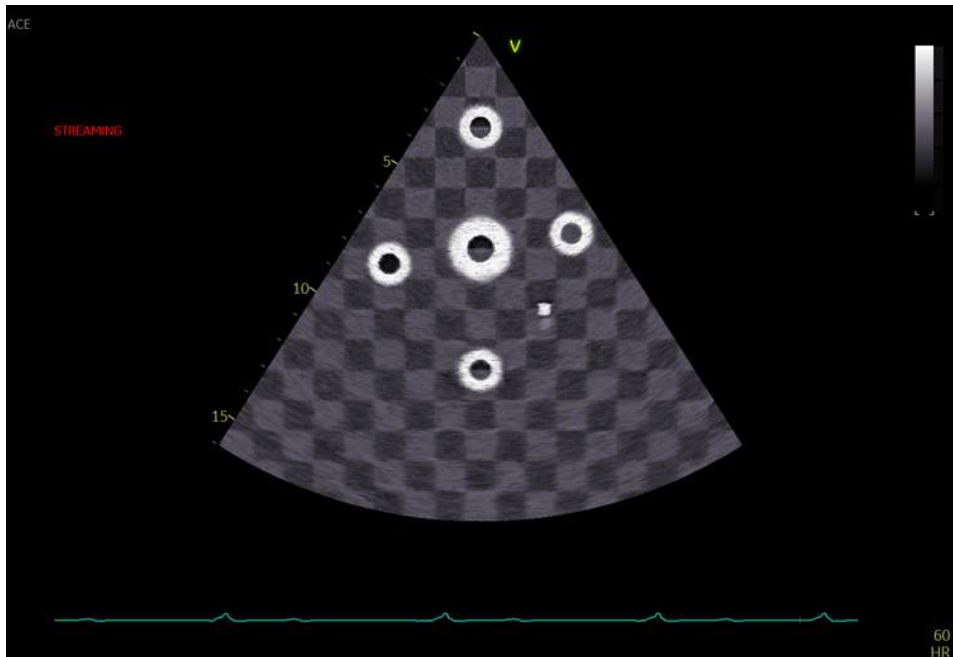


Figure 10-79. Active streaming window (example)

Data streaming can be stopped by pressing **Stop Data Streaming** on the top right tray menu.

Streaming in process (continued)

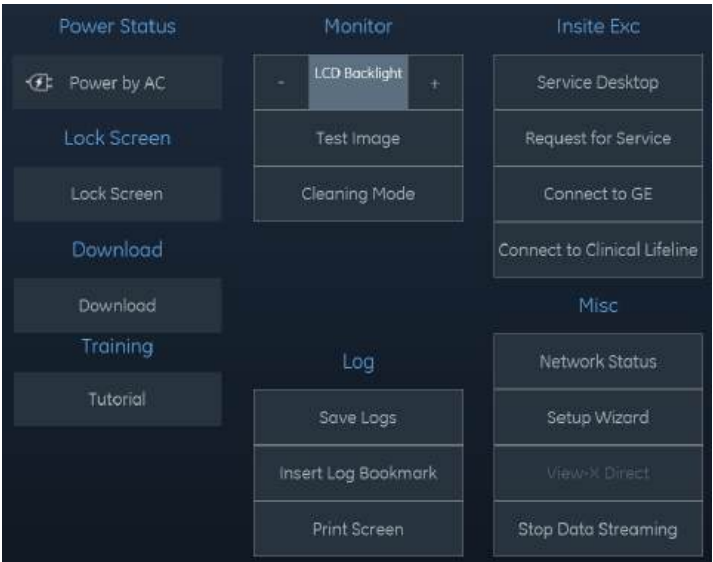


Figure 10-80. Stop Data Streaming

Configuration of the archiving functions

- Press **Config** from the shortcut bar and log on as administrator if required.
- Select the **Connectivity** category and the **Other** subgroup.

The *Other* window with the Patient List displayed.

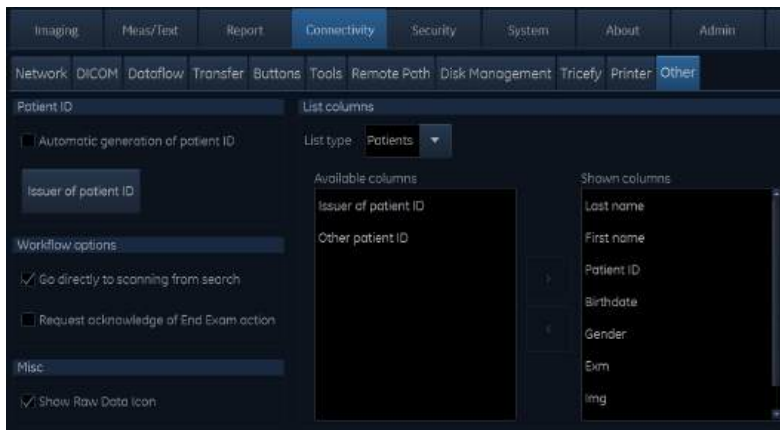


Figure 10-81. The Other window

Configuration of the Patient, Worklist and Examination list in the Archive screen

1. In the *List type* drop-down menu, select the list to edit.
2. To add a column to the list:
 - Select a column to display in the *Available columns* field and press  to add it to the list.
 - Press  /  to move the column.
3. To remove a column from the list:
 - Select the column to remove in the *Show columns* field and press .

NOTE: *The columns First name, Last name, Patient ID, Last exam and Exam date cannot be removed for the lists.*

Network configuration

To be able to use the network functions when connected to a hospital network, the system must have a proper network address. See 'System's Network settings' on *page 10-49* for more information.

Dataflow

Communication between the Vivid *iq* and other information providers on the network takes the form of dataflows. Each dataflow defines the transfer of patient information and images from an input source to the unit, and from the unit to one or several output sources. Input/output devices cannot be added/removed to/from the pre-defined dataflows. However the settings for the devices can be adjusted.

See 'Dataflows available' on *page 10-3* for a complete list and description of dataflows available.

Dataflow adjustments

1. Press **Config** and log on as administrator if required.
2. Select the **Connectivity** category and **Dataflow** subgroup.
The *Dataflow* sheet is displayed.
3. Select **Add Dataflow** (choose a custom or factory template).

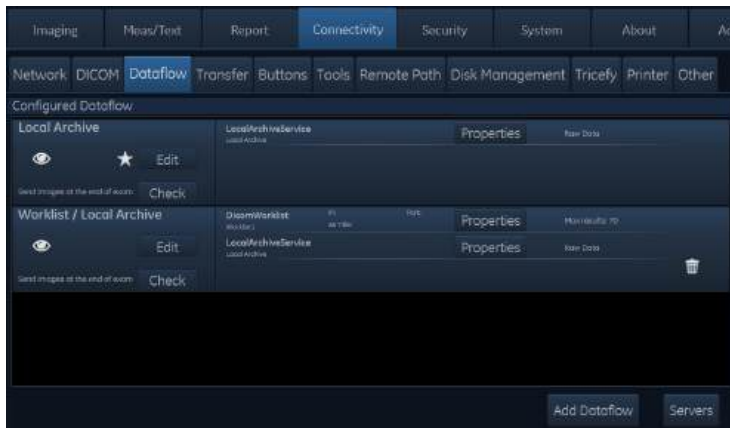


Figure 10-82. The Dataflow sheet

Dataflow adjustments (continued)

Then, click on the **Edit** button on the selected dataflow to open up the screen below:

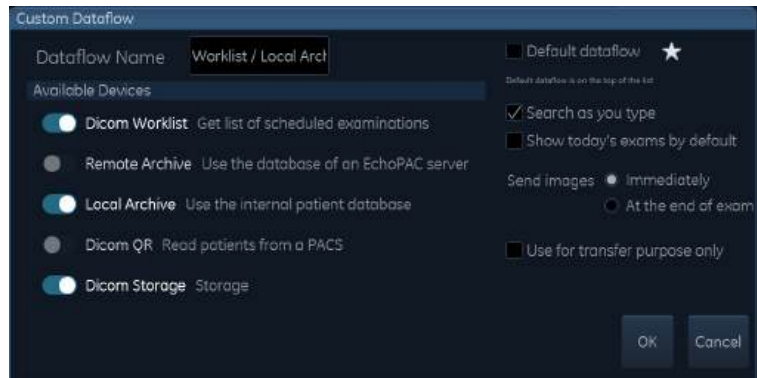


Figure 10-83. Custom Dataflow settings

- Check **Default dataflow** to make it default. It will then show up at the top of the dataflow list — with the star icon next to it.
- **Search as you type** will narrow the displayed patients in the archive the more letters/numbers are entered.
- **Show today's exam by default** will limit the displayed patients when the box is checked.
- Images can be sent immediately after Image Store (also called Direct Store) or at the end of the exam by configuring **Send images**.
- If a dataflow is only to be used for transfer purposes and not as a dataflow used for acquiring exams, check the **Use for transfer purpose only** checkbox.

Adjusting the assigned devices

1. Select the dataflow to configure.
2. Select the input or output device to configure.
3. Press **Properties**.
The *Properties* window is displayed.
4. Adjust the device specific parameters as desired (see table below). Not all the settings listed below apply to all devices.

General settings	Definition
Name	Free text: give a descriptive name for the device.
IP address	Select from drop-down menu (if available)
Database Location	Automatically selected according to the IP address
File destination	Automatically selected according to the IP address

Image settings	Definition
Raw Data Settings	Raw Data Settings gives you the ability to select which images to transfer in raw data format by mode: • All images • Apical 2D (auto classified) • Parasternal 2D (auto classified) • 2D/Biplane/Triplane • M-mode • Colorflow/TVI/Biplane/Triplane • Color M-mode • PW/CW • 4D • 4D Color
Raw Compression	Enables compression of raw data images upon storage and export. Raw compression is active only if the setting <i>Allow raw data</i> is checked.
Max Framerate	Select 25, 30 or Full (original acquisition) from the pop-up menu. Applies to DICOM only.
Compression	Select compression type or no compression.
Quality	Set picture quality from 1 to 100%. A low picture quality level allows high data compression, while a high picture quality restrains the compression. Applies to DICOM only.
Allow Multiframe	☒ : Allow cineloop storage.
Systole only (for Stress)	When this setting is active, all stress images will be sent to the DICOM server showing only systole. The setting is selectable when transferring only multiframe (not raw data).

Connection settings	Definition
Retry	Set maximum number of connection retries, time interval between tentative and time-out.

DICOM settings	Definition
AE Title	The Application Entity Title is set during DICOM configuration. Refer to the network specifications.
Port No	The Port no. is allocated during DICOM configuration. Refer to your network specifications.
Verification	Verify the connection to another DICOM application.
Storage commitment	Send a request to a PACS, asking it to permanently archive image(s).
MPPS	Modality Perform Procedure Step: send information (typically to a HIS) that a scheduled exam has been started, performed or interrupted.
DICOM SR settings	• Allow SR: enable DICOM SR. • Allow SR private data: include current exam data in a private format within DICOM SR to retain measurements and complete exam information when recalling an exam from a DICOM environment. This is especially important if EchoPAC Plug-in is used in the DICOM environment or if any exam at any later time is expected to be recalled to Vivid <i>iq</i> or EchoPAC Software Only using DICOM Query/Retrieve. If the DICOM server does not allow the private data format within DICOM SR files, this feature should be disabled. • Signed Doppler velocities: send signed Doppler velocities. • Use older SR version: when checked a <i>Use older SR version</i> pull-down menu is displayed. The current exam data will be sent in the same format as the selected SR version. Details about format and content of the SR version can be found in the corresponding user manual of the selected version. See also 'DICOM SR' on <i>page 10-72</i>.

Default remote path setting

The user can define a default remote path for a network shared folder (\\server-name\share-name). The default remote path can then be selected as a destination archive for the following operations:

- Export traces function in Q-Analysis
- Export of system error log file
- Export of report templates
- Save as function for images
- Save as function for reports

To define a default remote path:

1. Press **Config** and log on as administrator if required.
2. Select the **Connectivity** category and **Remote Path** subgroup.
The *Remote Path* sheet is displayed.
3. In the *Export Path* section, enter a remote path of a shared folder on the network.
To check the connection, press **Check**.
4. In the *Configurable Remote Path User* section enter the user name and password required to access the shared folder.

The screenshot shows a software interface with a top navigation bar containing tabs: Imaging, Meas/Text, Report, Connectivity (selected), Security, System, and About. Below this is a sub-navigation bar with tabs: Network, DICOM, Dataflow, Transfer, Buttons, Tools, Remote Path (selected), Disk Management, Tricify, Printer, and Other. The main content area is titled 'Remote Path' and contains two sections. The first section, 'Export Path', has a text box for 'Export Path' and a 'Check' button. The second section, 'Configurable Remote Path User', has text boxes for 'User' and 'Password'. A note on the right states: 'NOTE: The default User/Password is always used as primary login credentials. No attempt is made to use the secondary credentials if login succeeds using the primary ones. This user and password are secondary credentials for remote path access. Remote paths can be set up for Export, Disk Management, Backup and Restore.'

Figure 10-84. The Remote Path sheet

XML Export configuration

The destination for transfer of patient records to XML formats must be configured prior to use. See 'Transferring patient records/examinations' on *page 10-83* for a description of the transfer function.

To configure the Transfer function:

1. Press **Config** and log on as administrator.
2. Select the **Connectivity** category and **Transfer** subgroup.
The *Transfer* sheet is displayed (Figure 10-85).
3. Select the dataflow **Export to XML**.

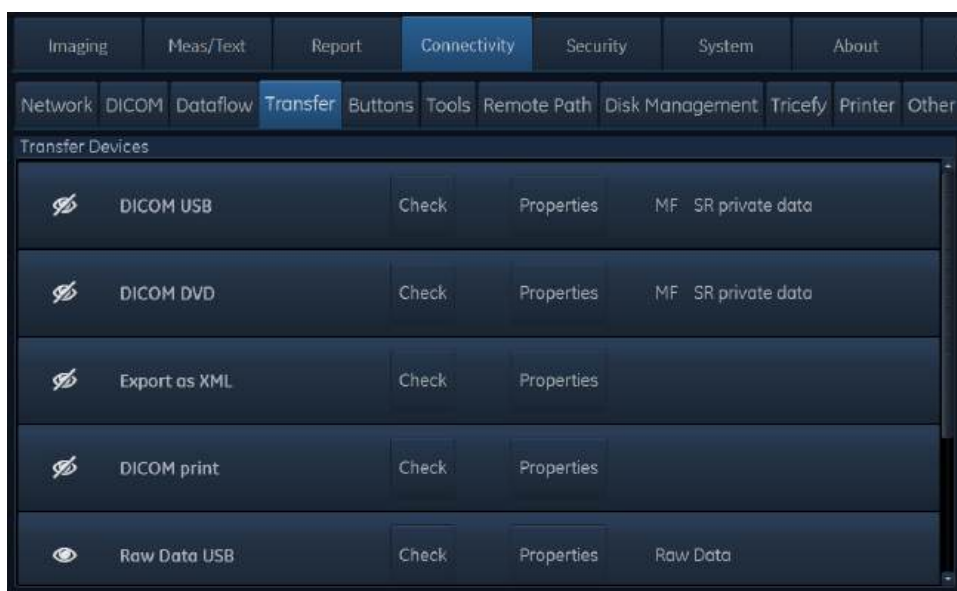


Figure 10-85. The Transfer sheet (Export to XML)

Transfer to XML format - configuration

1. Press **Properties** for the device **Export as XML**.
The corresponding properties window is displayed.

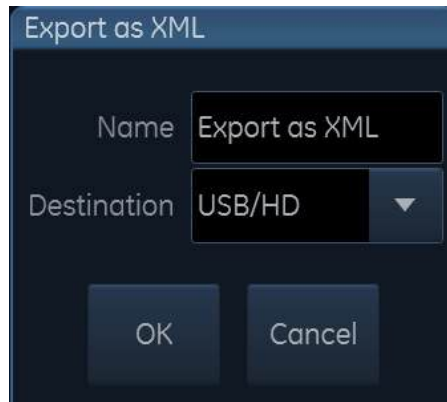


Figure 10-86. The Export as XML properties window

2. Select a removable media or a network volume remote path as the destination in the *Destination* pull-down menu.
3. If **Remote path** is selected, enter the remote path and press **Check** to verify the connection.
4. Select **OK** and press **Config**.

Patient ID

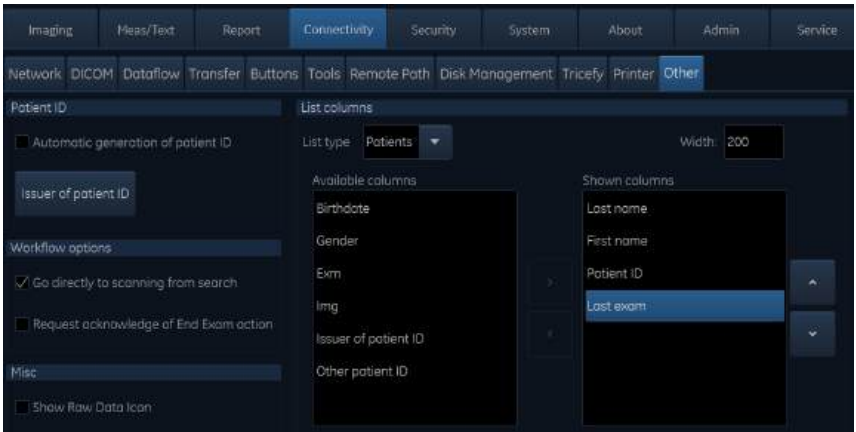


Figure 10-87. The Other sheet

Setting	Description
Automatic generation of patient ID	In the Archive screen (Figure 10-6 on page 10-18), the issuer of a patient id may be specified for a patient id. ☒: A Patient ID is automatically generated by the system. ☐: A Patient ID is required and must be entered by the user when creating a new patient record in the archive.
Issuers of patient ID	In the Archive screen (Figure 10-6 on page 10-18), the issuer of a patient id may be specified for a patient id. An issuer may be added, modified, or deleted. The issuer set as default will be used as issuer for all new patients that are created. In addition, in transfer between remote and local archive, two patients with same patient id, one with empty issuer and one with default issuer, are considered the same patient.

Database maintenance

1. Press **Config** and log on as administrator.
2. Select the **Security** category and **Audit** subgroup.
The *Audit* sheet is displayed.
3. Press **View Audit Log**.
The *Audit log viewer* window is displayed (see Figure 10-88).
4. Adjust the filters as required and press **Search**.
A log is generated showing the activity on the unit.

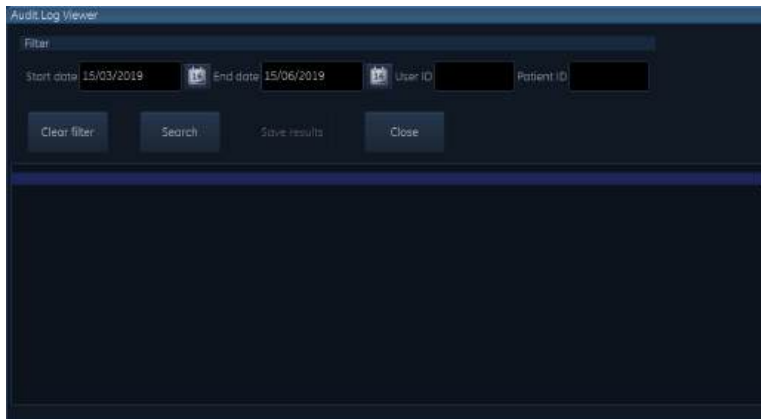


Figure 10-88. The Audit log viewer

5. Press **Save results** to save the log file.
The *Save as* window is displayed.
6. Select the destination media and enter a file name.
7. Press **Save** to save the log file.

Activity report

The Activity report function enables the creation of a report based on study type and user for a defined time frame.

1. Press **Config** and log on as administrator.
2. Select the **Admin** category and **Activity Report** subgroup.
The *Activity Report* sheet is displayed.
3. Press **View activity report**.
The *Activity report* window is displayed.
4. Adjust the time frame, select the type of studies and users.
5. Select whether to print or save the report as a file.
6. Press **Send** to create the report.

The screenshot shows the 'Activity Report' window. The 'Time frame' section has 'Last' selected with a value of '1' and unit 'months'. The 'Date range' section shows 'from 15/06/2019' and 'to 15/06/2019'. The 'Activities to be reported' section contains a grid of checkboxes for various study types and age groups. The 'Show activities for' section has checkboxes for 'Sonographer (operator)', 'Referring physician', 'Diagnosing/reading physician', 'Lab', and 'Ward/Department'. The 'Report settings' section shows 'Template: Standard landscape' and 'Send to: Printer'. At the bottom are 'Preview', 'Send', and 'Close' buttons.

Figure 10-89. The Activity report window

Unlock patients

If for any reason an examination is not properly finished, the patient record is locked and cannot be opened again unless it is unlocked.

To unlock patient records:

1. Press **Config** on the touch panel.
2. Select the **Connectivity** category and the **Tools** subgroup.
3. In the *Tools* sheet, select the patient record(s) to unlock.
You can search for a specific patient record or a group of patient record using the searching filters.
4. Select **Unlock** to unlock the selected patient record(s) or select **Unlock all** to unlock all patient records listed.
A *Confirmation* window is displayed.
5. Select **OK**.

Patient management presets

The following settings related to patient management can be adjusted in **Connectivity > Other** subgroup:

Setting	Description
Request acknowledge of End Exam action	☒ : The user is asked to confirm action when ending an examination.
Go directly to scanning from search	☒ : The unit goes directly to the <i>Scanning</i> screen after creating a patient record. ☐ : The unit displays the <i>Patient info and exam</i> screen after creating a patient record for further information entry. The user must press Patient or one of the scanning keys on the Control panel to enter the <i>Scanning</i> screen.

Chapter 11

Report

This chapter describes:

‘Creating a Report’ on page 11-3

‘Working with the Report Function’ on page 11-4

‘Structured Findings’ on page 11-10

‘Report Designer’ on page 11-31

‘Report Templates Management’ on page 11-50.

Introduction

The system enables the creation of patient and examination reports containing measurements, images and analysis that were made during the examination. The layout of the reports is defined by generic templates delivered with the system. Custom templates can also be made.

Saved reports are *read-only*. Therefore it is recommended that the data is carefully reviewed before the report is saved. Use the worksheet to facilitate the review and adjustment of data before generating a report. The final report can be printed on a regular printer.

Creating a Report

Reports summarize data obtained in the examination. They can contain data and images.

Once generated, the report can be viewed, images can be added, wall segment diagrams can be assigned and text can be entered in the free text fields. All other information must be changed from the *Patient info and exam* screen, the *Worksheet* screen or the *Structured Findings* screen.

Working with the Report Function

To open a report

1. Press **Report** (available from the *Patient info and exam* screen, *Worksheet* screen or from the *Shortcut Bar*).

The default template for the current examination is displayed as below. The information entered during the examination is automatically filled in (e.g. Demographic, Diagnosis, Comments...etc.).

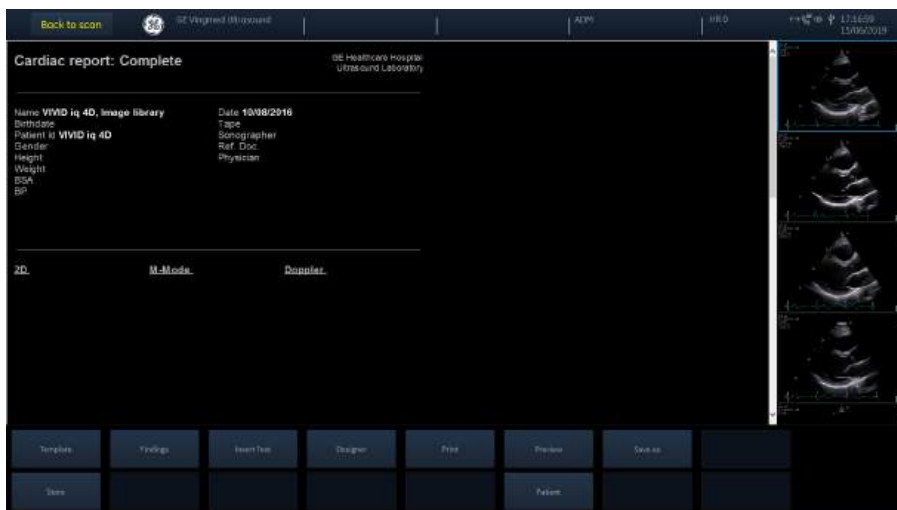


Figure 11-1. The Report screen

To choose another report template

1. Press **Template**.
The *Template selection* menu is displayed showing the available report templates organized by application.
2. Do the following:
 - Select a template from the current application template list.The selected template is displayed on the screen.

To change patient information

1. Select the heading of the information to change.
The *Patient info and exam* screen is displayed.
2. Change the information as required.
3. Press **Report** when completed.
The user is asked to confirm the changes.
4. Select **Save** to save the change or **Discard** to abort.

Images in the report

1. To add an image to the report, place the pointer over an image in the clipboard and press the trackpad.
The image is inserted into the first free image container in the report.
2. To remove an image from the report, press the image in the container.

To print a report

Only members of the user group “Cardiologist” are allowed to print a report (see ‘System Users’ on *page 4-61*).

1. Press **Print**.
The report is printed on the default printer. A status window is displayed showing the printing process.
For printer configuration, see page 13-11.

To store a report

Only members of the user group “Cardiologist” are allowed to store a report (see ‘System Users’ on *page 4-61*).

1. Press **Store**.

The report is stored in the Report archive.

Alternative storage

Reports can also be saved in a user-defined locations in the following formats:

- **Compiled HTML (.CHM) files:** readable from Internet Explorer.
- **Portable Document Format (.PDF) files:** readable with Adobe Acrobat reader.
- **Text (.TXT) files:** only text data is saved; readable with a text editor.

1. Press **Save as**.

The *Save as dialogue* window is displayed.

2. Select the destination folder from the *Save in archive* pull down menu.

NOTE: To configure the default remote path, see ‘Default remote path setting’ on *page 10-129*.

3. Select **PDF**, **CHM** or **TXT** format.
4. Press **Save**.

Retrieving an archived report

1. Press **Retrieve**.

A list of the available reports for the actual examination is displayed.

The default name for a report is of type:
<template type>_<store date>_<store time>.

2. Select the report to retrieve.

*NOTE: To display the current report, select **Show active exam**.*

Retrieving a DICOM PDF report

The system supports read-only access to DICOM PDF reports created on a DICOM server.

1. To select patients containing DICOM PDF reports, use the **DICOM Query retrieve - DICOM server** dataflow.
2. To view the report, select **Report** and press **Retrieve**. A list of the available reports for the actual examination is displayed, including DICOM PDF reports.
3. Select the report to retrieve.

The retrieved DICOM PDF report is read-only and is shown in a separate window.

NOTE: The report will be automatically closed if the user selects any other screen than Analysis.

The patient containing DICOM PDF reports can be transferred from DICOM Server to Local Archive. Use **DICOM Query retrieve** as source and **Local Archive Int. HD** as destination.

NOTE: If the patient containing DICOM PDF report is transferred to any dataflow except Local Archive Int. HD, the report will not be available when the patient is opened in the destination dataflow.

Deleting an archived report

Only members of the user group “Cardiologist” are allowed to delete a report (‘System Users’ on *page 4-61*).

1. Press **Delete**.

A list of the available reports for the actual examination is displayed.

The default name for a report is of type:

<template type>_<store date>_<store time>.

2. Select the report to delete.

NOTE: DICOM PDF reports cannot be deleted.

Structured Findings

Introduction

Structured Findings is a feature that enables the user to insert pre-configured structured diagnostic statements and codes (e.g Billing, Accreditation) in the patient report and create a conclusion based on the inserted statements.

Prerequisite

To be able to insert structured diagnostic statements and create a conclusion in a patient record, the report template used must have assigned fields for the structured findings, the codes and the conclusion.

NOTE: *Factory templates have Findings and Conclusion fields.*

To create the assigned fields in a user-defined report template:

1. Press **Report**.
2. Press **Template** and select the desired report template.
3. Press **Designer**.
The *Report designer* screen is displayed.
4. Select the location in the report template where to insert the Structured findings fields and double click the trackpad.
5. Select **Insert** and **Archive Information**.
The *Archive information* box is displayed (Figure 11-2).
6. Select **Select All** under all three parameter fields in the *Archive information* box to deselect all parameters.
7. Select **Structured findings**, **Findings conclusion**, **Indication codes** and **Billing codes** in the *Exam Information* field (Figure 11-2).
8. Select **OK**.
9. Save the Report template and exit the Report designer.

Prerequisite (continued)

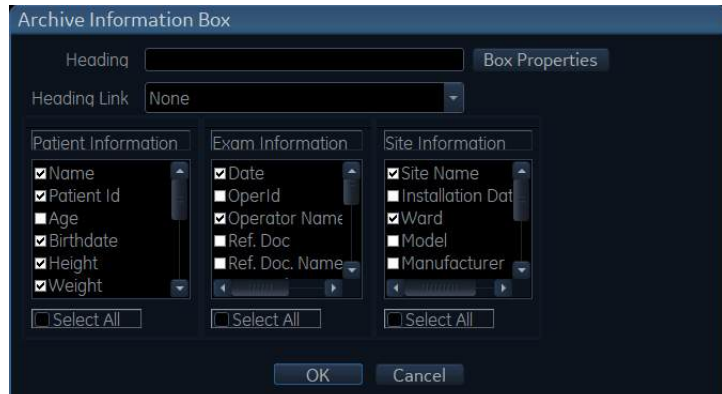


Figure 11-2. The Archive information box

Starting Structured Findings

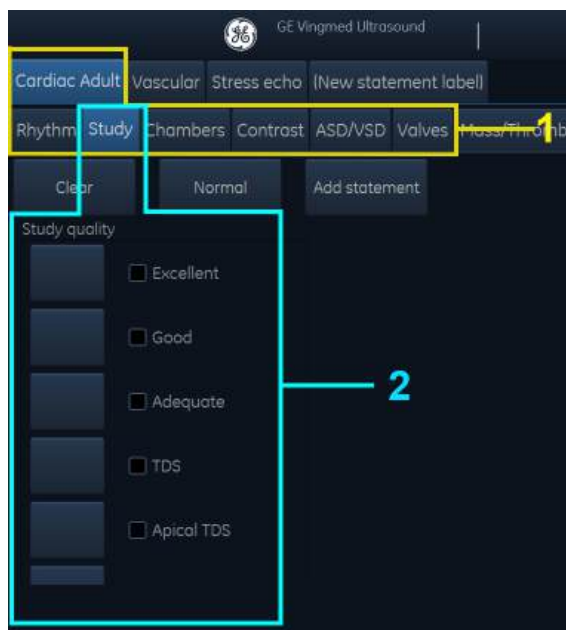
1. Press **Report**.
Make sure the current template has a Structured Findings field and a Conclusion field defined or select another template if necessary.
2. Press **Findings** or select the header of the Findings box in the report.

The *Structured Findings* window is displayed.

Structured Findings structure

The diagnostic statements are organized in tab folders (see Figure 11-3). Each tab folder may contain:

- Underlying tab folders that contain Tab sheets.
- Tab sheets that contain diagnostic statements.



1. Tab folder with underlying tab sheets
2. Tab sheet

Figure 11-3. Structured findings structure

There are three types of diagnostic statements (see Figure 11-4):

Structured Findings structure (continued)

- Check box statement: when selected the statement is included in the report.
- Combo box statement: create a statement by selecting one alternative text among several choices.
- Statement group: create several statements by selecting multiple check box statements.

The figure consists of three screenshots of the Vivid iq interface, each illustrating a different type of diagnostic statement:

- 1. Check box statement:** The first screenshot shows a single checkbox labeled "Normal LV" with a blue arrow pointing to it.
- 2. Combo box statement:** The second screenshot shows a "Left Ventricle" section with a dropdown menu. The selected option is "Normal LV", and the text "LV size, wall thickness and systolic function are normal, with an EF greater than 55%" is displayed. A blue arrow points to the dropdown menu.
- 3. Statement group:** The third screenshot shows a "Study quality" section with a list of checkboxes: "Excellent", "Good", "Adequate", "TDS", and "Apical TDS". A blue arrow points to the "Adequate" checkbox.

1. Check box statement
2. Combo box statement
3. Statement group

Figure 11-4. Diagnostic statement types

Using Structured Findings

1. Start Structured Findings (see page 11-11).
2. Browse to the tab sheet containing the statements of interest.
3. To insert a statement in the report (Findings field):
 - Check box statement: select the statement.
 - Combo box statement: select an alternative text in the combo box next to the statement.
 - Statement group: select the statements of interest within the group.

A preview of the selected statement(s) is displayed in the *Findings preview* field. The statement text in the preview field can be edited. This will apply only for the current report. Once a statement is selected an asterisk is displayed on the tab of the current sheet and folder.

NOTE: Select **Normal** to select only normal statements from the current tab sheet (see page 11-22 for more information on how to define normal statements).

NOTE: Select **Clear** to deselect all statements from the current tab sheet.

To insert a conclusion statement in the report:

- Press the **Conclusion** button in front of the statement of interest.

Using Structured Findings (continued)

A preview of the selected conclusion statement is displayed in the *Conclusion preview* field. Conclusion statements are displayed in a numbered list.

The list can be reordered: triple-click on the conclusion statement to move in the *Conclusion preview* field and use the **Arrow up** or **Arrow down** key to move the statement up or down.

The conclusion text in the preview field can be edited. This will apply only for the current report.

To display the changes in the report, select **Refresh report**.

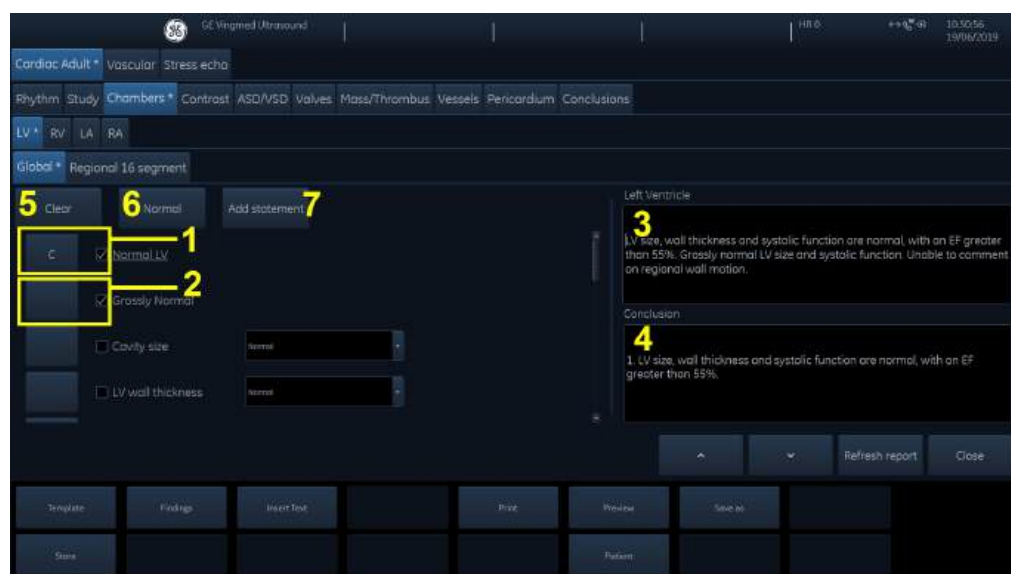
4. Press **Close**.

The report for the current patient is displayed with the selected findings, conclusion statement(s) and associated codes (if any).

NOTE:

Some diagnostic statements have measurements values in the body text referred by a tag (e.g the {EF} tag refers to EF measurement). These statements require that the actual measurement is done to display correctly in the report.

Using Structured Findings (continued)



1. Statement inserted in the Conclusion and Findings field.
2. Statement inserted in the Findings field only.
3. Findings preview field
4. Conclusion preview field
5. Remove all selections.
6. Insert normal findings for the current tab sheet.
7. Create and add a statement. The statement will be available only for the current examination.

Figure 11-5. Structured Findings window

Global selection of normal statements

It is possible to select all normal statements from all tab sheets belonging to the current top tab sheet.

1. Place the cursor in the *Statement* field, select **Normal**.

All statements defined as normal are selected from all the tab sheets. An asterisk is displayed on the tab of all the tab sheets that contain normal statements.

NOTE: This operation will remove any other “non-normal” previously selected statements.

2. To remove all statements at once, place the cursor in the *Statement* field, select **Clear**.

Structured Findings configuration

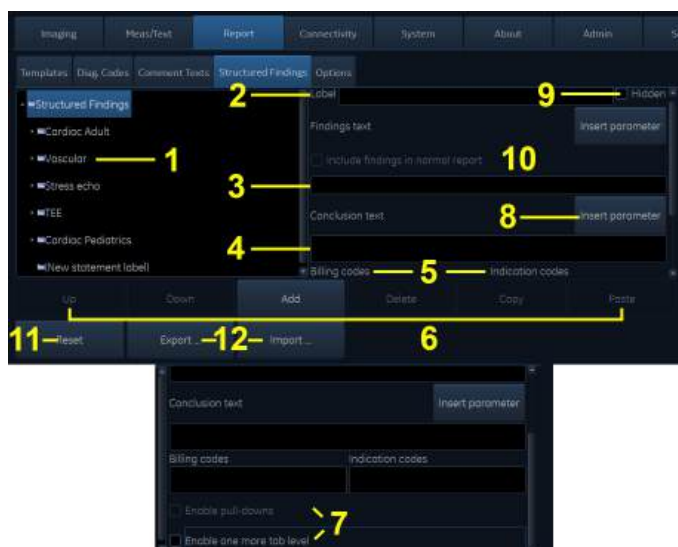
Structured Findings configuration is used to:

- Create, edit or delete finding statements, conclusion statements and codes.
- Organize the diagnostic statements in the *Structured Findings* screen.
- Define the normal diagnostic statements.

Accessing the Structured Findings configuration screen

1. Press **Config** and select the **Report** category.
2. Select the **Structured Findings** tab.

The *Structured Findings* configuration screen is displayed (Figure 11-6).

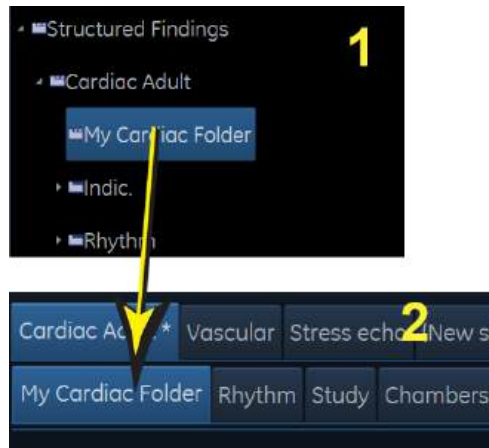


1. Structured Findings structure tree:
2. Tab or statement label
3. Findings text
4. Conclusion text
5. Codes for the selected statement
6. Create, move, copy or delete statement
7. Create folder, Combo box or statement groups
8. Enter a variable in statement or conclusion text
9. Hide selected tab or statement from the Structured Finding window
10. Set the selected statement as normal
11. Reset factory default findings
12. Export/import findings.

Figure 11-6. Structured Findings configuration screen

Creation of a tab folder

The following procedure describes how to create a new top level tab folder.



1. Configuration window
2. Structured findings window

Figure 11-7. New tab folder

Creation of a tab folder (continued)

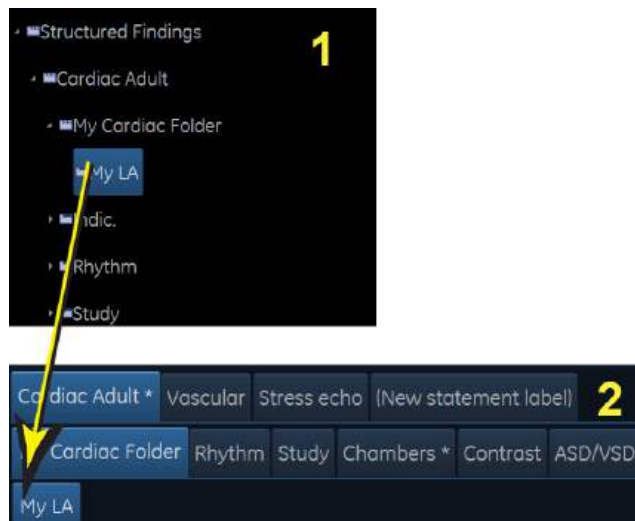
1. In the *Structured Findings* configuration window (Figure 11-6), select the Structured Findings tab folder.
2. Select **Add**.
A new entry is created in the Structured Findings tab folder. The new entry is by default a tab sheet (.
3. Select **Enable one more tab level** to change the new entry to a tab folder (.
4. With the new entry selected, follow the following steps:
 - Enter a name in the *Label* field (tab name).
 - Enter a description in the *Findings text* field. The description will be displayed in the report as a heading when selecting a statement from the underlying tab sheets. The system is always using the Findings text from the highest item in the structure as a heading for the selected underlying statements.
 - Enter the appropriate codes.

NOTE: *To enter several codes separate each code by a space.*

5. Press **Up** or **Down** to move the tab in the structure tree (or do drag and drop).

Creation of a tab sheet

The following procedure describes how to create a tab sheet in a tab folder.



1. Configuration window
2. Structured findings window

Figure 11-8. New tab sheet

1. Make sure that the tab folder is selected and press **Add**.
A new entry is created in the tab folder. The new entry is by default a tab sheet (📄).
2. With the new entry selected, follow the following steps:
 - Enter a name in the *Label* field (tab name).
 - Enter a description in the *Findings text* field.

If required:

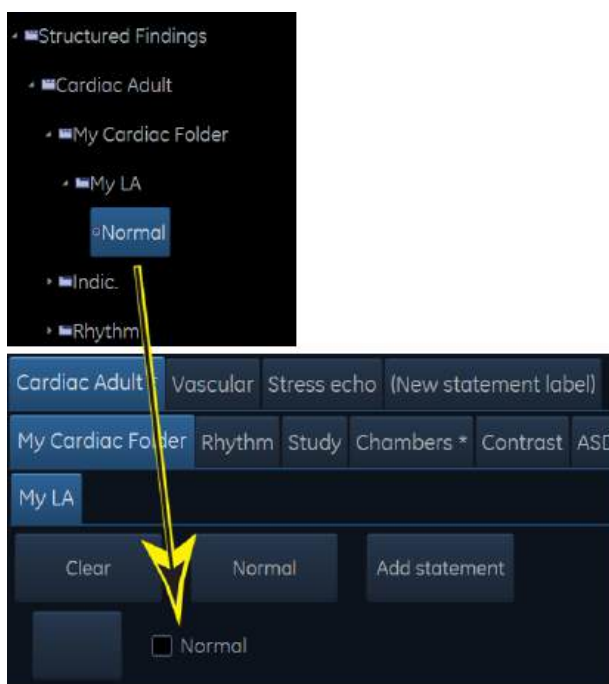
- Enter the appropriate codes.

NOTE: To enter several codes separate each code by a space.

Adding statements in the tab sheet

Check box statement

The following procedure describes how to create a check box statement.



1. Configuration window
2. Structured findings window

Figure 11-9. New check box statement

1. Make sure that the tab sheet is selected and press **Add**.
A new entry is created in the tab sheet. The new entry is by default a check box statement.

Check box statement (continued)

2. With the new entry selected, follow the following steps:

- Enter a name in the *Label* field (statement name).
- Enter the full statement in the *Findings text* field.
- Enter a conclusion in the *Conclusion text* field (optional).

NOTE: If the Conclusion text field is left empty, the statement text will be used as conclusion when selected.

If required:

- Enter the appropriate codes.

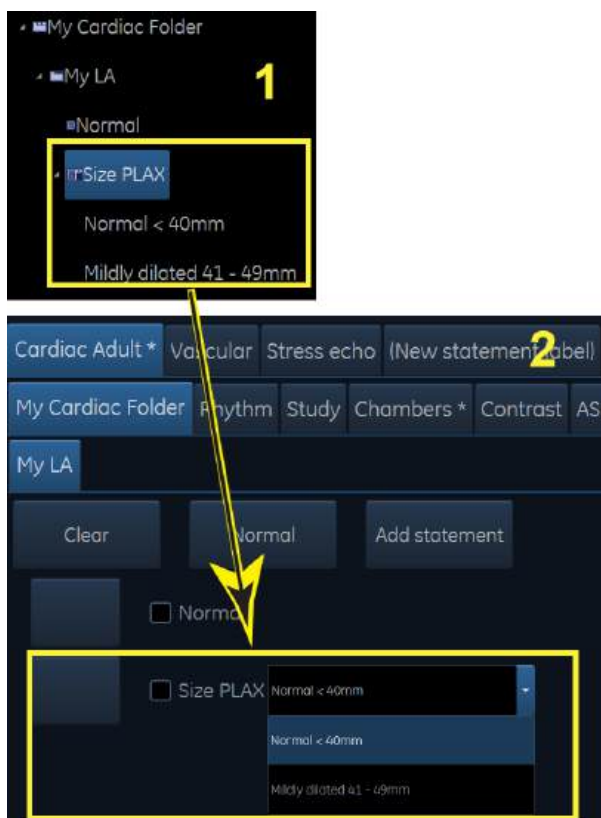
NOTE: To enter several codes separate each code by a space.

- Check **Include findings in normal report** to define the statement as normal.

All statements within the selected tab sheet that have this option checked will be included in the report when **Normal** is selected in the *Structured Findings* window (see 'Using Structured Findings' on page 11-14).

Combo box statement

The following procedure describes how to create a combo box statement.



1. Configuration window
2. Structured findings window

Figure 11-10. New combo box statement

Combo box statement (continued)

1. Create a new statement as described above. A check box statement is created by default.
2. With the new statement selected, press **Add**.
A new underlying entry is created and the parent statement is changed to a Combo box statement ().
3. With the new underlying entry selected, follow the following steps:
 - Enter a name in the *Label* field.
 - Enter a text in the *Findings text* field.
 - Enter a conclusion in the *Conclusion text* field (optional).
4. Repeat the procedure from step 2 to create as many underlying statements as necessary. Each underlying statement will be a selectable entry in the combo box.

Inserting variable parameters in a statement

Variable parameters such as patient name, institution name, measurement values...etc can be inserted in a statement as tagged information.

To insert variable parameters in a statement:

1. Place the cursor at the required position in the *Findings text* field (or *Conclusion text* field).
2. Press **Insert parameter**.

The *Insert parameter* window is displayed (see Figure 11-11).

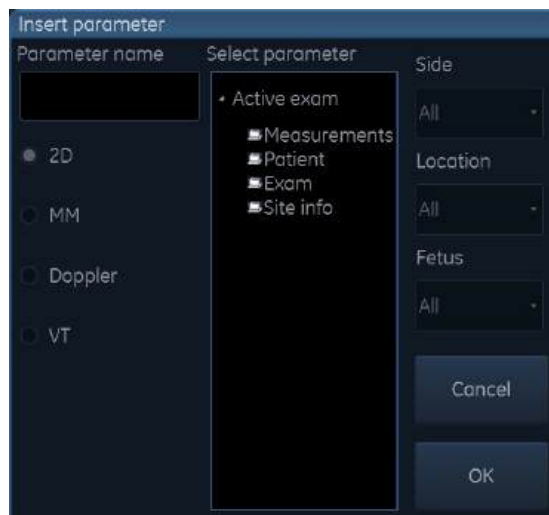


Figure 11-11. Insert parameter window

Inserting variable parameters in a statement (continued)

- 3. Browse and select the actual parameter to insert.

NOTE: For measurement values, select first the scanning mode.

- 4. Press **OK**.

NOTE: To display correctly in the report, the actual parameter value must exist, e.g. if a measurement value is included in a statement as a variable parameter, a measurement value must exist for the current patient, otherwise the parameter name is displayed.

- 5. If the selected parameter can be measured/calculated by different methods, the user is asked to select the preferred parameter to insert. Move the preferred parameter as first item in the list displayed and select **OK**.

The selected parameter is inserted in the statement as a tag (e.g the {EF} tag refers to EF measurement)

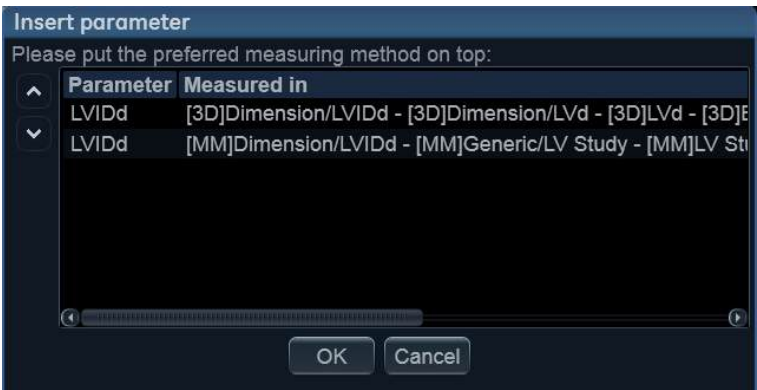


Figure 11-12. The parameter list

Copy of a statement

Tab folders, tab sheets and statements can be copied from one location to another. The word “Copied” is added to the copied item name.

1. In the *Structured Findings* configuration window (Figure 11-6), select the item to copy.
2. Select **Copy**.
3. Select the item to contain the copy.
4. Select **Paste**.

Deletion of a statement

Tab folders, tab sheets and statements can be deleted.



CAUTION

Deletion cannot be undone.

1. In the *Structured Findings* configuration window (Figure 11-6), select the item to delete.
2. Select **Delete**.

The selected item is deleted.

Factory reset

All statements can be reset back to the factory default.



CAUTION

Factory reset cannot be undone.

1. Select **Reset**.
The *Reset statements* window is displayed.
2. Select:
 - **Yes** to reset all statement to the factory default (No undo).
 - **No** to cancel the operation.

Exporting/Importing statements

Diagnostic statements can be exported from one system and imported on another system.

Exporting statements

1. In the *Structured Findings* configuration window (Figure 11-6), select **Export**.
A browsing window is displayed.
2. Browse to a destination and select **Save**.

Importing statements

1. In the *Structured Findings* configuration window (Figure 11-6), select **Import**.
A browsing window is displayed.
2. Browse to a destination and select **Open**.
3. Select one of the following options:
 - **Insert**: the statements are imported in a new top tab sheet, keeping the current statements in place.
 - **Replace**: the imported statements replace the existing ones.
 - **Cancel**: cancel the import.

Report Designer

Introduction

The Report designer software package enables the user to create report templates that best suit its needs.

Designing a report template consists of choosing the information to display in the report (e.g. header, footer, logo, patient information, images, measurements...etc.) and arrange it in the report viewer.

The Report designer function is based on the information container concept: each type of information is included within a container with parameters that can be configured (size, color, font properties, information to display...etc.).

Accessing the Report designer

1. Press **Report**.

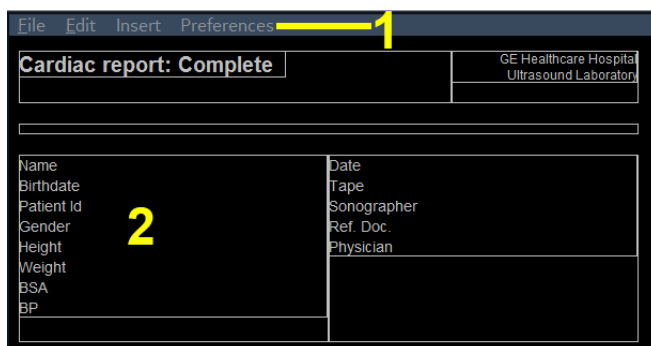
The *Report* screen is displayed.

2. Press **Designer**.

The *Report designer* screen is displayed with the selected template in the *Report template design area* (see Figure 11-13).

Report designer overview

The Report designer screen



1. Menu bar
2. Report template design area

Figure 11-13. The Report designer screen

The menu bar

Menu	Description
File	• New: start working on an new template. • Save: save the template using the same name. Factory report templates cannot be overwritten. • Save as: save the template using a new name. • Page setup: define printing orientation and header/footer for the printed report. • Print Preview: display a print preview of the report template. • Exit: exit the Report designer and returns to the report function. The user can choose whether to save the updates or restore the original template.

Menu	Description
Edit	• Delete: remove the selected object from the report template. • Undo: restore the previous state of the report template.

Menu	Description
Insert	• Page Break: insert a new page in the report template. • Table: configure and insert a table in the report template. • Logo: select and insert a logo to the report template. • Archive info: select and insert data from the following categories: Patient information Exam information Site information • Anatomical graphics: select and insert an anatomical graphic (cardiac, vascular or TEE). • Image: create a container for the display of ultrasound images. • Wall motion analysis: insert a container for the display of Stress Echo analysis results (cut planes Bull's eye and scoring table). • OB/GYN: insert OB graph. • Measurements: insert a container for the display of measurements and calculations. When creating a measurement container, the user is prompted through a configuration procedure enabling the selection of mode specific measurements and/or calculations. • Text field: insert a container where the user can write in the report. • Fixed text: insert a container with static text. The text typed during the creation of the container will be displayed in the report.

Menu	Description
Preferences	• Page Color: sets the default background color for the template page.

Designing a report template

Starting template designing

1. Start the Report designer (see page 11-31).
2. Press **File** and select **New** to display a blank page or use the current report template as basis template.

Setting the layout preferences

Adjusting the report page color background

1. Press **Preferences** and select **Page Color**.
The *Color selection* window is displayed.
2. Select the desired color.
3. Press **OK**.

Header and footer in the printed report

This function is described on page 11-46.

Inserting an information container in the report template body

The different types of information to be included in a report are grouped in information containers. Designing a report template consists in inserting and configuring the different information containers in the template page in an ordered manner.

Information containers can be inserted either:

- Directly into the report template body: this procedure does not allow side-by-side insertion, the information container will normally cover the width of the report template page.
- Within a table: this procedure allows side-by-side insertion of several information containers.

Inserting a table

1. Place the cursor at the desired insertion point in the *Report template design area*.
2. Press **Insert** and select **Table**.
3. Adjust the parameters as desired.
4. Press **OK**.

The table is displayed in the template.

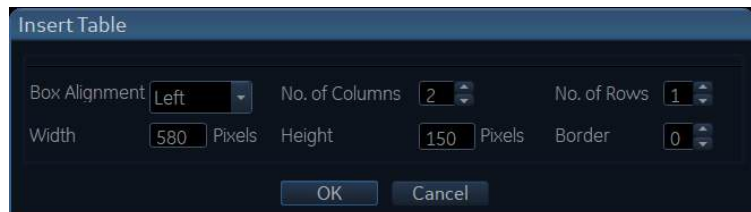


Figure 11-14. The Table properties window

Inserting a logo

1. Provide the hospital logo in JPEG or Bitmap format onto a removable media.
 2. Select the location where to insert the logo (a table cell or directly in the report template).
 3. Select **Insert** and **Logo**.
- The *Logo* box is displayed.

Inserting a logo (continued)



Figure 11-15. The logo box

4. Select a logo, or if not available, select **Import logo**.
Browse and select the logo and select **OK**.
5. Specify the appearance.
6. Select **OK**.

Inserting fixed text

Fixed text is an entry that cannot be changed in the report (e.g. hospital information).

1. Select the location where to insert the fixed text (a table cell or directly in the report template).
2. Select **Insert** and **Fixed text**.
The *Fixed text* box is displayed.

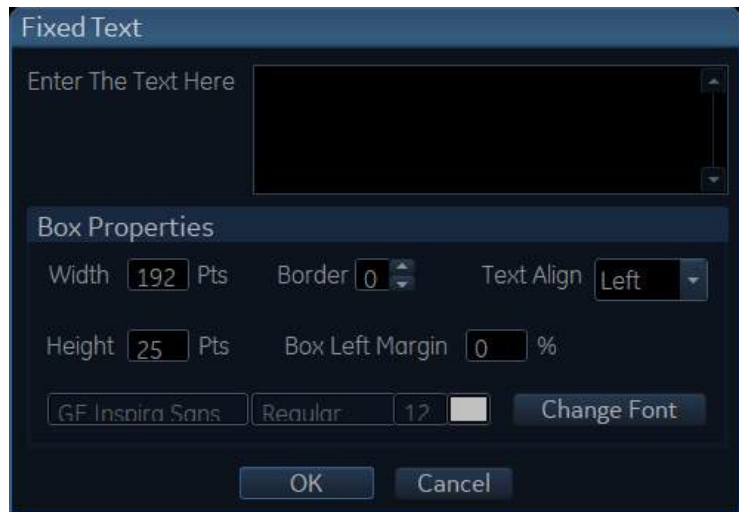


Figure 11-16. The Fixed text box

3. Enter the text and specify the appearance.
4. Select **OK**.

Inserting archive information

Archive information contains all the objects of the different information menus (Patient, Exam, Study and Site Information).

You may display the archive information over two columns using a table container as described below.

1. Insert a table for the archive information to the desired location (a table cell or directly in the report template).
2. Select the first table cell.
3. Select **Insert** and **Archive information**.

The *Archive information* box is displayed.

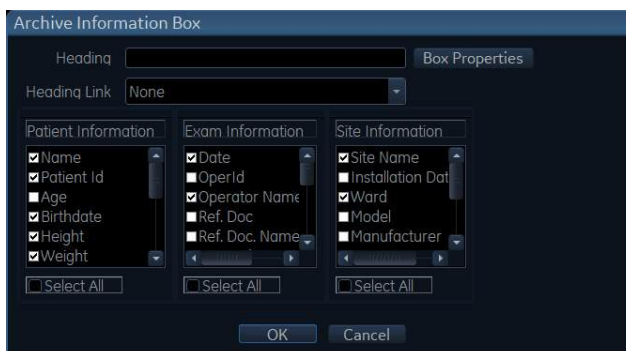


Figure 11-17. The Archive information box

4. If desired, enter a heading and select a heading link from the pull-down menu.
5. Select the Information parameters to be displayed in the first cell.
Select **Box properties** to change the font, alignment, appearance, etc.
6. Select **OK**.
7. Select the next table cell and repeat steps 3 to 6 to enter the remaining archive information.

Inserting an Image container

- Select the location where to insert the fixed text (a table cell or directly in the report template).
- Select **Insert** and **Image**.
The *Ultrasound image* box is displayed.

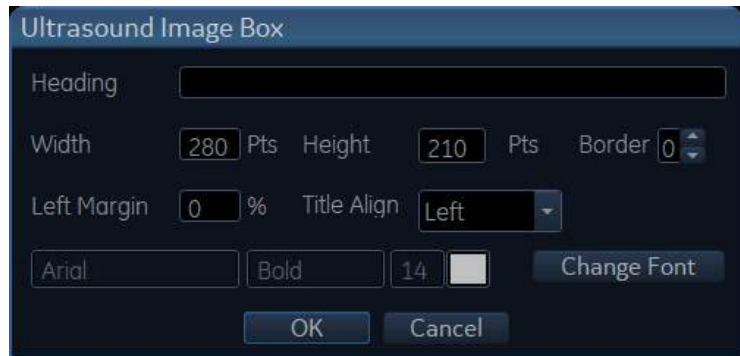


Figure 11-18. The Ultrasound image box

- If desired, enter a heading, set the container size and specify the text appearance.
- Select **OK**.

Inserting a measurement container

You may display the measurements over several columns using a table container as described below.

1. Insert a table for the measurements to the desired location.
2. Select the first table cell.
3. Select **Insert** and **Measurements**.
The *Measurements* box is displayed.

Inserting a measurement container (continued)

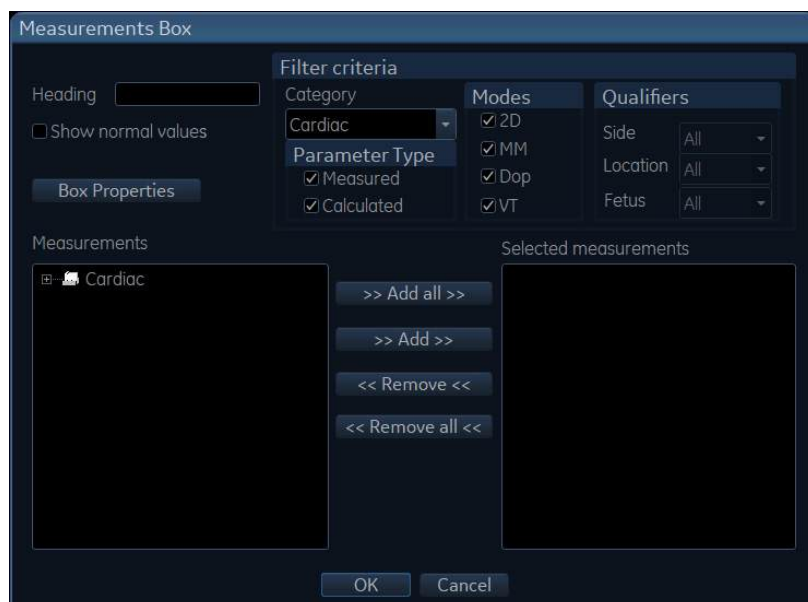


Figure 11-19. The Measurements box

4. Enter a heading (e.g. 2D).
5. Using the *Filter criteria*, define the type of measurements to be displayed (e.g. Cardiac, 2D, measured and calculated).
Select **Show normal value** to display user-defined Normal value next to the measurements in the Report (see 'Normal values' on page 8-226 for more information).

NOTE: *References for the normal values can be displayed in the report by checking **Normal value references** from **Insert -> Archive Info** (see page 11-38).*

The *Measurement* list on the left side is updated.

Inserting a measurement container (continued)

6. From the measurement list, select the measurement to insert and press **Add**. Both single measurements or a folder may be added.
7. The list of the inserted measurements is displayed in the *Selected measurement* list on the right side.
8. Press **OK**.
9. Select the next table cell and repeat steps 3 to 8 to insert several measurements.

Inserting Text fields

Text fields are:

- Containers for Referral reasons, Comments and Diagnosis information.
 - Containers for free text, where the user can type information in the report.
1. Select the location where to insert the text field container (a table cell or directly in the report template).
 2. Select **Insert** and **Text field**.
The *Text field* box is displayed.

Inserting Text fields (continued)

Text Field

Heading

Arial Bold 14 **Change Font**

Display ☒ Ref. Reasons ☐ Free Text 1 ☐ Free Text 5
☐ Comments ☐ Free Text 2 ☐ Free Text 6
☐ Diagnosis ☐ Free Text 3 ☐ Free Text 7
☐ Free Text 4 ☐ Free Text 8

Width Pts Border Height Pts

Left Margin % Title Align

Data
Arial Regular 14 **Change Font**

OK Cancel

Figure 11-20. The Text field box

3. Enter a heading.
4. From the *Display* field, select between:
 - **Referral reasons:** displays the information entered in the *Patient info and exam* window.
 - **Comments:** displays the information entered in the *Patient info and exam* window.
 - **Diagnosis:** displays the information entered in the *Patient info and exam* window.
 - **Free text 1-8:** creates an empty free text container.
5. If desired, adjust the font settings for the header and data.

Inserting Wall motion scoring analysis containers

Two different containers must be inserted for the Wall motion scoring analysis:

- A Wall motion scoring diagrams container (Cut planes or Bull's eyes)
- A Wall motion scoring table

Inserting Wall motion scoring diagrams container

1. Select the location where to insert the free text container (a table cell or directly in the report template).
2. Select **Insert, Wall motion analysis** and select between **Cut planes** and **Bull's eye**.

The corresponding *Wall motion scoring* box is displayed.

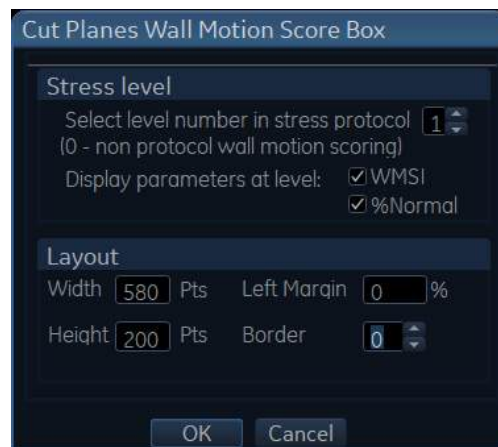


Figure 11-21. The Wall motion scoring box (Cut planes)

3. Adjust the parameters and select **OK**:

The scoring diagrams are inserted in the report template

Inserting Wall motion scoring table container

1. Place the cursor right below the *Wall motion scoring diagrams* container.
2. Select **Insert**, **Wall motion analysis** and select **Score table** box.

The *Score table* box is displayed.

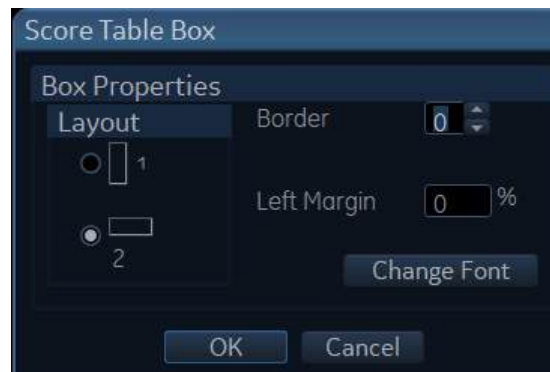


Figure 11-22. The *Score table* box

3. Adjust the layout parameters in the *Score table* box and select **OK**.

The *Score table* is inserted in the report template.

Editing the information container

Resizing the information container

1. Move the cursor over the container to resize and press **Set**, the container is highlighted.

Move the cursor over the border of the container to resize, the mouse cursor is changed to an arrow ↔ .

2. Press and hold down **Set**, use trackpad to drag the container border.

The container is displayed with anchor squares on the sides and at the corners.

Editing the information container properties

1. Double-click in the container to edit and select **Properties**. The *Properties* window is displayed.
2. Adjust the parameters specific to the selected container.

NOTE: *Some information containers have additional parameters that may be adjusted by selecting **Box properties**.*

Inserting a new page

1. Place the cursor at the desired insertion point in the *Report template design area*.
2. Press **Insert** and select **Page Break**.

Inserting header and footer

Header and footer may be defined to be displayed in the printed report. The header and footer are not visible in the on screen report.

To insert header and footer in the printed report:

1. Select **File** and **Page setup**.
The Page setup box is displayed.

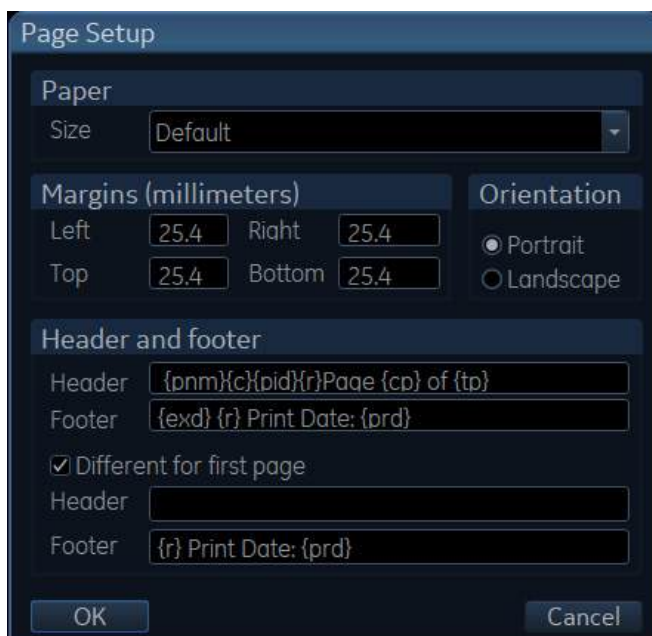


Figure 11-23. The Page setup box

Inserting header and footer (continued)

2. Adjust the printing orientation.
3. Define the header and footer for the printed report, by typing text and entering the required variables listed in the table below.

Check **Different on first page** and create a specific header/footer for the first page.

4. Select **OK**.

To check the display of the header and footer, select **File** and **Print preview**.

Variable	Description
{pid}	Patient ID
{pnm}	Patient name
{pdb}	Patient date of birth
{exd}	Examination date
{prd}	Current date (printing date)
{prt}	Current time (printing time)
{cp}	Current page
{tp}	Page count
{c}	Subsequent entries are centered
{r}	Subsequent entries are right aligned

Saving the report template

Replace an existing template

Factory templates cannot be overwritten.

1. Press **File** and select **Save**.
A dialogue window is displayed asking for confirmation.
2. Select:
 - **Yes** to save the report template
 - **No** to discard the report template
 - **Cancel** to go back to the Report designer without saving the report template.

Save existing template with a new name

1. Press **File** and select **Save as**.
The *Save as template* window is displayed.

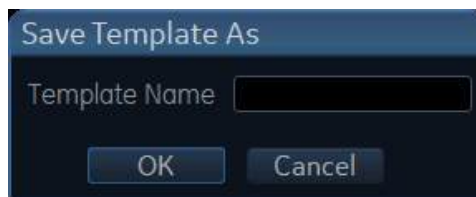


Figure 11-24. The Save as template window

2. Enter a name for the template.
3. Press **OK**.
The template is saved.

To exit the Report designer

1. Select **File** and **Exit**.
The *Exit* window is displayed.
2. In the *Exit* window, select:
 - **Yes**: to save the report template and exit the application.
 - **No**: to exit the application without saving the changes made in the report template.
 - **Cancel**: to return to the application.

Report Templates Management

Introduction

This section describes:

- Configuration of the *Template selection* menu.
- Deletion of user-defined report templates.
- Export/import of user-defined report templates.

The report templates management is done from the *Report templates* sheet in the system configuration package.

To access to the *Report templates* sheet:

1. Press **Config** and select the **Report** category.

The *Report category* sheet is displayed.

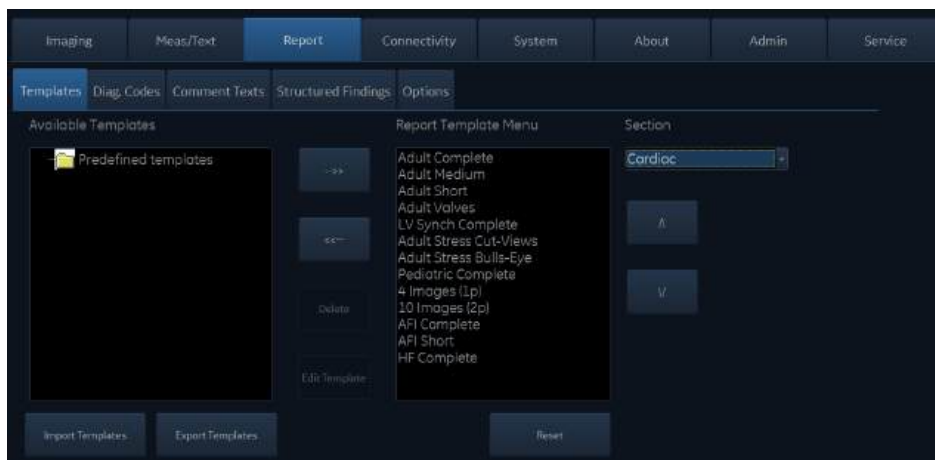


Figure 11-25. The Report templates sheet

Configuration of the Template selection menu

The *Template* selection menu displays the application specific report templates that can be selected when creating a report. The *Template* selection menu can be configured to display only the templates of interest.

Inserting a template in the Template selection menu

1. Press **Config** and select **Report**.
The *Report templates* sheet is displayed (Figure 11-25)
2. In the *Available templates* field (left field), select the template to insert in the *Template* selection menu.
3. Next to *Section*, select the appropriate application.
4. Press the **Right arrow button** .

The selected template is inserted in the *Template* selection menu.

NOTE: *Double-clicking on a template in the Available template field will also insert the template in the Template menu.*

Removing a template from the Template selection menu

1. In the *Report template menu* field (right field), select the template to remove.
2. Press the **Left arrow button** .

The selected template is removed from the *Template* selection menu.

NOTE: *Double-clicking on a template in the Report template menu field will also remove the template from the Template menu.*

Sorting the templates in the Template selection menu

1. In the *Report template menu* field, select the template to move.
2. Press the **Up** or **Down arrow buttons**  .

The selected template is moved accordingly in the *Template* selection menu.

Deleting a report template from the system

Only user-defined report templates can be deleted from the system.

1. In the *Available templates* field (left field), select the report to delete (Figure 11-25).
2. Press **Delete**.
A Confirmation window is displayed.
3. Select **Yes** to delete the report template.

Export/Import of Report templates

User-defined report templates can be exported to a removable media and imported from the removable media into another system.

Export of Report templates

1. Insert a removable media in the drive.
2. Press **Config** on the Operation panel and select **Report**.
The *Report templates* sheet is displayed (Figure 11-25 on page 11-50).
3. Select **Export Templates**.
The available user-defined templates are displayed in the *Export templates* window.

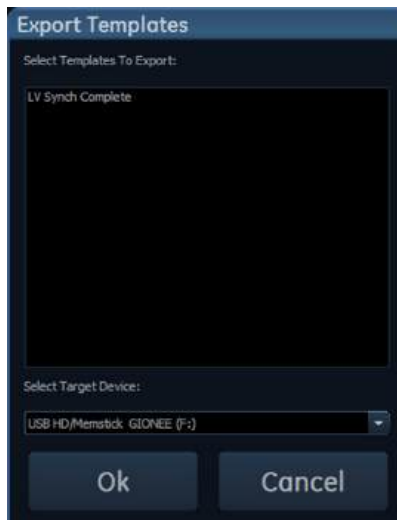


Figure 11-26. The Export templates window

Export of Report templates (continued)

4. Select the template(s) to export. Multiple selection can be done using the **Shift** or **Ctrl** key.
5. Select the desired removable media under *Select target device*.

NOTE: To export to a shared folder on a network, a remote path must be defined (see 'Default remote path setting' on page 10-129).

6. Press **OK**.
A Confirmation window is displayed.
The selected template(s) are exported to the removable media.
7. Press the right top of the touch screen to show the tray menu and select the media to eject.

Import of Report templates

1. Insert the removable media with the report template(s) to import.
2. Press **Utility/Config** and select **Report**.
The *Report templates* sheet is displayed (Figure 11-25 on page 11-50).
3. Select **Import Templates**.
The *Import templates* window is displayed.

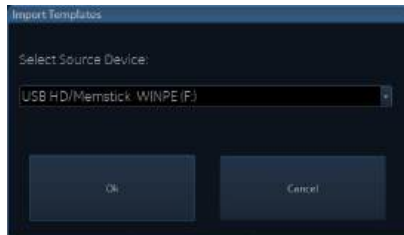


Figure 11-27. The Import template window

4. Select the source device from the pull-down menu.
5. Press **OK**.
A Confirmation window is displayed.
6. Press **OK**.
The templates are imported into the system.
7. Press the right top of the touch screen to show the tray menu and select the media to eject.

Chapter 12

Probes

This chapter describes:

‘Probe Overview’ on page 12-2

‘Probe Integration’ on page 12-20

‘Care and Maintenance’ on page 12-32

‘Probe Safety’ on page 12-62

‘Biopsy’ on page 12-73.

‘Probe Check’ on page 12-91.

‘Surgery/Intra-operative Use’ on page 12-101.

Probe Overview

Supported probes

Phased Array Sector probes

Probe	Mode	Technical data	Image
3Sc-RS	2D MM CMM CFM PWD CWD TVI TT SRI SI TSI TVM TVD Angio BFI BFIAngio BFlow AMM CAMM	Frequency: 1.3–4.6 MHz Foot print: 18 x 24 mm	

Probe	Mode	Technical data		Image
6S-RS	2D MM CMM CFM PWD CWD TVI TT SRI SI TSI TVM TVD Angio BFI BFIAngio BFlow AMM CAMM	Frequency: Foot print:	2.0–7.0MHz 17 x 24 mm	
12S-RS	2D MM CMM CFM PWD CWD TVI TT SRI SI TSI TVM TVD Angio BFI BFIAngio BFlow AMM CAMM	Frequency: Foot print	4.2–12.0 MHz 13 x 18 mm	

Probe	Mode	Technical data	Image
M5Sc-RS	2D MM CMM CFM PWD CWD TVI TT SRI SI TSI TVM TVD Angio BFI BFIAngio BFlow AMM CAMM	Frequency: 1.4–4.6 MHz Foot print: 18 x 27 mm	

Linear Array probes

Probe	Mode	Technical data	Image
9L-RS	2D MM CFM PWD Angio BFI BFIAngio BFlow AMM CAMM	Frequency: 2.0–10.0 MHz Foot print: 14 x 53 mm	
12L-RS	2D MM CFM PWD Angio BFI BFIAngio BFlow AMM CAMM	Frequency: 4.0–13.0 MHz Foot print: 13 x 47 mm	
L8-18i-RS	2D MM CMM CFM PWD Angio BFI BFIAngio BFlow AMM CAMM	Frequency: 4.5–18.0 MHz Foot print: 11 x 35 mm	
ML6-15-RS	2D MM CFM PWD Angio BFI BFIAngio BFlow AMM CAMM	Frequency: 3.5–15.0 MHz Foot print: 61 x 16 mm	

Probe	Mode	Technical data	Image
L4-20t-RS	2D MM CFM PWD Angio BFI BFIAngio BFlow AMM CAMM	Frequency: 4.0–20.0 MHz Foot print: 12 x 49 mm	

NOTE: L4-20t-RS probe is not supported on Vivid iq v206 Standard package.

Curved Array (Convex) probes

Probe	Mode	Technical data	Image
4C-RS	2D MM CMM CFM PWD Angio BFI BFIAngio BFlow AMM CAMM	Frequency: 1.5–5.0 MHz Foot print: 18 x 66 mm	
C1-5-RS	2D MM CMM CFM PWD Angio BFI BFIAngio BFlow AMM CAMM	Frequency: 1.5–5.0 MHz Foot print: 17 x 69 mm	
8C-RS	2D MM CMM CFM PWD Angio BFI BFIAngio BFlow AMM CAMM	Frequency: 3.0–10.0 MHz Foot print: 12 x 22 mm	

Doppler probes

Probe	Mode	Technical data	Image
P2D	CW Doppler	Frequency: 1.9–2.1 MHz Foot print: 16 mm	

Endovaginal probes

Probe	Mode	Technical data	Image
E8Cs-RS	2D MM CMM CFM PWD Angio BFI BFIAngio BFlow AMM CAMM	Frequency: 3.5–10.0 MHz Foot print: 19 x 24 mm	

Transesophageal Phased Array probes

Probe	Mode	Technical data	Image
6VT-D	2D MM CMM CFM PWD CWD TVI TT SRI SI TSI TVM TVD AMM CAMM	Frequency: 3.0–8.0 MHz Operating temperature: 8.5–42.5 °C	
10T-D	2D MM CMM CFM PWD CWD TVI TT SRI SI TSI TVM TVD AMM CAMM	Frequency: 3.1–10.0 MHz Operating temperature: 8.5–42.5 °C	

Probe	Mode	Technical data	Image
6Tc-RS	2D MM CMM CFM PWD CWD TVI TT SRI SI TSI TVM TVD AMM CAMM	Frequency: 3.0–8.0 MHz Operating temperature: 8.5–42.7 °C	
9T-RS	2D MM CMM CFM PWD CWD TVI TT SRI SI TSI TVM TVD AMM CAMM	Frequency: 3.6–10.0 MHz Operating temperature: 8.5–42.7 °C	

Transesophageal Phased Array probes (continued)

NOTE: 10T-D TEE probe is intended for patients with a weight above 2.5kg.

NOTE: 6VT-D probe is not supported on Vivid iq v206 Standard package and Vivid iq v206 PoC package.

NOTE: 10T-D TEE probe is not supported on Vivid iq v206 Standard package and Vivid iq v206 PoC package.

Intra Cardiac Echo (ICE) catheter

Probe	Mode	Technical data	Image
AcuNav8F	2D MM CMM CFM PWD CWD TVI TT SRI SI TSI TVM TVD AMM CAMM	Frequency: 4.2–11.5 MHz Operating temperature: 8.5–42.5 °C	
AcuNav10F	2D MM CMM CFM PWD CWD TVI TT SRI SI TSI TVM TVD AMM CAMM	Frequency: 4.2–11.5 MHz Operating temperature: 8.5–42.7 °C	

Probe	Mode	Technical data	Image
SoundStar 3D 10F	2D MM CMM CFM PWD CWD TVI TT SRI SI TSI TVM TVD AMM CAMM	Frequency: 4.2–11.5 MHz Operating temperature: 8.5–42.5 °C	
SoundStar eco 10F	2D MM CMM CFM PWD CWD TVI TT SRI SI TSI TVM TVD AMM CAMM	Frequency: 4.2–11.5 MHz Operating temperature: 8.5–42.5 °C	
SoundStar eco 8F	2D MM CMM CFM PWD CWD TVI TT SRI SI TSI TVM TVD AMM CAMM	Frequency: 4.2–11.5 MHz Operating temperature: 8.5–42.5 °C	

Probe Applications

Probe Application	Probe														
	C1-5-RS	4C-RS	8C-RS	E8Cs-RS	9L-RS	12L-RS	L4-20t-RS	L8-18i-RS	ML6-15-RS	M5Sc-RS	3Sc-RS	6S-RS	12S-RS	6Tc-RS	6VT-D
Fetal/Obstetrics	x	x		x						x	x	x			
Abdominal[1]	x	x	x	x	x	x	x		x	x	x	x	x		
Pediatric	x	x	x		x	x	x		x	x	x	x	x		
Small Organ[2]			x		x	x	x	x	x						
Neonatal Cephalic			x		x	x	x		x			x	x		
Adult Cephalic										x	x				
Cardiac[3]			x							x	x	x	x	x	x
Peripheral Vascular			x		x	x	x	x	x						
Musculo-skeletal Conventional	x	x	x		x	x	x	x	x						
Musculo-skeletal Superficial	x	x	x		x	x	x	x	x						
Thoracic/Pleural	x	x	x		x	x	x	x	x	x	x	x	x	x	
Urology[4]	x	x		x											
Transcranial			x							x	x	x	x		
Transesophageal														x	x
Transrectal				x											
Transvaginal				x											
Intraoperative[5]								x							
Intracardiac and Intraluminal															
Tissue Biopsy[6]	x	x		x	x	x	x		x	x	x				

Probe Applications (continued)

x = supported

[1] Abdominal includes GYN and Urological;

[2] Small Organ includes breast, testes, thyroid;

[3] Cardiac is Adult and Pediatric;

[4] Urology includes prostate;

[5] Intraoperative includes thoracic (cardiac) and vascular (PV);

[6] Includes image guidance for freehand needle placement;

Modes and Features	Probe																		
	3Sc-RS	M5Sc-RS [3]	6S-RS	12S-RS	6Tc-RS	6VT-D[3]	10T-D	9T-RS	9L-RS	12L-RS	L4-20t-RS	ML6-15-RS[3]	L8-18i-RS[3]	4C-RS	C1-5-RS[3]	8C-RS	E8Cs-RS	P2D	ICE Catheters
2D	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
Harmonics	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
Color (CFM)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
M-Mode	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
CMM	x	x	x	x	x	x	x	x					x	x	x	x	x		x
PW Doppler	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
CW Doppler	x	x	x	x	x	x	x	x										x	x
TVI [1]	x	x	x	x	x	x	x	x											x
TissueTracking[1]	x	x	x	x	x	x	x	x											x
AdvQScan (Strain, SR, TSI)[1][3]	x	x	x	x	x	x	x	x											x
TVM	x	x	x	x	x	x	x	x											x
TVD	x	x	x	x	x	x	x	x											x
Angio	x	x	x	x					x	x	x	x	x	x	x	x	x		
AdvVascular(B-Flow, BFI) [2]	x	x	x	x					x	x	x	x	x	x	x	x	x		
AMM	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
Curved AMM	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
Virtual Apex	x	x	x	x	x	x	x	x											x

Modes and Features	Probe																		
	3Sc-RS	M5Sc-RS [3]	6S-RS	12S-RS	6Tc-RS	6VT-D[3]	10T-D	9T-RS	9L-RS	12L-RS	L4-20t-RS	ML6-15-RS[3]	L8-18i-RS[3]	4C-RS	C1-5-RS[3]	8C-RS	E8Cs-RS	P2D	ICE Catheters
Virtual convex									x	x	x	x							
Strain Elastography									x	x					x				
EchoStress [1]	x	x	x	x	x	x	x	x											
AutoEF 3.0 [1]	x	x	x	x	x	x	x	x											x
AFI 3.0 [1]	x	x	x	x	x	x	x	x											x
Q Analysis	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
Vascular Contrast									x		x				x				
LVO Contrast [1][3]	x	x			x	x													
4D [4]						x													
Biplane or Triplane[3]						x													
LOGIQ View									x	x	x	x							
IMT									x	x	x	x							
AFI RV [1]	x	x	x	x	x	x													
AFI LA [1]	x	x	x	x	x	x													
Auto Measure – 2D [1]	x	x	x	x	x	x													
Auto Measure - Spectrum Recognition 2D[1]	x	x	x	x	x	x													
Cardiac Auto Doppler [1]	x	x	x	x	x	x													
HD Color [4]						x													
4DAutoAVQ [4]						x													
4DAutoLVQ [4]						x													
4DAutoMVQ [4]						x													
4D markers [4]						x													

Probe Applications (continued)

x = supported

[1] Only for cardiac applications/presets;

[2] Only for non-cardiac applications/presets;

[3] Probe or feature only available for Premium and 4D configurations;

[4] Probe or feature only available for 4D configuration;

Probe Usage

For details on connecting, activating, deactivating, disconnecting, transporting and storing the probes, See 'Probe Integration' on *page 12-20 for more information*.



Ultrasound Probes provided to clinics for human medicine should be used for humans only.



The use of the equipment outside the described conditions or intended use, and disregarding safety related information is considered abnormal use. The manufacturer is not liable for injury or damage caused by abnormal use. Any abnormal use will void the warranty of the equipment.

Maximum Probe Temperature

Table 12-1: Maximum Probe Temperature (Degrees °C)

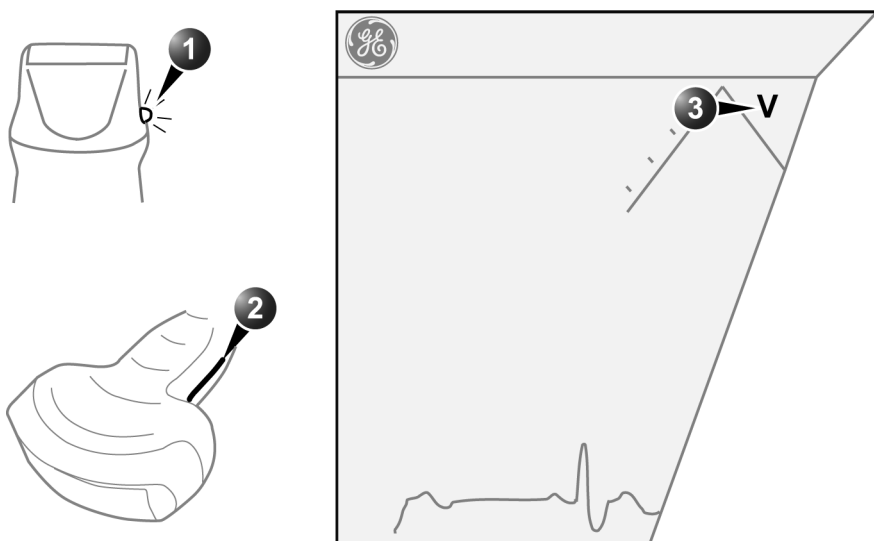
Probe	Max Temp	
	With TMM Phantom	In Air
C1-5-RS	39.8	37.4
4C-RS	39.8	37.5
8C-RS	40.55	42.6
E8Cs-RS	40.7	36.8
9L-RS	40.4	36.6
12L-RS	41.62	37.5
L8-18i-RS	37.8	33.2
L4-20t-RS	41.0	36.4
ML6-15-RS	40.89	37.4
M5Sc-RS	41	39.9
3Sc-RS	40.5	40.1
6S-RS	40.57	40.1
12S-RS	40.58	40.9
6Tc-RS*	40.5	34.1
10T-D	37.2	38.9
6VT-D*	41.6	36.1
9T-RS*	41.7	35.3
AcuNav8	39.61	N/A
AcuNav10	40.76	N/A
SoundStar 3D 10F	40.76	N/A
SoundStar eco 10F	40.76	N/A
SoundStar eco 8F	39.61	N/A
P2D	38.7	33.5

Table 12-1: Maximum Probe Temperature (Degrees °C)

Probe	Max Temp	
	With TMM Phantom	In Air
Notes: 1. In accordance with IEC 60601-2-37, the maximum lens temperature is limited to 43°C with thermal phantom, while 50°C in air. 2. Lens temperature measured under following conditions per IEC 60601-2-37: • The temperature is measured on the surface of the APPLIED PART of the TRANSDUCER ASSEMBLY in those areas that give the highest surface temperature. • Probe placed upright in contact with above thermal phantom. • Autofreeze capability disabled. • Lens temperature monitored for 30 min. 3. *The ultrasound scanner is designed with a thermal safety system to prevent the operative temperature from exceeding 42.5°C for 6VT-D and 42.7°C for 6Tc-RS and 9Tc-RS.		

Probe orientation

Some probes are provided with a green light (LED) orientation marking near their head (see Figure 12-1). Probes which do not have a LED have an indentation (notch) for orientation on the probe housing. This LED, or notch, corresponds with the **V** mark on the scanning screen. The **V** mark indicates the orientation of the probe to the scan.



1. LED
2. Notch

3. V-mark on screen: indicates the orientation of the probe to the scan.

Figure 12-1. Orientation marking on probe and on screen

Probe labelling

Each probe is labelled with the following information(Please refer to 'Probe Label Explanation' on *page 2-64* for detailed information):

- Seller's name and manufacturer
- Operating frequency
- Probe serial number
- Year of manufacture
- The probe name displayed on both the probe housing and the connector can be read when the probe is connected. It is also automatically displayed on the screen when the probe is connected.

Probe Integration

Unpacking



CAUTION

In case of packaging being

- damaged
- unintentionally opened before use; and
- if the packaging is exposed to environmental conditions outside of those specified,

Please contact your GE representative.

Connecting the probe

Probes can be connected at any time, whether the unit is on or off.

Before connecting the probe:

- Inspect the probe and the probe cable for any damage.
- Do a visual check of the probe pins and system sockets. Remove any dust or foam remains from the probe pins.



CAUTION

Do not allow the probe head to hang freely. Impact to the probe head may result in irreparable damage.



CAUTION

Take the following precautions with the probe cables:

- Do not bend the cable acutely.
- Do not cross cables between probes.



WARNING

Do NOT touch the patient and any of the connectors on the ultrasound unit simultaneously, including ultrasound probe connectors.

Connecting the probe (continued)

To connect a probe:

1. Place the probe's carrying case on a stable surface and open the case.
2. Carefully remove the probe and unwrap the probe cord.
3. Align the connector with the probe port and carefully push into place with the cable facing the front of the system.
4. Flip the connector locking lever up.
5. Carefully position the probe cord so it is free to move and is not resting on the floor.
6. When the probe is connected, it is automatically activated.



Figure 12-2. Probe connection to Vivid *iq*

Activating the probe

When a probe is connected to the unit it is automatically detected.

Selecting a probe and an application

1. Select **Probe** on the shortcut bar. A list of the probe and application presets is displayed.
2. Select the desired application preset to start scanning.



CAUTION

Check that the correct TI category is displayed. TIB must be displayed when a fetal application is selected.

Switching Application Preset using QuickApps

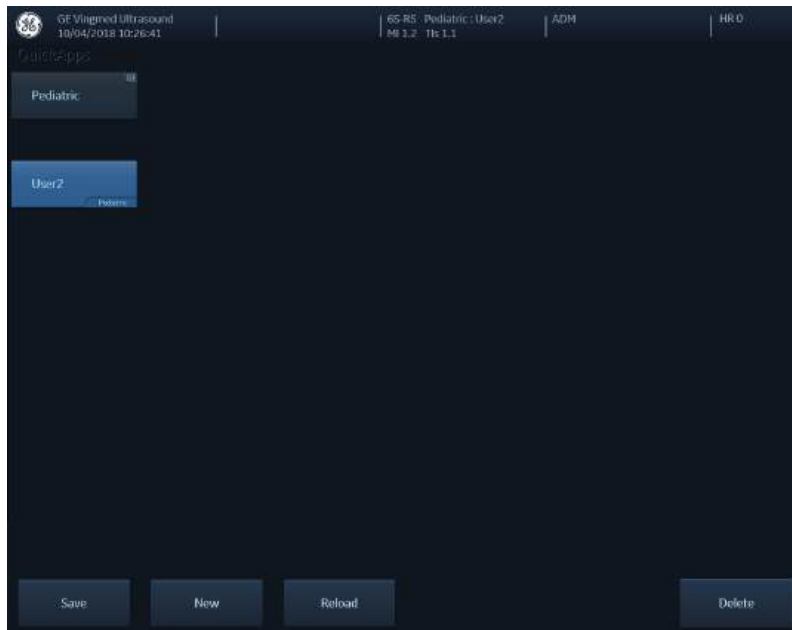
QuickApps provides an easy access to specific imaging settings, such as coronary or contrast imaging, without leaving the selected imaging preset.

QuickApps keeps the current scanning mode and image geometry parameters (such as 2D Depth, 2D Width, Color ROI size and position) as adjusted by the user, while optimizing imaging parameters for that selected scanning situation.

The Vivid *iq* comes with a set of factory QuickApps presets for most supported probes and Application Presets. Factory QuickApps cannot be modified, but user-defined QuickApps presets can be created as needed.

QuickApps can be managed on the fly as described below:

Switching Application Preset using QuickApps (continued)



1. **New:** To create a new QuickApps preset based on the currently active QuickApps preset or Imaging preset. Press **New** and name the new QuickApps preset as desired.
2. **Reload:** Has two different functions:
 - If a factory QuickApp is active, **Reload** will restore the default factory settings.
 - If a user-defined QuickApp is active, **Reload** will restore the most recently saved settings on that QuickApp.
3. **Save:** To overwrite the currently active QuickApps preset. It is only possible to use **Save** when working with a user defined QuickApps preset (**Save** is not available for factory QuickApps presets).
4. **Delete:** To delete a user defined QuickApps preset. Press **Delete** and select the QuickApp that should be eliminated.

Figure 12-3. Manage QuickApps

Disconnecting a probe

1. Press the connector locking lever down.
2. Pull the probe connector straight out of the probe port carefully.
3. Ensure that the probe head is clean before placing the probe in its storage case and/or hanging unit.



Figure 12-4. Probe disconnection from Vivid *iq*

Using Intra Cardiac Ultrasound Catheters

Overview of the AcuNav 8F, AcuNav 10F, SoundStar 3D 10F, SoundStar eco 10F and SoundStar eco 8F



CAUTION

The Vivid *iq* system is designed for compatibility with commercially available ICE catheters (AcuNav 8F, AcuNav 10F, SoundStar 3D 10F, SoundStar eco 10F and SoundStar eco 8F) and Carto systems.

Please verify clearance of these devices before using them with the Vivid *iq* system.

General description

The AcuNav 8F, AcuNav 10F, SoundStar 3D 10F, SoundStar eco 10F and SoundStar eco 8F ultrasound catheters are sterile, disposable, and licensed for single use only.

The catheters are optimized for intracardiac scanning. The catheters are a single-plane, 90-degree, wide-view imaging format catheter device with 64 channels that can transmit and receive data simultaneously.

With each catheter, the physician can maneuver the imaging plane located inside the catheter tip to see the region of interest. The physician can steer the catheter to optimize tissue visualization.

The user can steer the tip of the catheter bidirectionally in two planes: left/right and posterior/anterior. The active face of the catheter faces anteriorly, and the scanning plane is longitudinal.

The reusable ICEcord-RS cable connects the catheter to the Vivid iq system.

NOTE: *The reusable ICEcord-RS cable is equivalent to the SwiftLink ICE probe catheter connector cable. This cable is designed exclusively for use with the The AcuNav 8F, AcuNav 10F, SoundStar 3D 10F, SoundStar eco 10F and SoundStar eco 8F ultrasound catheter on Vivid iq.*



CAUTION

Use special 'Carto' preset when connected to CartoSound System and be careful when adjusting parameters to avoid framerate lower than 30 frames per second.

Intended use of ICE catheters

All intra cardiac catheters are intended for intracardiac and intraluminal visualization of cardiac and great vessel anatomy and physiology as well as visualization of other devices in the heart.

The SoundStar 3D 10F/SoundStar eco 10F/SoundStar eco 8F ultrasound catheter is intended to operate when the Vivid *iq* is interfaced to the CartoSound. This catheter may also be used on the Vivid *iq* without any additional interface, identically to the operation of the AcuNav 8F/AcuNav 10F.



CAUTION

Federal law restricts this device to sale by or on the order of a physician.



WARNING

On rare occasions, the system may falsely detect that the 2D ICE catheter is in air and stop the scanning even while the catheter is inserted in the patient. In this case a message will appear, and the scanner will enter AirScan mode. In such a case press the **Freeze** button twice to resume normal scanning and try changing user controls or reposition the catheter to get image with more echoes



WARNING

ICE probes are not designed for transesophageal imaging.

Contradictions

Use of the catheter is contraindicated under conditions where the cardiac catheterization process would cause unacceptable risk to the patient. Contraindicated conditions include, but are not limited to, cases where vascular access is inadequate. Known contraindicated conditions include:

- Sepsis
- Major coagulation abnormalities
- Presence of any intracardiac thrombus
- Deep vein thrombosis
- Significant peripheral vascular disease or abnormalities



WARNING

The catheter is not for use in coronary vessels or fetal tissue. Using the catheter in coronary vessels or fetal tissue can cause patient injury.

NOTE: *Before using the AcuNav ultrasound catheter please read the ACUSON AcuNav Ultrasound Catheter User Manual where you will find.*

- Technical description of the catheter and connector
- Safety and care information for the catheter and connector
- Procedures for preparing, conducting, and ending an examination

CartoSound



CAUTION

In some cases, noise artifacts may appear in the ultrasound image when using (ICE) ablation catheters and Carto mapping system is active.

In order to help reduce the noise level, please ensure that:

- The facility grounding is connected via a ground potential equalization (equipotentiality) cable to the terminal located in the rear of the system (marked with symbol).
- External ferrite filter is placed around the 'Swiftlink' probe cable.

Identifying the correct Ultrasound Catheter Model

Inspect the catheter selected for use to make sure it is the catheter model compatible to the Vivid *iq* systems.

NOTE: *The label on the catheter's package should state: Not for Use on Siemens Systems.*



CAUTION

The system will not recognize a catheter which is not intended for use with GE systems according to above table.

Connecting the Ultrasound Catheter

1. Connect the RS connector of the ICEcord-RS cable to the system like any other RS probe connector
2. Follow the detailed instructions provided in the separate ACUSON AcuNav Ultrasound Catheter User Manual.



CAUTION

Make sure the catheter is not in scanning mode while held up in the air. When the catheter is scanning while not placed on tissue, there is a potential risk of damage to the crystal elements as the temperature at the tip may rise above the approved limit.

Automatic Freeze while Ice catheter is in the air

Whenever the probe is scanning without any contact to the tissue the system will sense this and will freeze the scanning within a couple of seconds. In this case a message on the prompt line will appear: AirScan Mode.

As soon as the ICE catheter is placed inside a blood vessel or in water the scanning will resume.



CAUTION

On some rare occasions, the system may falsely detect "probe-in-air" and stop the scanning even while the catheter is inserted in the patient. In this case the message above will appear and the scanning will "freeze" but the Freeze button will remain lit in blue color (scanning state).

In such a case press the Freeze button twice to resume normal scanning.

NOTE: *When selecting a preset while using the ACUSON AcuNav 10F/ SoundStar 3D 10F or the SoundStar eco ICE catheter, the preset list may contain a preset named "Carto". This special preset is intended to optimize the use of the SoundStar 3D 10F ICE or SoundStar eco 10F catheter to operate with the CartoSound System only. Please note that this preset may appear on the list even though the CartoSound system option has not been installed. Do not use the "Carto" preset when system is not connected to the CartoSound System.*

Care and Maintenance

Planned maintenance program



CAUTION

Improper handling can lead to early probe failure and electric shock hazards.

DO follow the specific cleaning and disinfection procedures provided in this chapter and the germicide manufacturers instructions.

Failure to do so will void probe warranty.



CAUTION

Transesophageal, endocavity and intraoperative probes require special handling. Refer to the user documentation enclosed with these probes.

NOTE: *Keep a log of all probe maintenance, along with a picture of any probe malfunction.*

It is recommended to keep a maintenance log and note all probe malfunctions. Follow the maintenance schedule below to ensure optimum operation and safety:

Before first use

- Inspect the probe.
- Clean the probe.
- Disinfect the probe.

After each use:

- Inspect the probe.
- Clean the probe.
- Disinfect the probe.

Before each use:

- Inspect the probe.

Inspecting the probe



CAUTION

If any damage is found, DO NOT use the probe until it has been inspected and released for further use by a GE service representative.

After each use:

1. Inspect the lens, the probe housing and the cable (Figure 12-5) for cracks, cuts, tears, and other signs of physical damage.
2. Look for damage that might allow liquid into the probe.

Before each use:

1. Inspect the lens, the probe housing and the cable (Figure 12-5) for cracks, cuts, tears, and other signs of physical damage.



CAUTION

Inspect probes for sharp edge or rough surfaces that could injure sensitive tissue.

2. Look for damage that might allow liquid into the probe.
3. Test the functionality of the probe. Check also modular combinations and common operability of system and accessories.

1. Housing
2. Strain relief
3. Seal
4. Lens

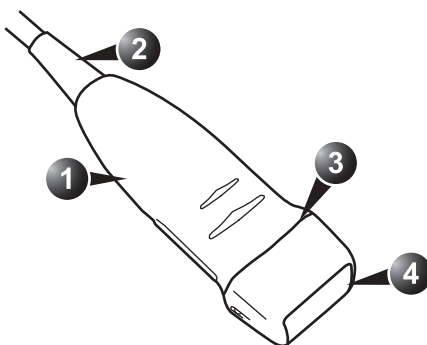


Figure 12-5. Probe parts



CAUTION

Transesophageal, endocavity and intraoperative probes require special handling. Refer to the user documentation enclosed with these probes.

Safety tests

Recommended maintenance schedule: According to respective national regulations, and according to the manufacturer recommendations for the ultrasound system.

Probe Maintenance Intervals

The following maintenance schedule is suggested for probes and biopsy equipment to ensure proper operation and safety:

Action	Daily	After/Before each use	As necessary
Inspect the probe	-	X	X
Clean the probe	X	X	X
Disinfect endocavity probe	-	X	X
Disinfect all other probe types	-	X	X

Electric test

Check the electric safety of system combinations according to IEC 62353 or respective national regulations.

Probe Leakage Current

Probe leakage current test should be performed:

- Annually
- After corrective maintenance or as required by your facilities quality program.

NOTE: *Attempting do-it-yourself repairs invalidate warranty, and are an infringement to regulations and are inadmissible according to IEC 60601-1. Only authorized personnel may perform service and repairs. For expected lifetime of equipment and probes see Service Manual.*

Environmental conditions

Probes can be used in clinical environment.

Ensure that the probe face temperature does not exceed the normal operation temperature range.

Probes should be operated, stored, or transported within their probe specific parameters.

For operational probe environmental parameters, see 'Probe Overview' on *page 12-2*. Probe specific storage and transport conditions are defined on the individual environmental label on the probe box.

Cleaning and disinfecting probes



WARNING

Probes must be cleaned and disinfected before they are replaced or disposed.



CAUTION

Transesophageal, endocavity and intraoperative probes require special handling. Refer to the user documentation enclosed with these probes.

The reprocessing instructions provided in this document have been validated with the chemicals specified in Table 12-4 on page 12-41. Therefore, only those agents listed in Table 12-4 should be used for reprocessing, and any reprocessing performed using chemicals not listed in Table 12-4 must be validated by the user.

Adequate cleaning and disinfection between patient cases are necessary to prevent disease transmission. All probes must be thoroughly cleaned prior to disinfection. The level of disinfection required is based on patient contact.

- Probes that contact mucosal or non-intact skin require cleaning followed by High-Level Disinfection by either soaking or use of a Trophon EPR. Verify probe compatibility on the GE probe website shown below.
- Probes that contact intact skin require cleaning followed by Intermediate-Level Disinfection (wipe or spray).

With the exception of the chemicals listed in Table 12-4 on page 12-41, the chemicals listed on the GE Website have been tested for compatibility only.

NOTE: *The tables in the User Manual indicate the status when the User Manual was released. Please visit the website for the latest information.*

Probe Care Cards

The Care Card, supplied with every probe, contains a list of additional processing products that are compatible with probe materials, but GE HealthCare has not validated their efficacy. When using these products, refer to their manufacturer’s instructions for use. A complete list of compatible products is also available on the Ultrasound Probes website. This list updates periodically with new products and probes. (Refer to Table 12-2).

Table 12-2: Website Links

Support Documentation Library Web Site:
http://www.gehealthcare.com/Documentation
Ultrasound Probe Web Site:
https://www.gehealthcare.com/transducers
GEHC chemicals compatibility
https://cleaning.gehealthcare.com/

Table 12-3: Description of Pictogram on Probe Care Cards

Pictogram	Description	Standard
	“ATTENTION” - Consult accompanying documents” is intended to alert the user to refer to the operator manual or other instructions when complete information cannot be provided on the label.	ISO 7000-0434A
	“CAUTION” - Dangerous voltage (the lightning flash with arrowhead) is used to indicate electric shock hazards.	IEC 60417-6042
	Biohazard - Patient/user infection due to contaminated equipment. Usage • Cleaning and care instructions • Sheath and glove guidelines	ISO 7000-0659

Table 12-3: Description of Pictogram on Probe Care Cards (Continued)

Pictogram	Description	Standard
	Ultrasound probes are highly sensitive medical instruments that can easily be damaged by improper handling. Use care when handling and protect from damage when not in use.	N/A- by GE Healthcare
	Do not immerse the probe into any liquid beyond the level specified for that probe. Refer to the user manual of the ultrasound system.	N/A- by GE Healthcare
	Since there is a possibility of having negative effects on the probe, observe the specified immersing time by the germicide manufacturer strictly. Do not immerse the probe in liquid chemical germicides more than the time prescribed in the care card.	N/A- by GE Healthcare
	"Consult accompany document" - Refer to the ultrasound system user manual for important probe care and cleaning instruction.	ISO 7010-M002
	Authorized European Representative in the European Community.	ISO 15223-1
	Authorised Representative in Switzerland.	Swiss Medical Devices Ordinance 812.213
	Symbol indicates a useful information.	N/A- by GE Healthcare
	Compatible ultrasound coupling gels.	N/A- by GE Healthcare

Table 12-3: Description of Pictogram on Probe Care Cards (Continued)

Pictogram	Description	Standard
	Compatible cleaners or disinfectants available in spray format.	N/A- by GE Healthcare
	Compatible cleaners or disinfectants available in wipes format.	N/A- by GE Healthcare
	Compatible cleaners or disinfectants available in powder.	N/A- by GE Healthcare
	Compatible cleaners or disinfectants available in liquid format	N/A- by GE Healthcare
	Compatible automated reprocessors.	N/A- by GE Healthcare



CAUTION

CREUTZFELD-JACOB DISEASE

This device is not indicated for neurological use. Neurological contact on patients with this disease **MUST BE** avoided. If a device/probe becomes contaminated, there is no adequate means to disinfect it. In this case, the contaminated device/probe **MUST BE** discarded in accordance with local biologic waste hazard procedures.

Chemicals Used for Efficacy Validation

The table below lists the products and intended use (clean, Intermediate-Level Disinfection, High-Level Disinfection) that were validated.

Table 12-4: Products with validated efficacy performed by GE HealthCare

Product Type	Trade Name	Manufacturer	Minimum Contact Time	Active Ingredient	Validated for probe
Cleaning (Wipe)	Oxivir® Tb	Diversey	N/A	Hydrogen Peroxide	12L-RS,3Sc-RS,4C-RS,8C-RS,9L-RS,C1-5-RS,E8Cs-RS,L8-18i-RS,M5Sc-RS,ML6-15-RS,L4-20t-RS,P2D
Cleaning (Soak)	Enzol® (Cidezyme®)	Advanced Sterilization Products® (J&J)	1-Minute Soak	Proteolytic Enzymes	12L-RS,12S-RS,3Sc-RS,4C-RS,6S-RS,8C-RS,9L-RS,C1-5-RS,E8Cs-RS,L8-18i-RS,M5Sc-RS,ML6-15-RS,L4-20t-RS
	MetriZyme™	Metrex™			12L-RS,3Sc-RS,4C-RS,8C-RS,9L-RS,C1-5-RS,E8Cs-RS,L8-18i-RS,M5Sc-RS,ML6-15-RS,L4-20t-RS
	Prolystica® 2X Concentrate Presoak & Cleaner	Steris			12L-RS,12S-RS,3Sc-RS,4C-RS,6S-RS,8C-RS,9L-RS,C1-5-RS,E8Cs-RS,L8-18i-RS,M5Sc-RS,ML6-15-RS,L4-20t-RS
Intermediate-level Disinfectant (wipe or liquid)	Oxivir® Tb	Diversey	10-Minute Exposure	Hydrogen Peroxide	12L-RS,3Sc-RS,4C-RS,8C-RS,9L-RS,C1-5-RS,M5Sc-RS,ML6-15-RS,L4-20t-RS,P2D
Intermediate-level Disinfectant (wipe)*	Sani-Cloth AF3	PDI	3-Minute Exposure	Quaternary ammonium	12S-RS,6S-RS
High-level Disinfectant (Soak)	Cidex® OPA (FDA-cleared)	Advanced Sterilization Products (J&J)	12-Minute Soak	Ortho-phthalaldehyde	12L-RS,12S-RS,3Sc-RS,4C-RS,6S-RS,8C-RS,9L-RS,C1-5-RS,E8Cs-RS,L8-18i-RS,M5Sc-RS,ML6-15-RS
	McKesson OPA/28	McKesson	10-Minute Soak		

Probe Pre-Treatment at the Point of Use (Required for All Probes)

The pre-treatment step is for removal of gel and gross contamination.

1. After each use, remove protective sheath from the probe and gently remove all coupling gel from the probe by wiping with soft, lint-free cloth.



CAUTION

DO NOT use abrasive paper products when cleaning or wiping a GE Ultrasound probe. The use of abrasive wipes can damage the soft lens (acoustic window).

2. Wipe the probe with one of the wipes listed in Probe Care Card from the lens, past the strain relief. Wipe the cable with a lint-free cloth dampened with potable water to remove chemical residue. Dispose of the cloth, wipe and gloves in the clinical trash.

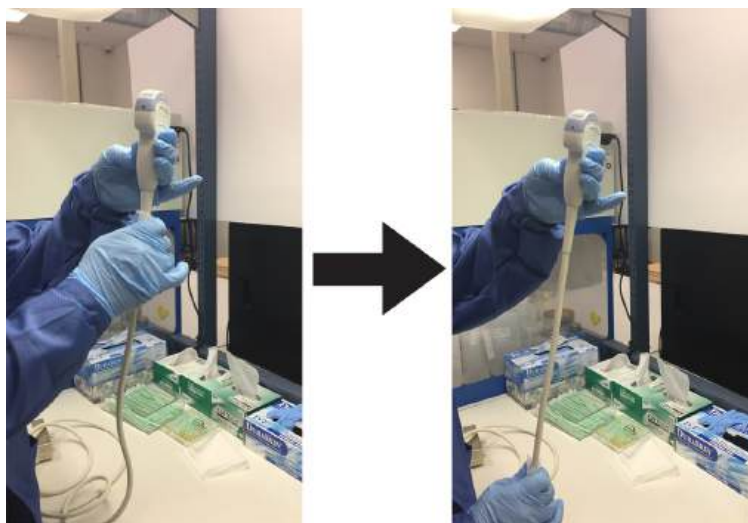


Figure 12-6. Cleaning the Probe Cable

NOTE: *Use of wipes listed in the Probe Care Card may result in discoloration of the cable.*

Probe Pre-Treatment at the Point of Use (Required for All Probes) (continued)



WARNING

Use caution when cleaning the connector. This cable connector should only be cleaned with a slightly dampened cloth or wipe. Exposure to excessive moisture will result in damage to the probe and possibly the ultrasound console. DO NOT wet the connector/console interface surface or labels.

3. After each use, inspect the lens, cable, and housing of the probe. Look for any damage that would allow liquid to enter the probe. If the probe is damaged, do not place it into any liquid (e.g. for disinfection) and do not use it until it has been inspected and repaired/replaced by a GE Service Representative.

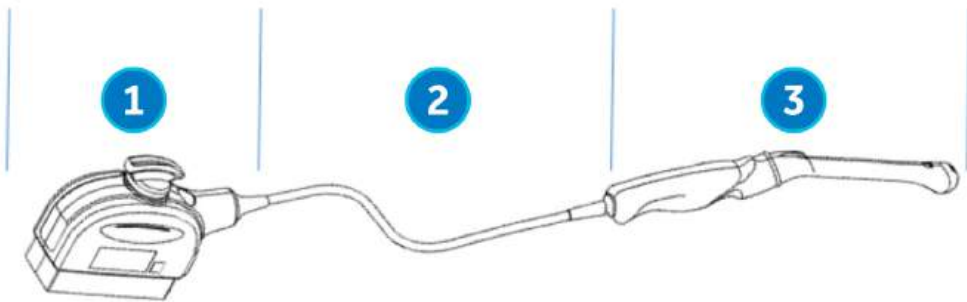


Figure 12-7. Inspect the Lens, Cable, and Probe House After Each Use

1. Cleaning only portion
2. Cleaning only or cleaning and disinfection portion
3. Cleaning followed by appropriate level of disinfection

Cleaning with Wipes

Manual cleaning is required to ensure the probes are cleaned to the extent necessary for further processing. Choose the most appropriate method, either the wipe or enzymatic soak.

1. Hold the probe at the proximal end near the strain relief cable. **DO NOT** suspend or hold the probe by the cable as this may damage the probe.
2. Dispense a cleaning wipe from the wipe canister.
3. Gently wipe the probe with a cleaning wipe from the cable strain relief to the distal end. Gently wipe the probe's lens.

NOTE: Pay special attention to lens, edges, and grooves.

4. Turn the probe and continue wiping until the entire surface of the probe has been cleaned. As the wipe becomes visibly soiled, discard the wipe into clinical trash and dispense fresh wipes as needed.
5. Wrap a clean wipe around a soft nylon bristle brush to access crevasses, such as biopsy notches, on the surface of the probe.
6. Visually inspect the probe for any remaining soil and, if necessary, repeat steps 3 through 5 until the probe is visibly clean.

Probe Manual Cleaning Instructions – Enzymatic Detergent

1. Ensure the probe has been disconnected from the console. Put on a clean pair of gloves and fill a sink or basin with warm potable water (30 - 40°C) to a level allowing immersion of the probe up to the immersion line shown in Figure 12-8 on page 12-45.
2. Prepare the cleaning solution in accordance with the detergent manufacturer's instructions.
3. Immerse the probe in the prepared cleaning solution up to the immersion line and ensure no air bubbles are trapped on the surface. Do not submerge probe beyond the immersion line shown in the user manual and in Figure 12-8 on page 12-45.

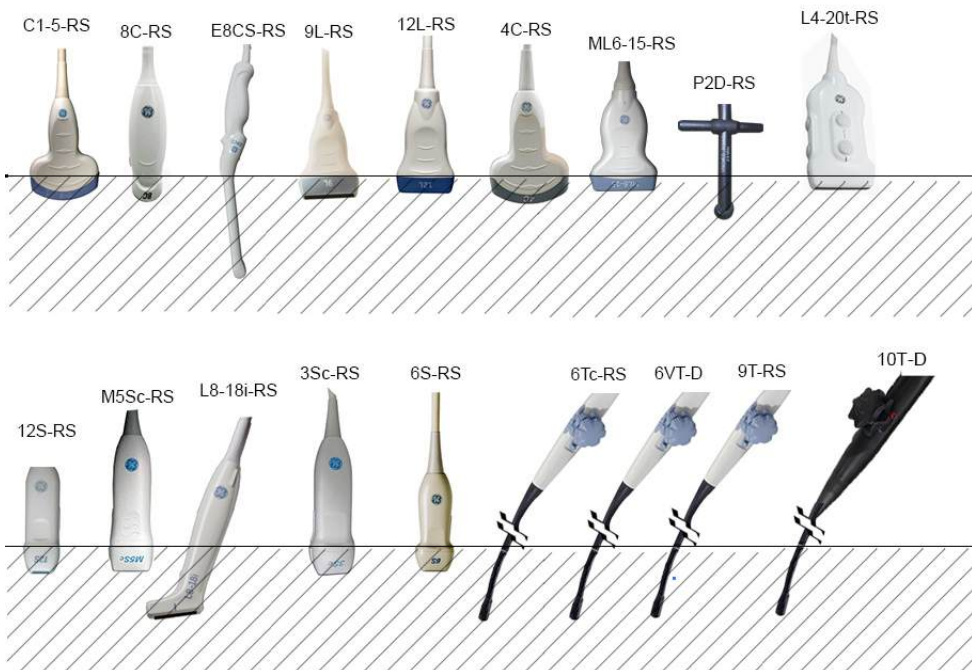


Figure 12-8. Probe Immersion Levels, 1=Fluid Level

Table 12-5: Description of Pictogram for Probe Immersion Levels

Pictogram	Description
	Fluid Level

Probe Manual Cleaning Instructions – Enzymatic Detergent (continued)

4. Brushing with a clean, soft, nylon bristle brush from the base of the cable strain relief to the distal tip is critical to ensure cleaning and disinfection efficacy.

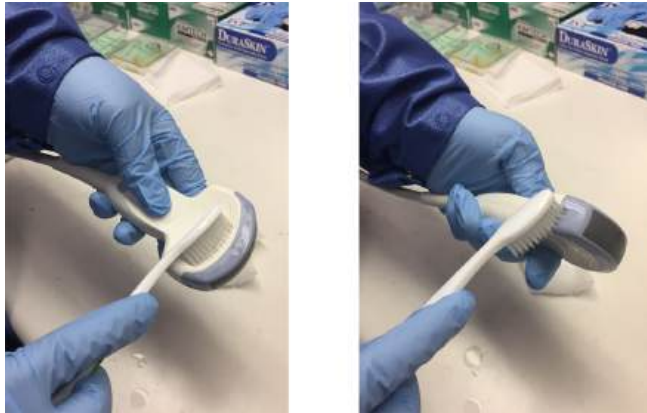


Figure 12-9. Cleaning the probe using a brush



CAUTION

Do not use the brush on the probe lens.

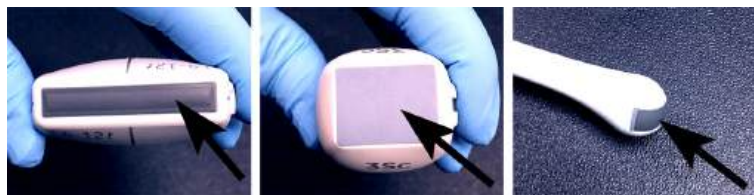


Figure 12-10. Probe Lens Examples

5. Continue brushing the probe for not less than the minimum contact time listed on the detergent manufacturer's label.

Probe Manual Cleaning Instructions – Enzymatic Detergent

(continued)

6. Visually inspect the probe for soil. Repeat Steps 3 through 5 until all visible soil has been removed from the surface of the probe.
7. Rinse the probe under running warm potable water (30 - 40°C) for not less than 2 minutes. Scrub the surface of the probe with a clean, soft, nylon bristle brush from the base of the cable strain relief to the distal tip.



CAUTION

Do not use the brush on the probe lens.

8. Visually inspect the device in a well-lit area to ensure all surfaces are free from residual cleaning solution. Repeat Step 7 if visible cleaning solution is observed.
9. Thoroughly dry the probe using a clean lint-free soft and dry cloth or wipe.



CAUTION

DO NOT use a twisting motion or abrasive paper products when wiping the probe as this may damage the soft lens.

Cable and Connector Manual Cleaning



WARNING

Use caution when cleaning the connector. This cable connector should only be cleaned with a slightly dampened cloth or wipe. Exposure to excessive moisture will result in damage to the probe and possibly the ultrasound console. DO NOT wet the connector/console interface surface or labels.

NOTE:

1. The cable and connector surfaces can be cleaned with the cleaners or wipes listed in the Probe Care Card.

Use of wipes listed in the Probe Care Card may result in discoloration of the cable.

2. Wipe the cable with a lint-free cloth dampened with potable water to remove chemical residue.

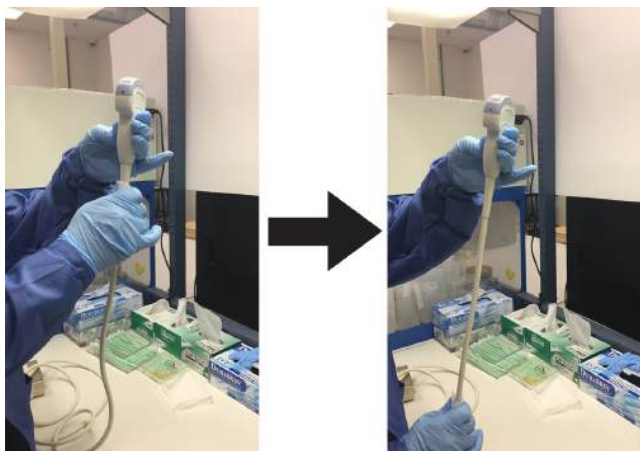


Figure 12-11. Cleaning the Probe Cable

Probe Intermediate-Level Disinfection - Spray

For Intermediate-Level Disinfection of surface-contacting probes, choose either the spray or wipe method.

NOTE: *Probes that contact only intact skin may be disinfected in this manner. All probes that contact non-intact skin or mucous membranes (e.g., endocavitary, Transesophageal) require High-Level Disinfection.*



CAUTION

After each use, inspect the lens, cable, and housing of the probe. Look for any damage that would allow liquid to enter the probe. If the probe is damaged, do not place it into any liquid (e.g. for disinfection) and do not use it until it has been inspected and repaired/replaced by a GE Service Representative.

1. Put on a new pair of gloves and spray enough disinfectant solution to saturate a new disposable lint-free wipe or cloth.
2. Holding the probe near the strain relief, apply the dampened cloth to the patient contacting lens. Wipe the probe from the lens to the strain relief, slightly rotating the probe after each wiping pass.
3. After the probe has been completely wiped, dampen a second wipe with disinfectant and starting at the probe lens begin wiping the probe in a rotating motion moving down towards the strain relief. Spray disinfectant directly on the recessed areas and ridges to saturate.

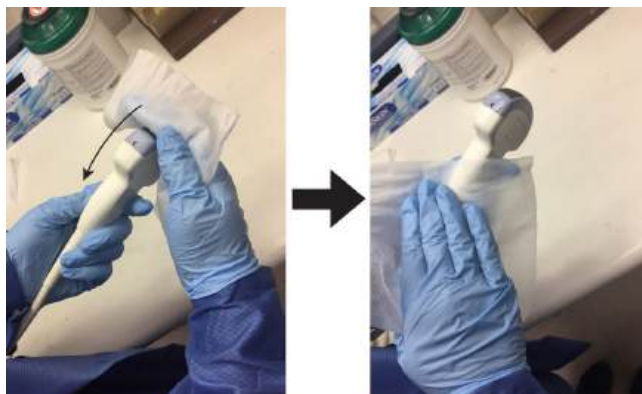


Figure 12-12. Disinfecting the Probe Moving from Lens to Strain Relief

Probe Intermediate-Level Disinfection - Spray (continued)

4. Once the probe has been completely wiped, dampen a third wipe with disinfectant and continue wiping the probe as needed to ensure the surface remains wet for the required exposure time. Use as many wipes as needed and respray disinfectant on recessed areas and ridges, to ensure all surfaces remain wet for the minimum required contact time listed in the disinfectant manufacturer's instructions for use.
5. Dry all surfaces of the probe using a sterile lint-free wipe or cloth.
6. Saturate a soft, lint-free wipe with de-ionized or purified water (remove excess water, wipe should be damp but not dripping) and thoroughly wipe all surfaces of the probe to remove chemical residue. Discard the wipe.
7. A total of three (3) rinses are required. Repeat Step 6 two additional times using new wipes and water.



WARNING

Failure to properly rinse probes with water following disinfection may cause skin irritation.

8. Thoroughly dry all surfaces of the probe using a soft, lint-free wipe or cloth, changing wipes/cloths when necessary to ensure the probe is completely dry. Visually inspect the probe to ensure all surfaces are dry. Repeat drying steps if any moisture is visible.
9. If the probe is not immediately reused, store the probe in a manner that will protect and keep the probe from being recontaminated. This may be accomplished by placing the probe in a storage cabinet with filtered air flow and/or by using a disposable storage cover placed over the probe.

Probe Intermediate-Level Disinfection - Disinfectant Wipe



CAUTION

After each use, inspect the lens, cable, and housing of the probe. Look for any damage that would allow liquid to enter the probe. If the probe is damaged, do not place it into any liquid (e.g. for disinfection) and do not use it until it has been inspected and repaired/replaced by a GE Service Representative.

1. Put on a new pair of gloves. Holding the probe near the strain relief, apply the wipe to the patient contacting lens. Wipe the probe from the lens to the strain relief, slightly rotating the probe after each wiping pass.
2. After the probe has been completely wiped, use a second wipe and starting at the probe lens begin wiping the probe in a rotating motion moving down towards the strain relief. Wring the wipe above recessed areas, seams, and ridges to drip disinfectant directly onto these less accessible surfaces.

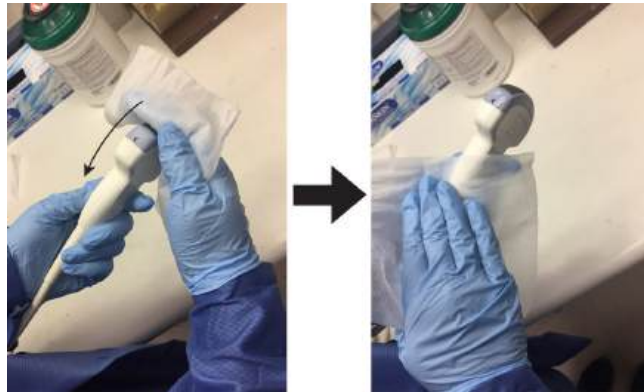


Figure 12-13. Disinfecting the Probe Moving from Lens to Strain Relief

NOTE:

Probes that contact only intact skin may be disinfected in this manner. All probes that contact mucous membranes (e.g., endocavitary, Transesophageal) require High-Level Disinfection.

Probe Intermediate-Level Disinfection - Disinfectant Wipe

(continued)

3. Once the probe has been completely wiped, use a third wipe and continue wiping the probe as needed to ensure the surface remains wet for the required exposure time. Use as many wipes as needed and drip additional disinfectant on recessed areas and ridges, to ensure all surfaces remain wet for the minimum required contact time listed in the disinfectant manufacturer's instructions for use.

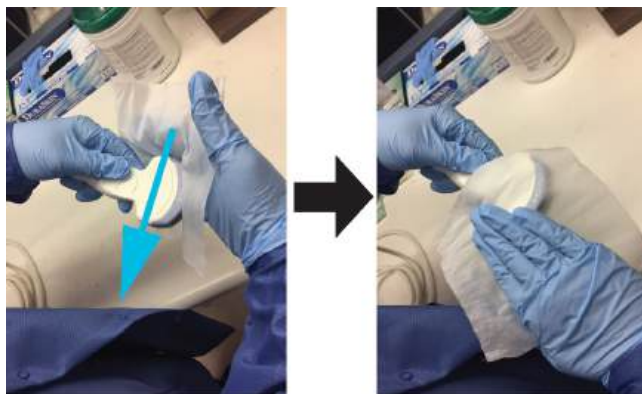


Figure 12-14. Disinfecting the Probe

4. Dry all surfaces of the probe using a soft, lint-free wipe or cloth.
5. Saturate a soft, lint-free wipe with de-ionized or purified water (remove excess water, wipe should be damp but not dripping) and thoroughly wipe all surfaces of the probe to remove chemical residue. Discard the wipe.
6. A total of three (3) rinses are required. Repeat Step 5 two additional times using new wipes and water.



Failure to properly rinse probes with water following disinfection may cause skin irritation.

Probe Intermediate-Level Disinfection - Disinfectant Wipe (continued)

7. Thoroughly dry all surfaces of the probe using a soft, lint-free wipe or cloth, changing wipes/cloths when necessary to ensure the probe is completely dry. Visually inspect the probe to ensure all surfaces are dry. Repeat drying steps if any moisture is visible.
8. If the probe is not immediately reused, store the probe in a manner that will protect and keep the probe from being recontaminated. This may be accomplished by placing the probe in a storage cabinet with filtered air flow and/or by using a disposable storage cover placed over the probe.

Probe High Level Disinfection - Soak

High-Level Disinfection is required for devices that contact intact mucous membranes or non-intact skin. High Level Disinfection can be performed using either a disinfectant soaking method or an automated system such as Trophon® EPR.



CAUTION

After each use, inspect the lens, cable, and housing of the probe. Look for any damage that would allow liquid to enter the probe. If the probe is damaged, do not place it into any liquid (e.g. for disinfection) and do not use it until it has been inspected and repaired/replaced by a GE Service Representative.

1. Ensure the probe has been disconnected from the console. Put on a clean pair of gloves and fill a sink or basin with High-Level Disinfectant diluted in accordance with the disinfectant manufacturers instructions to a level allowing immersion of the probe up to immersion line shown in Figure 12-8 on page 12-45.

NOTE: *Cleaning and disinfection instructions for Transesophageal probes are documented in the Transesophageal Probe Care Card and User Manual.*

NOTE: *All semi-critical probes* that contact mucous membranes require High-Level Disinfection.*

**Semi-critical probes are probes that contact mucous membranes or non-intact skin.*

NOTE: *Handles of semi-critical probes that are not submerged during High-Level Disinfection require low or Intermediate-Level Disinfection to avoid cross contamination.*

Probe High Level Disinfection - Soak (continued)

2. Immerse probe in the disinfectant up to the immersion line and ensure no air bubbles are trapped. Ensure the probe remains in the disinfectant for at least the minimum contact time listed in the disinfectant manufacturer's instructions for use.

NOTE: *Over-exposing ultrasound probes to high-level disinfectants may damage the ultrasound probe. NEVER exceed the disinfectant manufacture's maximum exposure time.*



CAUTION

Ensure that the probe is suspended. The probe face should not be resting against the tank/basin surface and should be in full contact with the liquid. Carefully place the probe in the basin, taking care not to damage the transducer lens.



Figure 12-15. Probe suspended in disinfectant basin

3. Thoroughly rinse the probe by immersing it in a large volume of critical (purified) water for a minimum of 1 (one) minute. Remove the probe and discard the rinse water.
Do not reuse the water. Always use fresh volumes of water for each rinse. Repeat Step 3 two additional times, for a total of 3 (three) rinses.



WARNING

Failure to properly rinse probes with water following disinfection may cause skin irritation.

Probe High Level Disinfection - Soak (continued)

4. Thoroughly dry all surfaces of the probe using a soft, lint-free wipe or cloth, changing wipes' cloths when necessary to ensure the probe is completely dry. Visually inspect the probe to ensure all surfaces are clean and dry. Repeat drying steps if any moisture is visible.
5. If the probe is not immediately reused, store the probe in a manner that will protect and keep the probe from being recontaminated. This may be accomplished by placing the probe in a storage cabinet with filtered air flow and/or by using a disposable storage cover placed over the probe.

The instructions provided above have been validated to properly prepare GE Ultrasound probes for re-use. It remains the responsibility of the processor to ensure that the processing is performed as specified in this document. This may require verification and routine monitoring of the process.

Probe High-Level Disinfection - Trophon® EPR

When performing High-Level Disinfection of GE ultrasound probes with the Trophon® EPR, it is not necessary to disconnect the probe from the ultrasound system. The probe must be inactive (not selected) during the disinfection cycle.

1. Upon completion of probe cleaning, ensure the probe has been thoroughly dried with a clean, lint-free soft and dry cloth or wipe. Carefully dry the probe by wiping from the distal tip to the strain relief.



CAUTION

DO NOT use abrasive paper products when cleaning or wiping a GE Ultrasound Probe. The use of abrasive wipes can damage the soft lens (acoustic window).



CAUTION

DO NOT use a twisting motion when wiping the probes as this may damage the soft lens.

2. Visually inspect the probe to ensure the probe is visibly clean.
3. Follow the Trophon instructions for probe placement and operation of the Trophon system. Incorrect positioning of the probe may lead to High-Level Disinfection not being achieved.



CAUTION

Damage to the probe may occur if the probe is placed in contact with the Trophon chamber wall. Curved probes must be correctly positioned in the chamber using the Curved Probe Positioner (CPP) supplied with the Trophon system.

4. Once the Trophon High-Level Disinfection cycle is complete, don a new set of gloves and promptly remove the probe from the Trophon machine. DO NOT allow the probe to remain in the machine for extended periods of time.

Probe High-Level Disinfection - Trophon® EPR (continued)

5. Hold the probe at the proximal end near the strain relief cable. DO NOT suspend or hold the probe by the cable, as this may damage the probe.
6. Wipe the probe from the distal end to the proximal end with a clean, lint-free soft and dry cloth or wipe to remove any residual hydrogen peroxide from the probe surface.



CAUTION

DO NOT use a twisting motion or abrasive paper products when wiping the probe.

7. If the probe is not immediately reused, store the probe in a manner that will protect and keep the probe from being recontaminated. This may be accomplished by placing the probe in a storage cabinet with filtered air flow and/or by using a disposable storage cover placed over the probe.

Covering the Transducer using a Sterile, Protective Sheath



CAUTION

Protective barriers may be required to minimize disease transmission. Probe sheaths are available for use with all clinical situations where infection is a concern. Use of legally marketed, sterile probe sheaths is mandatory for intra-cavitary and intra-operative procedures.

1. Place an appropriate amount of gel inside the protective sheath and/or on the transducer face.

NOTE:

Failure to use imaging gel may result in poor image quality.

2. Insert transducer into sheath, making sure to use proper sterile technique. Pull cover tightly over transducer face to remove wrinkles and air bubbles, taking care to avoid puncturing the sheath.



Figure 12-16. Applying the Sheath

1. Secure the Sheath with a rubber band.
2. The probe sheath should extend past the end of the probe to the probe's cable.

Covering the Transducer using a Sterile, Protective Sheath (continued)

NOTE: No gel was applied to the probe in this photo.

3. Secure the sheath in place.

NOTE: Failure to use a sheath that fully covers the transducer to the cable strain relief may lead to cross-contamination of the transducer.

4. Inspect the sheath to ensure there are no holes or tears. If the sheath becomes compromised, stop the procedure and replace immediately.

Coupling gels

In order to ensure optimal transmission of energy between the patient and probe, a conductive gel or couplant must be applied liberally to the patient where scanning will be performed.



CAUTION

Do not apply gel to the eyes. If there is gel contact to the eye, flush eye thoroughly with water.



CAUTION

Only use GE-recommended gels. Use of unapproved gels may result in damage to the probe and void the warranty.

Refer to the Probe Care Card enclosed in the probe case or to the Internet link below for the latest list of compatible coupling gels.

http://www3.gehealthcare.com/en/Products/Categories/Ultrasound/Ultrasound_Probes

Precautions

Precautions: coupling gels should not contain the following ingredients as they are known to cause probe damage:

- Methanol, ethanol, isopropanol, or any other alcohol-based product
- Mineral oil
- Iodine
- Lotions
- Lanoline
- Aloe Vera
- Olive Oil
- Methyl or Ethyl Parabens (para hydroxybenzoic acid)
- Dimethylsilicone
- Polyether glycol based
- Petroleum

Probe Safety

Electrical hazards

Probes are driven by electricity, which can injure the patient or user when exposed to contact with conductive solution.



Do not immerse the probe into any liquid beyond the level shown in Figure 12-8 *on page 12-45*. Never immerse the probe connector or adaptors into any liquid.

Do not subject the probe to mechanical shock or impact, which may result in cracks or chips in the housing and degrade performance.

Inspect the probe before and after each use, as described on page 12-33, for damage or degradation to the housing, strain relief, lens and seal.

DO NOT apply excessive force to the probe cable, to prevent insulation failure.

Electrical leakage checks should be performed regularly by a GE service representative or qualified hospital personnel, according to the procedures described in EN 60601-1/ IEC 60601-1.

Mechanical hazards

Take precaution to avoid mechanical hazards.



WARNING

Observe immersion levels as displayed in Figure 12-8 on *page 12-45*.

Inspect probes for sharp edges or rough surfaces that could injure sensitive tissue.

DO NOT bend or pull the cable forcefully, to avoid mechanical shock or impact to the probe.

Biological hazards



CAUTION

Transesophageal and intraoperative probes and ICE catheters require a special handling. Refer to the user documentation enclosed with these probes.



CAUTION

Protective barriers may be required to minimize disease transmission. Probe sheaths are available for use with all clinical situations where infection is a concern. Use of legally marketed, sterile, pyrogen free probe sheaths is required for neurological intra-cavity and intra-operative procedures.



CAUTION

According to local regulations, the use of sterile sheath is mandatory when performing intra-cavity procedures in China.

To reorder sheaths, please contact your local distributor or the appropriate support resource.

Adequate cleaning and disinfection are essential to prevent disease transmission. It is the responsibility of the user to verify and maintain the effectiveness of the infection control procedures in use.



CAUTION

Risk of Infection. ALWAYS clean and disinfect the probe between patients to the level appropriate for the type of examination and use FDA-cleared probe sheaths where appropriate.

Special handling instructions

Using protective sheaths



Protective barriers may be required to minimize disease transmission. Probe sheaths are available for use with all clinical situations where infection is a concern.

Always use a legally marketed, sterile probe sheaths for intra-cavitary and intra-operative procedures.

For neurological intra-operative procedures, use of a legally marketed, sterile, pyrogen free probe sheath is **REQUIRED**.

Sterile probe sheaths are supplied as part of biopsy kits for those probes intended for use in biopsy procedures. In addition to the sheath and elastic bands, there are associated accessories for performing a biopsy procedure which are included in the kit. Refer to the biopsy instructions for the specific probes in the Discussion section of this chapter for further information.

Instructions. Custom made sheaths are available for each probe. Each probe sheath kit consists of a flexible sheath used to cover the probe and cable and elastic bands used to secure the sheath.

Reordering. To reorder sheaths, please contact your local distributor or the appropriate support resource.

Using protective sheaths (continued)



CAUTION

Devices containing latex may cause severe allergic reaction in latex sensitive individuals. Refer to FDA's March 29, 1991 Medical Alert on latex products.



CAUTION

Do not use pre-lubricated condoms as a sheath. In some cases, they may damage the probe. Lubricants in these condoms may not be compatible with probe construction.



CAUTION

DO NOT use an expired probe sheath. Before using probe sheaths, verify whether the term of validity has expired.

Endocavity Probe Handling Precautions

If the probe is contaminated with residuals of disinfectant before use, please follow the cautions below.



CAUTION

Sterile/sanitary sheaths are to be used on the probe during its actual use with patients. Wearing gloves protects the patient and operator.



CAUTION

If there is disinfectant leaking from the probe, DO NOT use the probe until it has been inspected and released for further use by a GE service representative.



CAUTION

Disinfectant Exposure to Patient: contact with a disinfectant to the patient's skin or mucous membrane may cause an inflammation. If this happens, refer to the disinfectant's instruction manual.

Disinfectant Exposure from Probe Handle to Patient: DO NOT allow the disinfectant to contact the patient. Only immerse the probe to its specified level. Ensure that no solution has entered the probe's handle before scanning the patient. If disinfectant comes into contact with the patient, refer to the disinfectant's instruction manual.

Disinfectant Exposure from Probe Connector to Patient: DO NOT allow the disinfectant to contact the patient. Only immerse the probe to its specified level. Ensure that no solution has entered the probe's connector before scanning the patient. If disinfectant comes into contact with the patient, refer to the disinfectant's instruction manual.

Restricted Areas

This equipment must not be used in the presence of inflammable gases.



CAUTION

This equipment is not to be used during transportation (e.g. ambulance cars, aircraft), but it is transportable between rooms (bedside-scanning).



CAUTION

This equipment can only be used up to a sea level of 2360m, if no other information is available.

Leakage of Silicon Grease

NOTE: *Sporadically, silicone grease can leak in small amounts from the probes' cable bushing. This leakage is not a failure or harmful to the human body. Silicone grease does not contain any hazardous substances and is only used to seal the cable bushing. In case of a leakage wipe the grease with a cloth.*

Probe handling and infection control

This information is intended to increase user awareness of the risks of disease transmission associated with using this equipment and provide guidance in making decisions directly affecting the safety of the patient as well as the equipment user.

Diagnostic ultrasound systems utilize ultrasound energy that must be coupled to the patient by direct physical contact. Depending on the type of examination, this contact occurs with a variety of tissues ranging from intact skin in a routine exam to recirculating blood in a surgical procedure. The level of risk of infection varies greatly with the type of contact.

One of the most effective ways to prevent transmission between patients is with single use or disposable devices. However, ultrasound transducers are complex and expensive devices that must be reused between patients. It is very important, therefore, to minimize the risk of disease transmission by using barriers and through proper processing between patients.



Risk of Infection. ALWAYS clean and disinfect the probe between patients to the level appropriate for the type of examination and use FDA-cleared probe sheaths where appropriate.



Adequate cleaning and disinfection are necessary to prevent disease transmission. It is the responsibility of the equipment user to verify and maintain the effectiveness of the infection control procedures in use. Always use sterile, legally marketed probe sheaths for intra-cavitary and intra-operative procedures.

For neurological intra-operative procedures, use of a legally marketed, sterile, pyrogen free probe sheath is **REQUIRED**. Probes for neuro surgical use must not be sterilized with liquid chemical sterilants because of the possibility of neuro toxic residues remaining on the probe.

Probe handling and infection control (continued)



CAUTION

In order for liquid chemical disinfectants to be effective, all visible residue must be removed during the cleaning process. Thoroughly clean the probe, as described earlier before attempting disinfection.

You **MUST** disconnect the probe from the Vivid *iq* prior to cleaning/disinfecting the probe. Failure to do so could damage the system.

DO NOT soak probes in liquid chemical disinfectant for longer than is stated by the disinfectant instructions for use. Extended soaking may cause probe damage and early failure of the enclosure, resulting in possible electric shock hazard.



WARNING

Ultrasound transducers can easily be damaged by improper handling and by contact with certain chemicals. Failure to follow these precautions can result in serious injury and equipment damage.

- Do not immerse the probe into any liquid beyond the level specified for that probe. Never immerse the transducer connector or probe adapters into any liquid.
- Avoid mechanical shock or impact to the transducer and do not apply excessive bending or pulling force to the cable.
- Transducer damage can result from contact with inappropriate coupling or cleaning agents:
 - Do not soak or saturate transducers with solutions containing alcohol, bleach, ammonium chloride compounds or hydrogen peroxide
 - Avoid contact with solutions or coupling gels containing mineral oil or lanolin
 - Avoid temperatures above 50°C.
- Inspect the probe prior to use and after use for damage or degeneration to the housing, strain relief, lens and seal. Do not use a damaged or defective probe.

6Tc-RS,9T-RS/6VT-D Probe Thermal Safety

Maintaining a safe thermal environment for the patient has been a design priority at GE. It is generally agreed that in order to avoid damage to body tissues, for long term exposures, tissue contact probe tip temperatures should be less than 42.7 °C (for 6Tc-RS,9T-RS)/42.5 °C (for 6VT-D). The ultrasound scanner incorporates an elaborate thermal safety system which informs the physician of the operating temperature of the probe, and prevents the operative temperature from exceeding given limits. Whenever the 6Tc-RS/9T-RS/6VT-D Probe is plugged into the system and selected, the probe tip temperature is displayed on the system monitor.

If the temperature sensor is not working properly when you plug the probe into the system, the probe will not be accepted and scanning will not be possible.

If the probe temperature is over 42.7 °C (for 6Tc-RS,9T-RS)/42.5 °C (for 6VT-D) (including probe temperature measurement error), the system will shut down the probe transmitting.

The absolute tolerance of 6Tc-RS, 6VT-D, 9T-RS probe surface temperature measurement is less than 0.5°C.

High temperature protection levels

The temperature is always displayed on the system monitor. The system has two levels of upper thermal limit: the first high limit is set at 41.0 °C, and the second high limit is set at 42.7 °C (for 6Tc-RS,9T-RS)/42.5 °C (for 6VT-D). If the temperature of the probe tip reaches 41.0 °C, the temperature display turns red, the system enters freeze mode, and a warning appears on the monitor, asking the user if he/she wishes to continue scanning up to a higher temperature limit. If the response is OK, the scanner will resume scanning. If he/she selects Cancel, or no response is given, the system will remain in Freeze mode. If the temperature reaches 42.7 °C (for 6Tc-RS,9T-RS)/42.5 °C (for 6VT-D), the system will freeze unconditionally. The user will not be allowed to start scanning until the temperature has decreased 0.5 °C below the limit where the system entered Freeze mode. To restart scanning, the user must press the Freeze button.



CAUTION

Transesophageal probes require special handling. Refer to the user documentation enclosed with these probes.

6Tc-RS/6VT-D Probe

After the probe has been selected, the scan plane positioning system automatically calibrates. This calibration cycle lasts 10 to 15 seconds. After the calibration is complete, the probe temperature sensor is activated, and the probe temperature is displayed.

In case the initialization of the probe fails (no response from the scan plane button after initialization), re-select the probe to repeat the initialization routine.

Biopsy

User qualification for biopsy

Biopsies must only be performed by physicians with adequate experience. Under all circumstances the necessary safety precautions and sterility measures have to be respected.

Introduction

The system supports biopsy capability for the 9L-RS, 12L-RS, 3Sc-RS, C1-5-RS, 4C-RS, M5Sc-RS, ML6-15-RS, E8Cs-RS and L4-20t-RS probes. The biopsy option is intended for use by a duly licensed physician who has received the appropriate training in biopsy techniques as dictated by current relevant practices, as well as in proper operation of the ultrasound unit.

Precaution concerning the use of biopsy procedures



WARNING

Do not freeze the image during a biopsy procedure. The image must be live to avoid a positioning error.



CAUTION

The use of biopsy devices and accessories that have not been evaluated for use with the equipment may not be compatible and could result in injury.



CAUTION

The invasive nature of biopsy procedures requires proper preparation and technique to control infection and disease transmission. Equipment must be cleaned and disinfected as appropriate for the procedure prior to use.

- Follow the probe cleaning and disinfection procedures and precautions to properly prepare the probe.
- Follow the manufacturer's instructions for reprocessing of biopsy devices and accessories.
- After use, follow proper procedures for decontamination, cleaning, and waste disposal.

Improper cleaning methods and the use of certain cleaning and disinfecting agents can cause damage to the plastic components that will degrade imaging performance or increase the risk of electric shock.

General biopsy safety



CAUTION

All biopsy equipment depicted and described in these Instructions for use has been validated for use with the system and software. If biopsy equipment which is not listed in these Instructions for use is used, the user has the possibility to configure and store the predicted biopsy line. In this case the user has to be aware that the biopsy equipment/probe/system/software combination may not be validated and therefore responsibility for correct configuration and usage lies with the user.



CAUTION

- Use of legally marketed, sterile probe sheaths is recommended for biopsy procedures
- Before using a biopsy guide, read and follow the biopsy guide independent manuals given by the manufacturer
- Every time before using a biopsy guide ensure its correct position and optimal fit on the probe.
- Always use a straight needle for each biopsy procedure.
- Before performing a biopsy, ensure that the selected and displayed biopsy line corresponds to the biopsy needle guide mounted to the ultrasound probe (left/right).
- The biopsy needle and the biopsy needle guide (and the bore inside) must be sterile.

General biopsy safety (continued)



CAUTION

For detailed information on a biopsy guide, please contact the manufacturer of the biopsy guide.



CAUTION

Biopsy equipment is not sterile when delivered unless it is clearly labeled! If biopsy equipment is not sterile it is mandatory to clean and sterilize it before usage. For additional details please contact the legal manufacturer of the biopsy equipment.



CAUTION

Ensure the correct position and optimal fit every time before using a biopsy guide.



CAUTION

- Disposable biopsy guides: Single-use components must be disposed as infectious waste.
- Reusable biopsy guides must be sterilized before they are disposed.



CAUTION

Before starting a biopsy procedure with a 3D/4D probe always perform a volume scan first. This is important to ensure proper mechanical alignment and centering of the transducer element before the biopsy is performed.

General biopsy safety (continued)



CAUTION

- The default biopsy lines provided with the system software, must be verified at least once by the user. The procedure must be repeated if probes and/or biopsy guides are exchanged.
- Before performing a biopsy, prepare a water bath of approx. 47°C and make sure that the displayed biopsy line coincides with the needle track. Observe probe specific information on the temperature of the water bath.
- The needle used for water bath alignment must not be used for a biopsy performed on a patient.
- Depending on the needle stiffness/thickness and the elasticity and composition of the different tissue-types in the path of the biopsy needle, the actual needle track can deviate from the predicted biopsy line. The biopsy needle might bend and not follow a straight line.

Freehand biopsy



CAUTION

When performing a freehand biopsy, i.e. without a biopsy guide, it is the user's responsibility to use appropriate equipment. Ensure that the needle (especially the needle tip) is always visible in the ultrasound image during the whole biopsy procedure.



CAUTION

Always only use basic modes when performing a freehand biopsy.

NOTE: *A water bath alignment verification is also necessary before performing freehand biopsy procedures.*

Reusable biopsy needle guides



CAUTION

For cleaning and sterilization of biopsy guides, see “Probe Biopsy Guide Processing Procedures” in Ultrasound Probes and Accessories Reprocessing Manual.

Preparing the Biopsy guide attachment - Convex, Sector and Linear probes

Convex, Sector and Linear probes have an optional biopsy kit specific for each probe. The biopsy kit consists of:

- A reusable non-sterile bracket
- Disposable sterile Ultra-Pro II™ Needle guide kits (Civco Medical Instruments Co, Inc.) consisting of:
 - Sets with needle inserts covering gauge size 14 through 23 (2.1 mm to 0.6 mm)
 - Sterile sheath
 - Rubber bands
 - Gel
- A reusable needle guide
- Instructions

In addition sterile Ultra-Pro II™ Needle guide kits can be ordered as replacement kit.



NEVER reuse the TR5° disposable biopsy guide attachment and Disposable sterile Ultra-Pro II Needle guide kits.



Read the following instructions and the user's guide for the Ultra-Pro II™ Needle Guide kit before using the biopsy equipment.

Disposable components are packaged sterile and are single-use only. Do not use if integrity of packing is violated or if expiration date has passed.

Bracket attachment procedure

1. Identify the appropriate biopsy guide bracket as shown in Figure 12-17.

Probe	Biopsy Guide	Biopsy bracket
9L-RS	Multi-angle, disposable with a reusable bracket	
12L-RS	Multi-angle(in plane biopsy kit), Disposable with a Reusable Bracket	
	Infinite-angle (in plane biopsy kit), Disposable with a Reusable Bracket	
ML6-15-RS	Multi-angle, disposable with a reusable bracket	
3Sc-RS	Multi-angle, disposable with a reusable bracket	

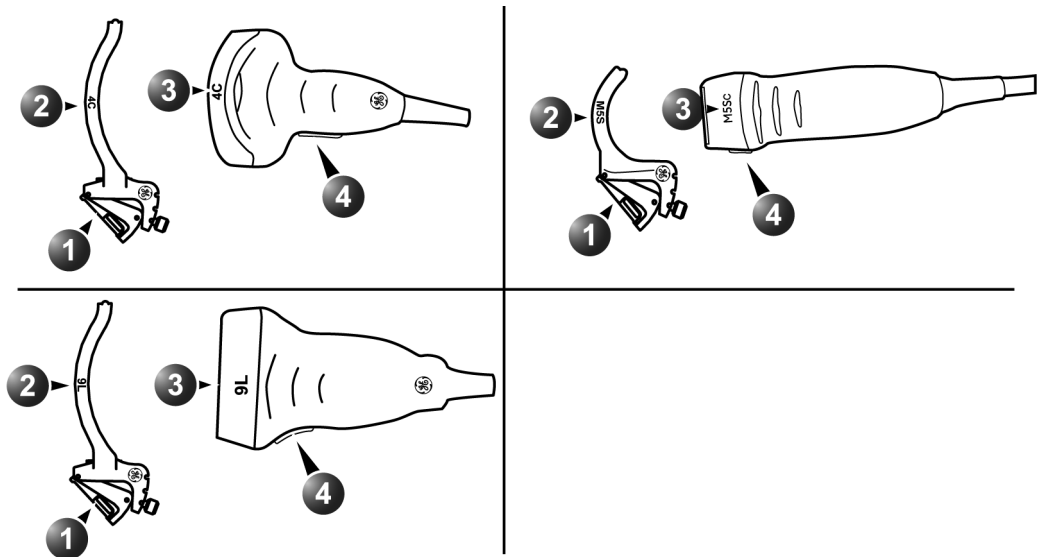
Probe	Biopsy Guide	Biopsy bracket
C1-5-RS	Multi-angle, disposable with a reusable bracket	
4C-RS	Multi-angle, disposable with a reusable bracket	
E8Cs-RS	Fix angle, disposable with a plastic bracket	
	Fixed angle, reusable with a stainless steel bracket	
M5Sc-RS	Multi-angle, disposable with a reusable bracket	
L4-20t-RS	Multi-angle, disposable with a reusable bracket	

Figure 12-17. The biopsy brackets

Bracket attachment procedure (continued)

2. Orient the bracket so that the needle clip attachment is on the same side as the probe orientation mark, see Figure 12-18.
3. Attach the biopsy bracket to the probe by sliding the bracket over the end of the probe until it clicks or locks into place.

Make sure the bracket is firmly attached to the probe.



1. Needle clip attachment on the bracket
2. Bracket label
3. Probe label
4. Probe orientation mark

Figure 12-18. Probe/bracket alignment (representative examples)

Placing the probe and bracket into the sterile sheath

Refer to the Ultra-Pro II™ Needle Guide user manual.

Attaching the needle guide to the bracket

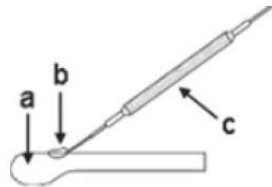
Refer to the Ultra-Pro II™ Needle Guide user manual.

Biopsy guide mounting

All biopsy needle guides can easily be mounted to the transducer. Biopsy guides have a special stop or handle to guarantee a good fix into the notch of transducers.

Installation of the attachment

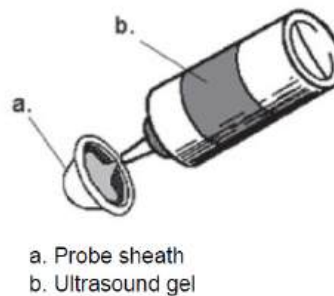
Before installing the attachment, the filling must be removed from the probe head where the biopsy guide attachment will be installed. This is only for first time installation. See Figure 12-19.



- a. Probe head
- b. Area where the biopsy guide attachment is installed
- c. Filling remover tool

Figure 12-19. Remove the filling

1. Fill the probe sheath with acoustic coupling gel as shown in Figure 12-20.



- a. Probe sheath
- b. Ultrasound gel

Figure 12-20. Ultrasound gel placement

Installation of the attachment (continued)

2. Place the gel-filled probe sheath on the transducer face and bring it up the probe body so that the adjustment knob of the probe is completely covered with the probe sheath as shown in Figure 12-21.

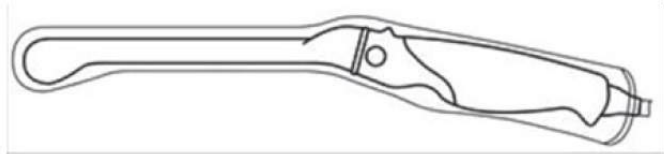


Figure 12-21. Probe sheath application

3. Apply gel to outer surface of the probe sheath at the transducer location for scanning.
4. shows the relationship between the displayed image direction during an axial scan compared to the probe and probe position.

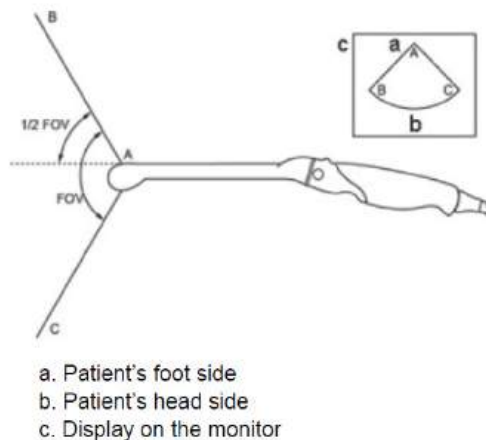


Figure 12-22. Scan plane orientation

Displaying the Guide zone

1. Select **Biopsy** on the Side Bar at the right side of the touch screen.
2. If the needle multi-angle is supported, select the correct angle from the *Biopsy* menu.

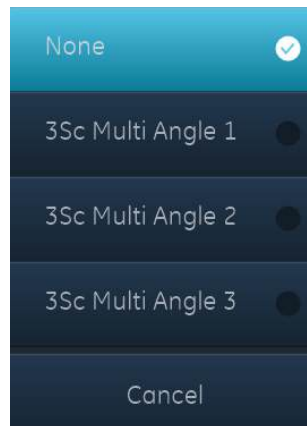
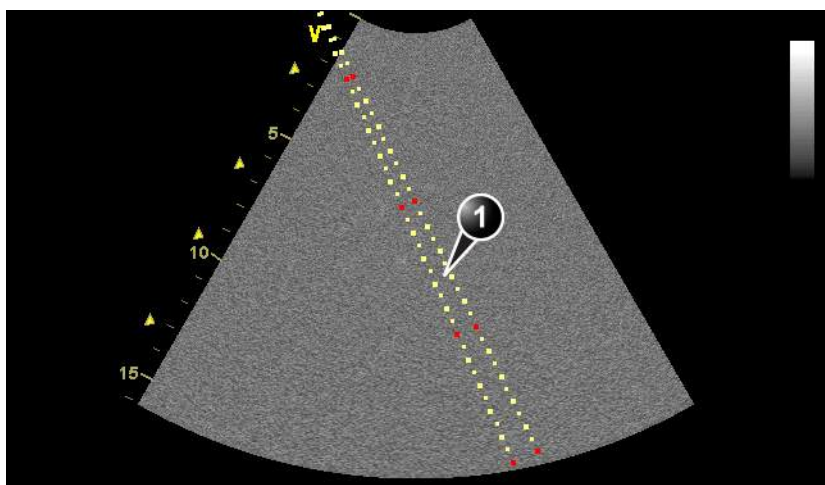


Figure 12-23. The Biopsy menu

Displaying the Guide zone (continued)

The biopsy guide zone is displayed on the screen.



1. Biopsy guide zone

- 5 cm between the red marks
- 1 cm between the large yellow marks
- 0.5 cm between two consecutive marks

The first red mark is at 5 cm from the top of the needle guide.

Figure 12-24. Biopsy guide zone

Biopsy needle path verification

Perform the Needle path verification once a year or whenever there is a suspicion of malfunction.

To verify that the path of the needle is accurately indicated within the guide zone on the system monitor, perform the following:

1. Properly install the bracket and biopsy guide (see page 12-79).
2. Scan in a container filled with a glycerol solution (6% in water).
3. Display the biopsy guide zone on the monitor (see page 12-85).
4. Ensure that the needle echo falls within the guide zone markers.

Starting the biopsy procedure

1. Select **Biopsy** on the Side Bar at the right side of the touch screen.
2. Place sterile coupling gel on the scanning surface of the probe/sheath.
3. Scan to locate the target. Center the target in the electronic guidezone path.

NOTE: *Enabling color flow would allow for visualization of the vascular structure around the area to be biopsied.*

4. Place the needle in the guide between the needle barrel and needle clip. Direct it into the area of interest for specimen retrieval.

Cleaning, disinfection and disposal

1. Refer to the Ultra-Pro II™ Needle Guide user manual for cleaning and disinfection of the bracket.
2. Perform cleaning and disinfection of the probe as described in page 12-45.
3. Dispose the sheath, bands and needle guide after use, according to medical regulations for biohazardous waste.



CAUTION

When the biopsy needle guide kit is opened, all parts must be discarded after the procedure whether they have been used or not.

Manual cleaning for E8Cs-RS biopsy guides(E721 STARTER KIT)

NOTE: *Efficacy of this manual cleaning process has been validated using Cidezyme/ENZOL Enzymatic Detergent.*

1. Remove the biopsy guide and protective sheath(s) from the probe.
2. Whenever possible the biopsy guide should be rinsed immediately after use. If the biopsy guide cannot be cleaned immediately after use, cover the biopsy guide with a towel dampened with purified water. Devices may remain in this condition for a maximum of 4 hours.
3. Remove all visible soil. Flush the biopsy guide using utility water (30 - 40°C) for not less than 2 minutes.
4. Prepare the enzymatic detergent according to the manufacturer's recommendations, using utility water.
5. Submerge the biopsy guide in the prepared solution and soak for no less than 2 minutes.
6. After the 2-minute soak, while the biopsy guide is submerged in the cleaning solution, vigorously scrub the device with a soft nylon bristle brush.
7. Use a round nylon cleaning brush to clean the biopsy lumen. Use a syringe to flush cleaning solution through the lumen. Scrub the device for a minimum of 2 minutes.
8. Remove the device from the cleaning solution and rinse thoroughly under running utility water (30 - 40°C) taking care to remove any visible detergent. Rinse the device for a minimum of 1 minute.
9. Visually inspect the device for any residual soil or detergent. Repeat steps 6 through 8 until the device is visibly clean.



CAUTION

Do not clean any portion of the attachment with methanol, ethanol, isopropanol, or any other alcohol base detergent. Such substances can cause irreparable damage to the attachment.

Autoclave sterilization for E8Cs-RS biopsy guides(E721 STARTER KIT)

NOTE: Sterilization efficacy testing was performed using worst-case parameters for time, temperature and load density. Parameters listed in the tables are the minimum required to ensure a Sterility Assurance Level (SAL) of 10⁻⁶ or better.

- 1. Place the cleaned biopsy guide in an approved autoclave pouch.
- 2. Autoclave using the following parameters.

Table 12-6: Autoclave sterilization parameters

Parameter	Cycle Type 1	Cycle Type 2
Sterilizer	Pre-vacuum	Pre-vacuum
Preconditioning Pulses	3	3
Temperature (Minimum)	132°C	121°C
Exposure Time (Minimum)	3 Minutes	20 Minutes
Drying Time (Minimum)	15 Minutes	15 Minutes
Package Configuration	Tyvek Pouch (14 x 25 cm)	Tyvek Pouch (14 x 25 cm)

Probe Check

Introduction

Probe Check is a probe assessment tool that evaluates each probe element integrity by transmitting on one channel at the time and recording the lens reflection, while scanning in the air. During the test the probe lens should be clean because any gel residue might affect the test result. This test is intended to be used during the life of the probe to evaluate possible probe deterioration over time.

Activation of the Probe Check can be done manually from the probe/application menu, or run automatically when the probe/application is selected. The interval of the automatic test can be configured in the system configuration.

The Probe Check evaluates the ratio of weak elements to total element count and the overall reflection level from the probe lens. If the Probe Check fails, the user is still allowed to continue using the probe, but should then evaluate if the image quality is adequate for clinical use.

NOTE: *Probe Check checks element integrity. There are other defects that can deteriorate probe performance that the Probe Check cannot detect, so the user should evaluate whether the probe performance is adequate regardless of the outcome of the test.*

NOTE: *GE is NOT responsible for the confirmation regarding the normal function of the ultrasound probe before use.*

Supported probes

The probes that currently have this test available have a button labelled **Test Probe** in the probe/application menu. To activate the test manually one should open the probe menu and select Preset **Config/Test Probe** at the bottom of the application list. The **Test Probe** button is then available in the application menu.

Probe Test Activation

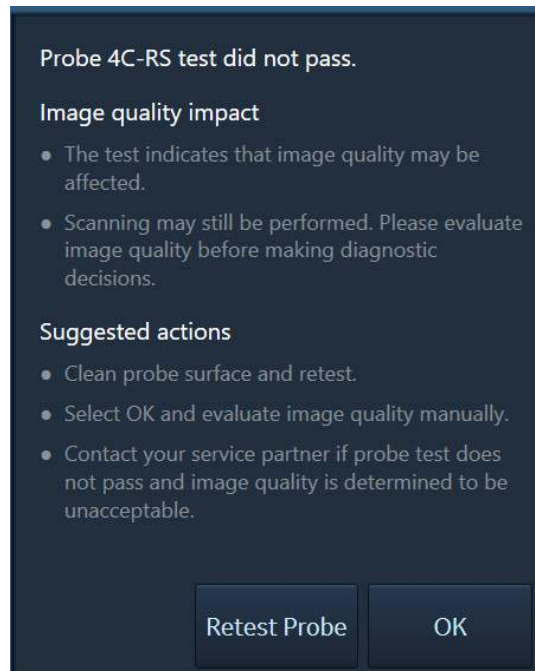
Auto Trigger

When the probe is connected to the scanner, the probe test will run automatically when you select probe/application. The interval between testing can be configured, and the test will run at probe/application selection when the previous test of the chosen probe type is older than the configured interval.

When the probe test is activated during probe/application selection, then “Probe Check: Checking probe, please wait...” is displayed in the info bar at the bottom of the screen, then “Loading Probe/Application, please wait...” and finally “Probe Check: Probe test passed” if the test passed.

Auto Trigger (continued)

However, if the test fails the following user dialog appears:



Probe Check Message:

Probe test did not pass

Image Quality impact information

- The test indicates that image quality may be affected.
- Scanning may still be performed. Please evaluate image quality before making diagnostic decisions.

Suggested actions:

- Clean probe surface and retest.
- Select OK and evaluate image quality manually.
- Contact your service partner if probe test does not pass and image quality is determined to be unacceptable.

Figure 12-25. Failed test user dialog

The dialog informs the user that the probe element integrity check failed, and image quality may be suboptimal.

Auto Trigger (continued)

If the lens is not clean, it should be cleaned, and the test should be repeated by selecting the **Retest Probe** button. Even if the test fails one can resume scanning by selecting the **OK** button. The image quality and the probe sensitivity should in that case be evaluated and judged whether it is acceptable for clinical use and diagnostic decisions.

If image quality is confirmed not acceptable, please contact your Service partner.



CAUTION

DO NOT allow the probe head to hang free. Any possible impacts to the probe head could result in irreparable damages to the probe.

Auto Trigger interval configuration

The Probe Check frequency can be configured by entering **Config > Imaging > Probe Check** where one can select from five intervals:

- **Every exam:** probe check will be activated for each exam.

NOTE: Every exam is selected as default.

- **Once 1 day:** probe check will be activated upon probe/application selection if it is more than one day since last time the check was performed.
- **Once 7 days:** probe check will be activated upon probe/application selection if it is more than seven days since last time the check was performed.
- **Once 30 days:** probe check will be activated upon probe/application selection if it is more than thirty days since last time the check was performed.
- **Never:** probe checking will never execute during probe/application selection. If this choice is configured the user should run the test manually at regular intervals.

Auto Trigger interval configuration (continued)

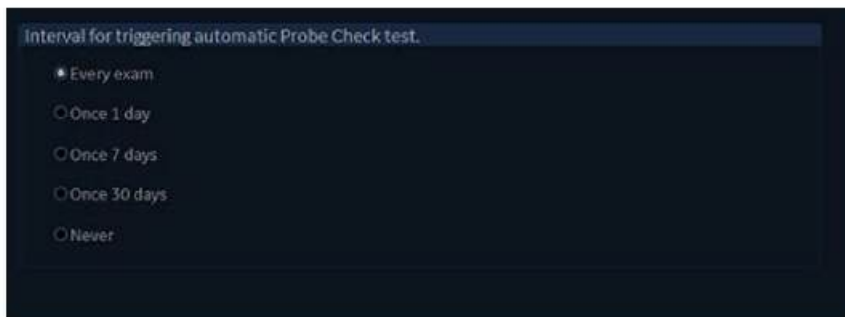


Figure 12-26. Configuration screen for Probe Test interval

If the auto test frequency is set low in the configuration, it is recommended to run Probe Check manually on a regular basis and especially if the probe performance shows sign of image or sensitivity deterioration. For curved and linear probes, compromised probe elements will typically show up as a localized dark area at shallow depths. For phased arrays, all elements are used for all imaging directions, but fewer elements are used at shallow depths, so loss of elements is most likely to give reduced image intensity at shallow depths. The following three images illustrate this.

Auto Trigger interval configuration (continued)

Figure 12-27. Example of image degradation for a curved probe



Figure 12-28. Example of image degradation for a linear probe

Auto Trigger interval configuration (continued)



Figure 12-29. Example of image degradation for a phased array probe

Manual Trigger

Users can run the Probe Test manually at any time by entering the probe menu, selecting the probe to be tested, and then selecting the **Preset Config/Test Probe** button at the bottom of the application list. This menu displaying all applications will have a **Test Probe** button at the lower right corner if the Probe Test is available for the probe in question.

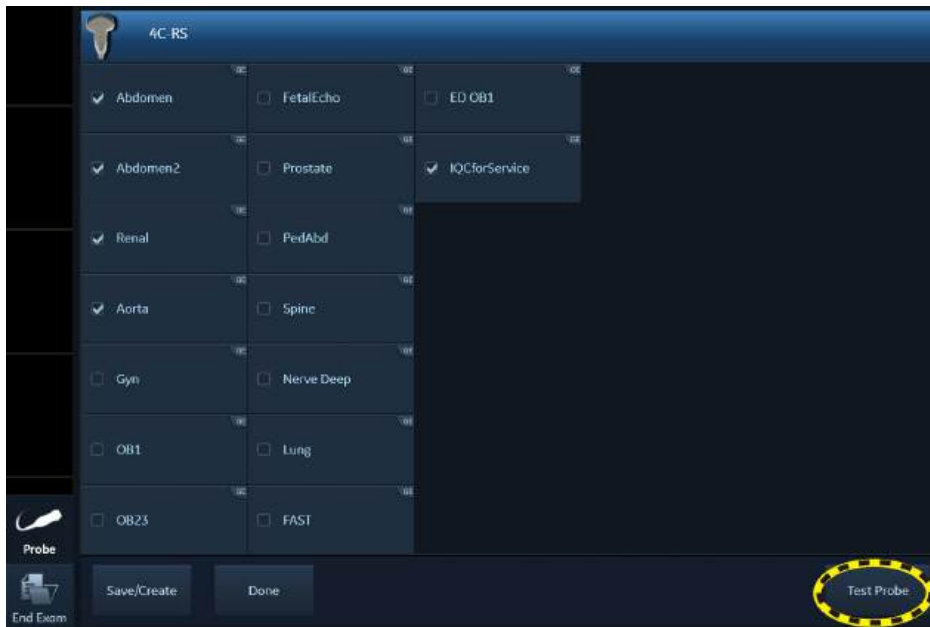
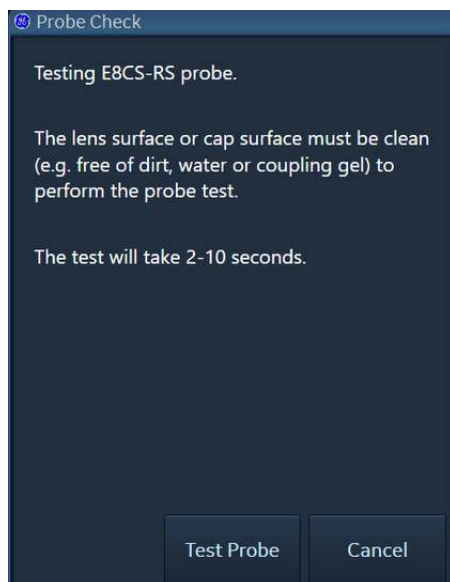


Figure 12-30. Manual Probe Test

Manual Trigger (continued)

After selecting the **Test Probe** button the following user dialog will appear:



Probe Check Message:

Probe test
The lens surface or cap surface must be clean (e.g. free of dirt, water or coupling gel) to perform the probe test.
The test will take 2-10 seconds.

Figure 12-31. Probe Test manual activation user dialog

After selecting **Test Probe** the probe test activates and the user feedback is the same as described for the automatically activated "Probe Test".

Surgery/Intra-operative Use

Preparing for Surgery/Intra-operative Procedures

Preparing the transducer for intra-operative use follows the same sterile procedure as for biopsy use except that no biopsy attachments are used. See 'Preparing the Biopsy guide attachment - Convex, Sector and Linear probes' on *page 12-78 for more information*. Sterile gel is applied to the transducer face and a sterile sheath completely covers the transducer and cable which has first undergone a thorough cleaning and high-level disinfection.



CAUTION

For surgery/intra-operative procedures, a sterile environment is required. Therefore, the probe must be thoroughly cleaned and high-level disinfected prior to use.

Preparing for Surgery/Intra-operative Procedures (continued)

To ensure a sterile environment during the procedure, it is recommended that this be a two-person job.

1. Perform a high level disinfection of the probe.
2. The scanner (surgeon, sonographer, etc.) should be sterile and gloved.
3. Place an adequate amount of sterile coupling gel on the face of the probe.
4. Place the proper sterile sheath over the probe and cord.

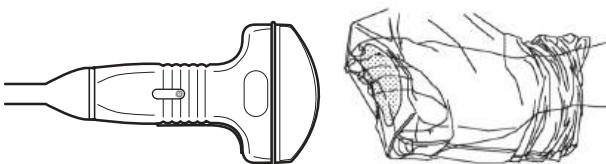


Figure 12-32. Applying Sterile Sheath

5. Depending on the type of procedure, use either sterile water or sterile gel on the sheath cover.

Chapter 13

Peripherals

This chapter describes:

‘Printing’ on page 13-8.

‘Printing Configuration’ on page 13-9

Introduction

Peripherals

This chapter provides information on peripherals that can operate with the ultrasound unit and be used in the patient environment.

- SONY UP-D898MD B/W Printer
- SONY UP-D25MD Color Printer
- Footswitch MKF 2-MED USB GP26 (option)
- Internal ECG
- External ECG
- Pediatric ECG electrodes
- NetGear A6210/A8000 wireless network Adapter
- LITEON eUAU108 DVD-R/W (option)
- Transcend DVD Writer kit
- HDMI to S-video/VGA: TVC-0104AA
- Isolated HDMI Splitter: DVT-8211HM
- USB memory stick
- USB HDD
- Digital Expert Kit

NOTE: *The Vivid iq does not support software encrypted USB stick.*

Introduction (continued)



WARNING

Any devices or cables, other than those sold with the ultrasound unit, connected to the Peripheral /accessory connector panel or to an USB port on the unit may result in an increase of the electromagnetic emission from the unit, or a decrease of the electromagnetic immunity of the unit.



CAUTION

Use only GE approved internal equipment when replacing an internal peripheral.

External peripheral equipment must be in compliance with related IEC standards for safety. The electrical medical systems conformance to IEC60601-1 or EN must be verified.

All devices meeting IEC60950 must be kept outside of the patient environment, as defined in IEC60601-1, unless it, according to IEC60601-1, is equipped with additional protective earth or extra isolating transformer. Commercial devices such as laser cameras, printers, VCRs and external monitors, usually exceed allowable leakage current limits and, when plugged into separate AC outlets, are in violation of patient safety standards. Suitable electrical isolation of such external AC outlets, or providing the device with extra protective earth, will be required in order to meet IEC60601-1 standards for electrical leakage.

Introduction (continued)



CAUTION

The image quality on the external monitor may be sub-optimal compared to the scanner monitor.



CAUTION

For compatibility reasons, use only GE-approved probes, peripherals, or accessories. DO NOT connect any probes or accessories without approval by GE.



CAUTION

When using peripheral device, observe all warnings and cautions given in Peripheral manufacture's manuals.

CartoSound/SoundStar support

The Vivid *iq* can interface with the Carto 3 system, which includes the CartoSound 3-D electroanatomical navigation system and the SoundStar ultrasound Catheter, manufactured by Biosense Webster.

The interface will allow the Vivid *iq* system to send Images to the CartoSound system over a VGA video cable or, if supported by Carto system, over peer-to-peer LAN connection.

The Vivid *iq* is able to send ultrasound scaling parameters to the CartoSound system via a peer-to-peer LAN connection.

Detailed instructions on interfacing and using the Vivid *iq* with the CartoSound and SoundStar Catheter is found in dedicated user manuals issued by Biosense Webster, Inc. named:

- CartoSound Image Integration Module (part no. UG-4800-12 (00A))
- CARTO 3 System Image Integration Modules User Guide (part no. UG-5400-122)

NOTE: *Before using CARTOSOUND, please read the Instructions For Use provided by the manufacturer.*

NOTE: *When turning the Vivid *iq* on, while interfaced to the CartoSound the boot-up process may take up to about 3 minutes.*

NOTE: *During CARTO interventions, the local user of the scanner shall be able to access the system and read the system screen or the system external screen.*

CartoSound/SoundStar support (continued)



WARNING

The recalled data on the Carto system may be sub-optimal or different compared to what is available on the scanner.



WARNING

Image quality on the Carto system may be sub-optimal compared to the system monitor.



WARNING

Use special 'Carto' preset when connected to CartoSound™ System and be careful when adjusting parameters to avoid framerate lower than 30 frames per second.

Using CartoSound

When the CartoSound interface is connected, select **CartoSound** from the shortcut bar. An icon on the status bar shows the connection status:

	The Vivid iq system is waiting for connection from the Carto system.
	The Vivid iq system is connected to the Carto system. The live image on screen is transferred to the Carto system.
	The Vivid iq system is not connected to the Carto system.

Receiving images over peer-to-peer LAN connection is allowed only to members of the ConsultingPhys group. A user member of ConsultingPhys group must be available on the Vivid iq, and the Carto system must be configured to use this user when connecting to the Vivid iq. See User setup for data streaming.

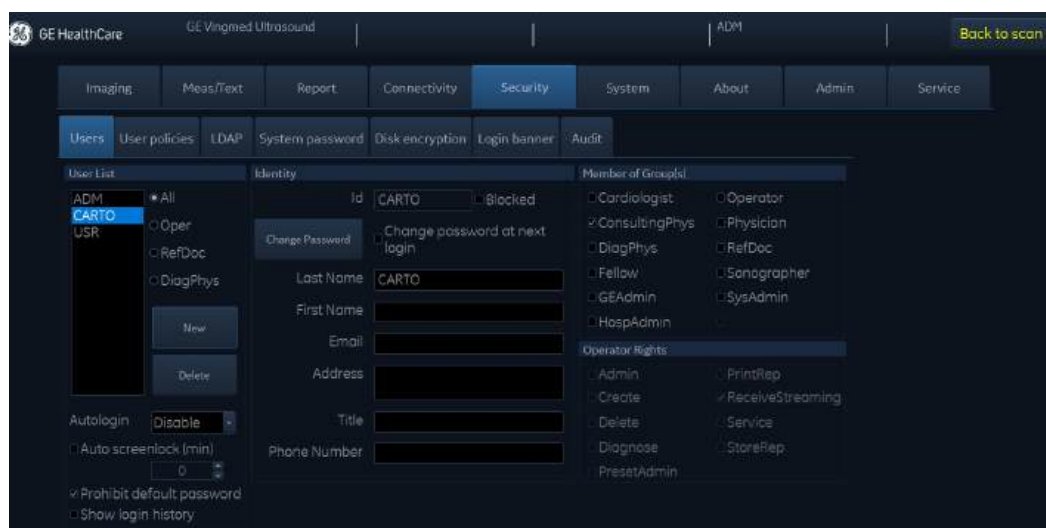


Figure 13-1. User setup for receiving images over peer-to-peer LAN connection

Introduction

The printer device is controlled from the **P1/P2** tab on the operation panel on the shortcut bar (see Figure 13-2).

The **P1/P2** tab can also be configured to perform alternative storage (i.e. storage to DICOM media or secondary capture). See page 13-9 for configuration of the **Print** tab.

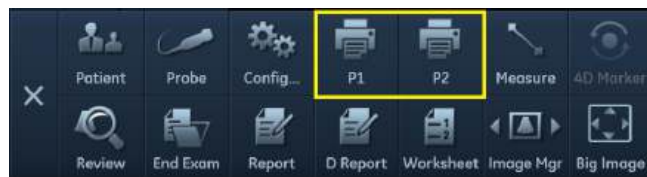


Figure 13-2. The printer control on the operation panel

To print an image

1. Select **P1/P2** on the shortcut bar (see Figure 13-2).
The image displayed on the screen is printed on the printer, depending on the tab assignment configuration (see page 13-9).

NOTE: *For details on the Thermal video printer operation, consult the manufacturer operator manual provided with the printer.*

Printing Configuration

Introduction

System configuration for printing requires to:

- configure the **P1/P2** tab on the Shortcut bar.
- select and set up a printer.

Print tab configuration

The **Print** tab on the shortcut bar can be configured to perform several actions (e.g. Video Print, Laser print, DICOM storage...etc.).

To configure the **P1/P2** button:

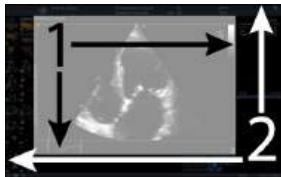
1. Select **Config** on the operation panel.
2. Select the **Connectivity** category and **Buttons** subgroup.
The *Buttons* sheet is displayed (Figure 13-3).

3. In *Output Buttons* field select **P1**.
4. Select an output device in the *Available output* field and press the **Right arrow** button to assign the device to the selected button.

The *Properties* window for the selected device is displayed, if configurable.

5. Adjust the device specific parameters and select **OK**.
6. Adjust the image specific parameters (see table below).

Print tab configuration (continued)

Image parameters	
Format	Select between: • Raw DICOM • DICOM
Image compression	Select compression mode or no compression.
Quality	When JPEG compression is selected, adjust the picture quality between 1 and 100%. A low picture quality level allows high data compression, while a high picture quality restrains the compression.
Image frames	Select between: • Single: stores single frame only • Multiple: stores cineloops • Secondary Capture: stores a screen shot
Capture Area	Select between: 1. Video Area (1) 2. Whole Screen (2) 

To remove a device, select the device in the *Selected devices* field and press the **Left arrow** button.

Printer setup

Printers are configured in the **Connectivity>Printer** tab:

1. To select a printer, highlight it in the table.
2. Click **Preferences** to adjust Paper size and Orientation.
3. Click **Set as Report Printer** to use it for printing reports.
4. Click **Add Printer** and use the windows printer wizard to add one.

NOTE: *Adding printer drivers is not possible*

5. Click **Remove Printer** to remove printers from the list available for the scanner.
6. Click **Open Queue** to view jobs in the printer spooler.

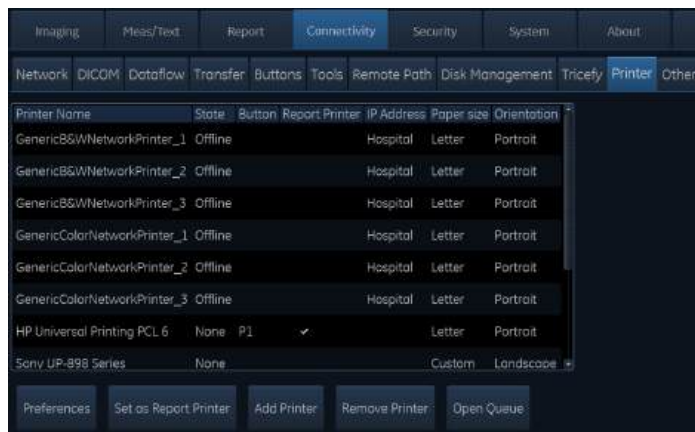


Figure 13-3. The Additional outputs sheet

Inverted print

Different from the traditional printing technique, this new function prints the ultrasound image with white-colored background outside sector area. It also preserves scan information in the final printout.

To activate the inverted print, press **Config->Report->Options** and check the **Enable inverted print** box.

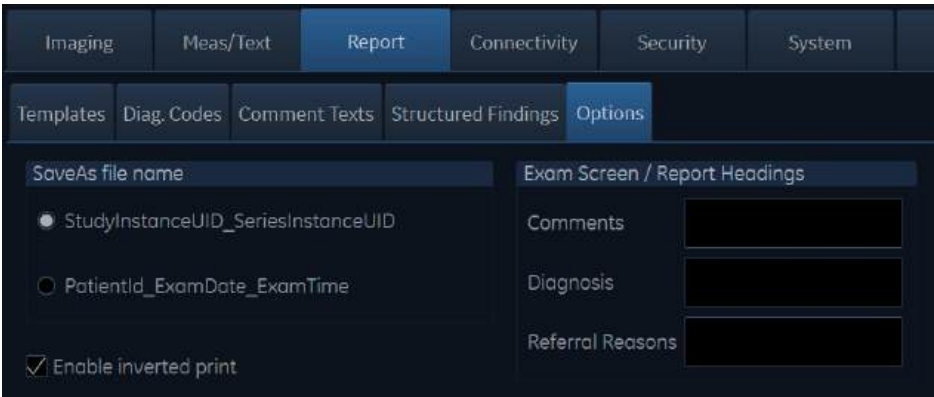


Figure 13-4. Enable Inverted Print

Chapter 14

Maintenance

This chapter describes:

‘System Data’ on page 14-2

‘System Care and Maintenance’ on page 14-27

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‘eDelivery - Software update’ on page 14-63

System Data

Features/Specifications

NOTE: Some feature(s)/probe(s) may not be available in some country(ies)/region(s), please contact your sales representative for detailed information.

Table 14-1: General Specifications

Dimensions and Weight Dimension for console: • Height: 64±1 mm (2.5±0.04 inch) with feet: 73±1 mm (2.9±0.04 inch) • Width: 390±1 mm (15.4±0.04 inch) • Depth: 362±1 mm (14.3±0.04 inch) Weight for console: • Weight with battery: 5.2±0.1 kg (11.5 ±0.2 lbs) Weight for generic cart: • Max Weight: 65 kg (143 lbs.) with full configuration (Console, Cart, Multi-probe box, probes, charge box with batteries). Weight for Standard/Premium cart: • Max Weight: 55kg (121 lbs.) with full configuration (Console, Mobile Cart, Multi-probe box, probes, charge box with batteries, DVD/printer shelf, rear handle with cable management). Console Electrical Power Input • 22Vd.c., 6.8A Scanning time from battery without power supply is approximately one hour ¹. Console Power Adapter Electrical Power Input • Voltage: 100-240 Va.c. • Frequency: 50/60 Hz • Power: 2.0A max, 175 VA Output • 22Vd.c., 6.8A Operating System • Windows® 10 ¹ Depending on operation modes used	Console Design • Laptop Style • ECG port • Integrated solid state drive • Multiple USB ports (front/back) • Integrated speakers for premium sound • CPU - Intel duo core • DC power input • USB interface (5) • HDMI interface • ECG port • LAN 10/100/1000 base Cart Design • Multiple USB ports • Multiple probe holders • Multiple probe cable hooks • Charge box (optional) • Multi-probe box (optional) <i>Note: Please refer to Vivid iq Mobile Cart User Instruction for detailed specification for cart.</i>

Table 14-2: User Interface

Operator Keyboard • Innovative track pad design - a new track pad provides new ergonomic gestures, including two-finger swipe to control Depth and Gain and Click to Set, allowing the user's arm to stay rested for a significant time during the exam • Ergonomic simplified hard key layout with ergonomic design around the track pad • Interactive back-lighting of application-specific push buttons - adjustable back-light intensity • Easy-to-learn user interface with intelligent touch keyboard • Image manager on the touch screen for quick review of image clipboard contents and easy export of images and loops to remote archives or media Touch screen • Full touch ability including swipe, pinch and double-tap to zoom, for fast and highly responsive user experience • 15.6" ultra-high-resolution, wide screen format, color, multi-touch LCD screen • On-Screen Touch keyboard with support for characters in 14 languages • Interactive user-configurable short-cut software menu	• Application-specific operator and sidebar touch menu controls operated by finger tapping and swiping • Overall gain, depth and zoom control bar on the touch for easy adjustment • Touch-screen control of TGC sliders Monitor • 15.6" wide screen FULL High-Definition (HD) flicker - free LCD display with full touch ability • 16.7 million simultaneous colors available • Ergonomic FlexFit design with adjustable typing angle and flexible view angle • Resolution: 1920*1080 pixels, Full HD • Fold down and lock mechanism for transportation • Screen can be adjusted in different angles for scanning mode, typing mode and closing, allowing to optimize the viewing angle in each position • Backlight adjustable • Selectable big image size to use more screen area for the ultrasound image for better visibility from a distance • Adaptive video formats and resolution

Table 14-3: System Overview

Applications (probe dependent) • Fetal/Obstetrics • Abdominal • Pediatric • Small Organ • Neonatal Cephalic • Adult Cephalic • Cardiac • Peripheral Vascular • Musculoskeletal Conventional • Musculoskeletal Superficial • Urology • Transcranial • Transrectal • Transvaginal • Transesophageal • Interventional Guidance • Thoracic/Pleural • Intraoperative • Intracardiac and Intraluminal Operating Modes • 2D Tissue • 4D Tissue • Tissue M-mode • Anatomical M-mode • Curved Anatomical M-mode • Extended field-of-view (LOGIQ™ View) • Virtual Convex • Virtual Apex • Coded Phase Inversion • Compound Imaging • 2D Color Flow • Multi-Dimensional Color Mode • 4D Color Flow • 2D Color Angio Flow • Color M-mode • Anatomical Color M-mode • B-Flow • Blood Flow Imaging • Blood Flow Angio Imaging • Strain Elastography • Pulsed Wave Doppler • Continuous Wave Doppler • LVO Contrast • Vascular Contrast (optional) • Contrast Low MI (optional) • Tissue Velocity Imaging • Tissue Tracking • Tissue Synchronization Imaging (optional) • Strain Imaging (optional) • Strain Rate Imaging (optional) • Tissue Velocity M-mode	• Tissue Velocity Doppler • Automatic Optimization • Scan Assis Pro • Scan Coach • Pre-Post Compare • 2D Stress (optional) • Automated Function Imaging (AFI) 3.0 (optional) • Easy AFI LV(optional) • AFI RV (optional) • AFI LA (optional) • Automated Ejection-Fraction (Auto EF) 3.0 (optional) • Easy AutoEF (optional) • AI Auto Measure – 2D (optional) • AI Auto Measure – Spectrum Recognition (optional) • Bi-plane • Tri-plane • 4D full-volume scanning – single-beat and multi-beat Scanning Methods • Electronic sector • Electronic volume • Electronic convex • Electronic linear • CW pencil Transducer Types • Sector phased array • Convex array • Linear array • Single crystal matrix array • 2D matrix array • Endovaginal Standard 4D Features • Single, dual or multiple cycle volume acquisition • Bi-plane acquisition includes tilt and rotate, and bi-plane prepare • Tri-plane acquisition • Multi-dimensional (bi-plane/tri-plane) color acquisition • FlexiSlice with depth mode • QuickRotate/Rotate • 2-Click crop • Flip crop • View crop • Dynamic view crop • Dual Crop • FlexiViews • FlexiZoom

Table 14-3: System Overview

• Laser Lines • Depth color render • Live multi-slice views • Measurement on render Optional 4D Features • Automated 4D left ventricular quantification • Automated 4D aortic valve quantification • Automated 4D mitral valve quantification • 4D markers • View-X • HD Color enhances the perception of 4D color when visualized on a 2D monitor Peripheral Options • DVDRW • Color printer • B/W video printer with optional in-verted background printing, allowing for environmentally sensitive ink saving • USB memory stick • One TB USB hard drive • HDMI cable • Video converter providing electrically isolated video signals for external mon-itors • digital Full HD 1920 x 1080 • analogue VGA 800 x 600 • Three-pedal configurable footswitch • Rolling bag • Ergonomic wrist rest Accessories (optional) • Interface cable for external ECG • ECG adapter for DIN-type pediatrics electrode leads Display Modes • Live and stored display format:full size and split screen, both with thumbnails, for still and cine • Instant-review screen displays 12 simultaneous loops/images for a quick study review • Selectable display configuration of duplex and triplex modes: side-byside or top-bottom during live, digital replay and clipboard image recall • Single-, dual- and quad-screen view • Simultaneous capability - 2D+PW - 2D+CW (with 6VT-D probe) - 2D + CFM/TVI + PW - 2D + CFM + CW (with 6VT-D probe) - 2D + CFM/Angio/TVI/SRI/TT/SI/TSI - 2D + M/AMM/CAMM - 2D + CFM/Angio/TVI/SRI/TT/SI/TSI + M/AMM/CAMM	- Real-time duplex or triplex mode (with 6VT-D probe) - Compound + M/CFM/PW - 4D + CFM (with 6VT-D probe) - 2D + bi-plane (with 6VT-D probe) - 2D + bi-plane + CFM/AMM/CAMM(with 6VT-D probe) - 2D + tri-plane (with 6VT-D probe) - 2D + tri-plane + CFM/AMM/CAMM(with 6VT-D probe) - 2D + color split screen(simultaneous mode) • Selectable alternating modes - 2D or compound + PW - 2D + CW - 2D or compound +CFM/PW - 2D + CFM +CW • Multi-image (split/quad screen) - Live and/or frozen - Independent cine playback • Timeline display - Independent 2D (or compound) + PW/CW/M display - A choice of display formats with various sizes of 2D + PW/CW/M • Top/bottom selectable format • Side/side selectable format • 4D display (with 6VT-D probe) - Two slice and render view - Quad view (three slice and render) - Single render view - Slice-only view - Live multi-slice - FlexiSlice (live and replay) with several layout selections - Bi-plane side/side view - Tri-plane view (quad including geometry viewer) - Crop view (three orthogonal slice + render) • Apical slice view (three 60 degrees view + render) • Cine rotate render view

Table 14-3: System Overview

Display Annotation • Patient Name: First, last and middle • Patient ID • Additional patient ID • Age, sex and birth date • Hospital Name • Date format: three types selectable - MM/DD/YYYY, DD/MM/YYYY, YYYY/MM/DD • Time format: Two types selectable - 24 hours, 12 hours • Gestational age from LMP/EDD/GA • Probe name • Probe Orientation • Depth scale marker • Focal zone markers • Image depth • Zoom depth • B-mode: Gain, Image frequency, Frame averaging, Dynamic range, Gray map • M-mode: Gain, Frequency, Time scale, Dynamic range • Doppler Mode: Gain, Angle, Sample volume size and position, Wall filter (low velocity reject), Velocity and/or frequency scale, Spectrum inversion • Time scale: PRF, Doppler frequency • Color flow Doppler mode: Frame rate, Sample volume size, Color scale, Power, Color baseline, Color threshold marker, Color gain, Frame averaging • Spectrum inversion • Acoustic frame rate • CINE gauge, image number/frame number • Bodymarks: Multiple human anatomical structures • Application/preset name • Measurement result • Operator message	• Displayed acoustic output: TIS, TIC, TIB • MI: Mechanical index • Power output in dB • Biopsy guide line and zone • Heart rate • TrackPad - driven annotation arrows • Active mode display • Stress protocol parameters • Parameter annotation follow ASE standard • Free text with word library • 4D slice intersection markers (with 6VT-D probe) • 4D gauge (with 6VT-D probe) • 4D markers • 4D viewing angle arrows (with 6VT-D probe) • 4D geometry viewer (with 6VT-D probe) • 4D number of cycles (with 6VT-D probe) • Scan plane position indicator and probe temperature are displayed with all TEE probes • Image orientation marker

Table 14-4: System Parameters

System Setup • Pre-programmable M&A and annotation categories • Different user presets per probe/application may be stored for quick access • User programmable preset capability with administrator preset protection • Factory default preset data, protected against modification • User Interface languages: English, LA Spanish, French, German, Italian, Por-tuguese (European and Brazilian), Russian, Swedish, Norwegian, Danish, Dutch, Finnish, Chinese • QuickApps: Factory and user programmable sub-preset feature that keeps 2D and geometry settings while allowing different color flow or contrast parameters • User-defined annotations • Body patterns • Customized comment home position CINE Memory/Image Memory • 500 MB of cine memory • Selectable cine sequence for cine review • Measurements/calculations and annotations on cine playback • Scrolling timeline memory • Dual-image cine display • Quad-image cine display • CINE gauge and cine image number display • CINE review loop • CINE review speed Image Storage • On-board database of patient information from past exams • User-selectable ECG and time gated acquisition available on touch panel during live scanning • User-selectable prospective or retrospective capture in config • Storage formats: - DICOM® - compressed or uncompressed, single/multi-frame, with/without raw data, storage via clipboard and/or seamlessly directly to destination device - Transfer/"Save As" JPEG, MPEG, AVI, DICOM, Raw DICOM formats	• Storage devices (optional) : - USB memory stick: 32 GB - CD-RW storage: 700 MB - DVD storage: -R (4.7 GB) - Mobile hard drive storage: 1 TB • Compare old images with current exam • Reload of archived data sets • Activation control of USB devices (for security) Annotations Body Marks • Body mark icons for location and position of probe • Option to automatically activate body mark on freeze • Easy selection of body marks from touch screen • Easy selection of body marks for dual-screen layout Text Annotations • Easy selection of text annotations from touch screen • Option to automatically activate annotation on freeze Connectivity and DICOM (optional) • Ethernet network connection • USB Wireless network connection kit (optional) • DICOM 3.0 • Verify • Print • Store • Modality worklist • Storage commitment • Modality Performed Procedure Step(MPPS) • DICOM Media exchange • DICOM spooler • DICOM Query/Retrieve • Structured reporting - compatible with adult cardiac, pediatric, vascular and abdominal • Media store of structured reporting • InSite™ ExC capability for remote service/access • Support of two patients' IDs in DICOM • Separate DICOM SR and image storage destinations • Simultaneous transfer of DICOM to multiple destinations • Streaming (option) sends the image information as digital video stream over Ethernet in real-time to clients • DICOM PDF Read • DICOM / TLS (encryption) • DICOM Implicit Encoding support

Table 14-4: System Parameters

Patient Archive EchoPAC™/Patient Archive • Integrated EchoPAC functionality adds connectivity and image analysis capability to scanner • Data format fully compatible with of-line EchoPAC Plug-in review/reporting stations of same or newer vintage • EchoPAC Plug-in allows instant access to ultrasound raw data provided by the system • Comprehensive review, analysis and post-processing capabilities on Echo-PAC Plug-in • Advanced quantitative analysis and post-processing capabilities • Q-analysis on raw data from Vivid iq on EchoPAC Plug-in • Three user levels help organize data security requirements • E-signoff compatibility, with clear indications in patient management screens and report screen that a report was signed off, and by whom and at what time. The signed off report and exam cannot be changed. The "Diagnosing Physician" field is automatically assigned to the user that did the sign-off Image and Data Management • Exceptional workflow with instant access data management • DICOM 3.0 support - see DICOM conformance statement for details • Support for transfer of the proprietary raw data files within the DICOM standard. With the use of the AI-based View Recognition this can be automated • 2D, CFM or TVI data at maximum frame rate may be reviewed by scrolling or by running cine loops (can contain more than 1,000 images for imaging modes) • Image clipboard for stamp-size storage and review of stored images and loops • Built-in patient archive with images/loops, patient information, measurements and reports • DICOM-SR Standard structured reporting mechanism • Structured findings report tools support efficient text entries with direct editing of findings text, usability improvements, new configuration options and conclusion section • User can enter normal values which are then compared to actual measurements • Configurable HTML-based report function	• Report templates can be customized on board • ASE-based default text modules(English), user-customizable • Internal archive data can be exported to removable image storage through DICOM media • Internal hard disk - for storing programs, application defaults, ultrasound images and patient archive • All data storage is based on ultrasound raw data, allowing to change gain, baseline, color maps, sweep speeds, etc., for recalled images and loops • DICOM media - read/write images on DICOM format • DICOM viewer embedded on media (optional and selectable in Config) • Alphanumeric data can be exported in Microsoft® Excel® compatible format • JPEG export ("Save As") for still frames • AVI and MPEG export ("Save As") for cineloops • Ability to transfer Systole Only for Stress echo loops to PACS. • Selectable raw data transfer to PACS including AI-based View Recognition for automatic view labelling CartoSound® Interface (optional) • The system can interface with the Carto® 3 EP navigation system and the SOUNDSTAR® ultrasound catheters manufactured by Biosense Webster • The interface allows the Vivid iq system to send images to the Carto 3 EP system • The Vivid iq is able to send ultrasound scaling parameters to the Carto 3 EP system via a peer-to-peer LAN connection Tricefy® Uplink (optional) • Tricefy is a Cloud service • Can serve as long-term archive • Can be used to share complete examinations with colleagues for information exchange and for consultation • Can be used to send images to patients

Table 14-4: System Parameters

Self-contained DICOM Viewer (optional) • Exams can be transferred to CD/DVD or USB media with an integrated GE Healthcare Ultrasound DICOM Viewer • The GE Healthcare Ultrasound DICOM Viewer allows to open and display still images and cine loops from media on a standard PC without installing any application on the host PC App Launchpad • The App Launchpad is a tab available on the Archive screen – when selected, various applications (“Apps”) can be launched • Only validated and released Apps are supported • 3rd-party Apps can be purchased through an AppStore on a GE Healthcare website • Consult with a GE Healthcare representative for more details	Raw Data Streaming (optional) • Provides streaming of raw data out to 3rd-party devices designed to process this data User Manual Available on Board • User manual and service manual are included on USB flash drive with each system. A printed user manual is available upon request.

Table 14-5: Service / Life cycle Offerings

Insite™ Express Connection (ExC) • Enables Remote Service and Training • Easy, flexible and secure connectivity configuration. The "Contact GE" on-screen button directly generates a real-time service request to the GE online engineering or application specialist. It takes a snapshot(e.g., error logs, setup files) of the system at the time of the service request to enable analysis of problem before customer contact • Virtual Console Observation (VCO) enables the customer to allow desktop screens to be viewed and controlled remotely over the encrypted tunnel to enable real-time training, device configuration and clinical application support • Operation of Insite Express Connection is dependent on the infrastructure being available - check with your local GE service representative • File transfer enables the customer (bio-med or clinician) to directly transfer system information (e.g., system logs, images, parametric data) to GE Healthcare product engineering teams (no patient data transferred) • Software reload provides remote application reconstruction and recovery capabilities in the event of system corruption Smart Service Interface (SSI) (optional) • A suite of GE proprietary service tools, designed for expert healthcare technology management professionals who want to streamline troubleshooting and diagnostics on their GE Vivid systems • Provides an intelligent visual dashboard with drill-down capability to rapidly assess equipment status and health • Can drive productivity by quickly isolating specific issues and decreasing overall system downtime • SSI is available for licensed qualified users; please contact your local sales representative for more information	eDelivery (optional) • eDelivery facilitates download of soft-ware patches for service purpose (e.g., security patches) • It is also an enabler for the ability to download apps from the AppStore Digital Expert (optional) • Enables the user to connect remotely to a GE Healthcare Clinical Specialist to receive application related training and help Imaging Insights • Support of Imaging Insights offering by providing system utilization data Probe Check (optional) • Automated transducer element check and reporting of potential image quality impacts

Table 14-6: Scanning Parameters

• Digital beamformer with up to 974,026 effective digital channels • Minimum field-of-view range (depth): 1 cm (probe dependent) • Maximum field-of-view range (depth): 33 cm (probe dependent) • Width range: 10° - 168° (probe dependent) • Continuous dynamic receive focus/ continuous dynamic receive aperture • Composite dynamic range up to 415 dB • Adjustable dynamic range • Image reverse: Right/Left • Image rotation of 0°, 180° • Touch user-interface inversion for right-hand scanning users Tissue Imaging General • Variable transmit frequencies for resolution/ penetration optimization • Display zoom with zoom area control • High-Resolution (HR) zoom - concentrates all image acquisition power into selected Region of Interest (ROI) • Variable contour filtering - for edge enhancement • Selectable grayscale parameters (availability preset-dependent): Gain, reject, DDP, clarity, dynamic range and compress - can be adjusted in live, digital replay and image clipboard recall • Automatically calculated TGC curves help reduce operator interaction • Automatically calculated lateral gain 2D Mode • Sector tilt and width control • Frame rate in excess of 1,000 fps, depending on probe, settings and applications • Coded octave imaging with coded phase inversion - GE Healthcare 3rd generation harmonic tissue imaging providing enhanced lateral and contrast resolution as compared to previous generation GE Healthcare products. Features help reduce noise, help improve wall definition, and axial resolution, making it well suited for a wide variety of patient groups • Confocal imaging – allows for multiple transmit focal zones over range of view and a high vector density, probes dependent • Automatic tissue optimization - single keystroke optimizes immediately automatically and dynamically different grayscale settings with the goal of signal independent uniform gain and contrast distribution	• UD clarity and UD speckle reduce imaging - an advanced image processing technique to remove speckle in real-time examining the relative difference between neighboring pixel values and determining whether the grayscale variations have a sharp difference, follow a trend, or are random in nature • Variable image width – a reduction either increases frame rate or increases the number of focal zones while maintaining the frame rate – application dependent • Multiple-angle compound imaging , multiple co-planar images from different angles combined into a single image in real-time to help enhance border definition and contrast resolution, as well as reduce angular dependence of border or edge as compared to no-compound imaging • LOGIQ View: Provides the ability to construct and view a static 2D image with wider field-of-view of a given transducer. This allows viewing and measurements of anatomy that is larger than what would fit in a single image • Virtual convex allows a wider field-of-view (FOV) in the depth to enhance image quality on linear probes • Virtual apex provides a wider field-of-view with phased array probes, effective at certain imaging views where a wide near field is preferred • L/R and up/down invert, in live, digital replay or image clipboard recall • Digital replay for retrospective review or automatic looping of images, allowing for adjustment of parameters such as gain, reject, anatomical M-mode, persistence and replay speed • Data dependent processing performs temporal processing which helps reduce random noise but leaves motion of significant tissue structures largely unaffected - can be adjusted even in digital replay • 256 shades of gray • Colorized 2D-mode, user-selectable in real-time, digital replay

Table 14-6: Scanning Parameters

Multi-Dimensional Mode (with 6VT-D probe) • Bi-plane scanning: two independent simultaneous scan planes where one of them can be rotated and tilted freely • Bi-plane prepare mode for ease of obtaining biplane views from 4D render data sets • Tri-plane: three independent simultaneous scan planes that can be rotated freely • Both bi-plane and tri-plane scanning is possible in all color Doppler modes 4D Mode • Flexi-volumes with customizable acquisition for volume size, volume rate or resolution • Single-beat 4D scanning with real-time volume rendering display • Multi-beat 4D scanning for high-resolution scanning • Adjustable volume sizes for both single- and multi-beat scanning • Adjustable volume shape control • Pre-defined volume sizes for quick volume setup • Adjustable number of cycles for multi-beat scanning • FlexiZoom for easy 4D visualization of structures of interest • 4D scanning supporting variable octave and fundamental frequencies • Coherent volume processing with motion compensation for seamless and artifact-free 4D and 2D slices • Variable frame rate settings available • Volume optimize control for volume rendering transparency and quality setting • Flip crop available for changing 4D view direction 180 degrees with mirrored crop volume • Live multi-slice layouts available during live 4D acquisition • FlexiSlice for interactive slicing, cropping and navigation designed to provide the user with a flexible, yet intuitive way of extracting 2D slices from 4D data sets; several layouts available depending on use case • View crop setting for toggle control of view plane vs. crop plane • 2-click crop for quick and easy extraction of standard and non- standard views for visualization of 4D structures seen during or after the examination • Dual crop for fast and efficient visualization of complex structures from both sides at the same time	• Laser lines to help improve the visual linkage between the 4D-rendered view and the 2D slices • Wide range of depth color rendering maps • QuickRotate and Rotate for a flexible and easily accessible way of obtaining the desired single- or multi-plane, two-dimensional views M-Mode • Trackpad steers M-mode line available with all imaging probes - max steering angle is probe dependent • Simultaneous real-time 2D- and M-mode • M-mode PRF 1 kHz - image data acquired is combined to give high-quality recording regardless of display scroll speed • Digital replay for retrospective review of spectral data • Several top-bottom formats, side-by-side format and time-motion-only format - can be adjusted in live or digital replay • Selectable horizontal scroll speed: 1, 2, 3, 4, 6, 8, 12, 16 seconds across display • Horizontal scroll can be adjusted in live or digital replay Anatomical M-mode • M-mode cursor can be adjusted at any plane • Curved anatomical M-mode - free (curved) drawing of M-mode generated from the cursor independent from the axial plane • Can be activated from live, digital replay or image clipboard recall • Anatomical color and tissue velocity M-mode • M&A capability Color Doppler Imaging General • Steerable color Doppler available with all imaging probes - max steering angle is probe dependent • TrackPad-controlled ROI • Touchscreen-controlled ROI • Removal of color map from the tissue during digital replay • Digital replay for retrospective review of color or color M-mode data allowing for adjustment of parameters such as encoding principle, color priority and color gain even on stored data

Table 14-6: Scanning Parameters

• PRF settings - user-selectable • Advanced regression wall filter gives efficient suppression of wall clutter • For each encoding principle, multiple color maps can be selected in live and digital replay - variance maps available • More than 65,000 simultaneous colors processed, providing a smooth display two-dimensional color maps containing a multitude of color hues • Simultaneous display of grayscale 2D and 2D with color flow • Color invert - user-selectable in live and digital replay • Variable color baseline - user-selectable in live and digital replay • Multi-variate color priority function gives delineation of disturbed flows even across bright areas of the 2D-mode image • Color Doppler frequency can be changed independently from 2D Color Flow Imaging • TruSpeed imaging allows either ultra-high frame rate or increased lateral resolution as compared to previous generation GE products • Frame rate in excess of 700 (it is 400 on 12S-RS) fps, depending on probe and settings • Variable ROI size in width and depth • User-selectable radial and lateral averaging to help reduce statistical uncertainty in the color velocity and variance estimates • Data Dependent Processing (DDP) performs temporal processing and display smoothing to help reduce loss of transient events of hemodynamic significance • Digital replay for retrospective review or automatic looping of color images, allowing for adjustment of parameters such as DDP, encoding principle, baseline shift, color maps, color priority and color gain even on frozen/recalled data • Application-dependent, multi-variate motion discriminator helps reduce flash artifacts • Dedicated coronary flow application • Multiple-angle compound imaging in 2D mode is maintained while in color Doppler mode Multi-Dimensional Color Mode (with 6VT-D probe) • Bi-plane and tri-plane scanning with all color Doppler and tissue velocity modes	4D Color Doppler Imaging (with 6VT-D probe) • Single-beat 4D color flow scanning • Volume size control to change the size of the color ROI • Multi-beat 4D color flow scanning using ECG stitching for increased volume rate • Pre-defined volume sizes for quick volume setup • Adjustable number of cycles for multi-beat scanning • Variable volume rate settings available • Flip crop available for changing 4D view direction 180 degrees with mirrored crop volume • View-crop setting for toggle control of view plane vs. crop plane • Tissue transparency control • Flow transparency control to visualize tissue behind the flow • HD Color - enhances the perception of 4D color when visualized on a 2D monitor by addition of shadowing and specular reflection techniques; in addition, it offers the ability to see turbulent velocity components inside the flow volume by use of transparency control Color Angio • Angle-independent mode for visualization of small vessels with increased sensitivity compared to standard color flow of previous GE products Color M-mode • Variable ROI length and position - user-selectable • User-selectable radial averaging to help reduce statistical uncertainty in the color velocity and variance estimates • Selectable horizontal scroll speed: 1, 2, 3, 4, 6, 8, 12, 16 seconds across display - can be adjusted during live, digital replay or image clipboard recall • Real-time 2D image while in color M-mode • Same controls and functions available as in standard 2D color Doppler Anatomical Color M-mode • GE Healthcare-patented, any plane color M-mode display derived from color Doppler cine loop • Applicable to Tissue Velocity Imaging • M&A capability

Table 14-6: Scanning Parameters

B-flow • B-flow is a digital imaging technique that provides real-time visualization of vascular hemodynamics by directly visualizing blood reflectors and presenting this information in a grayscale display • Use of GE Healthcare-patented techniques to boost blood echoes, and to help preferentially suppress non-moving tissue signals • B-flow is available for most vascular and shared service applications Blood Flow Imaging • Combines color Doppler with grayscale speckle imaging • Helps improve delineation of blood flow without bleeding into tissue or vessel wall Blood Flow Angio Imaging • Combines angio with grayscale speckle imaging Strain Elastography • Visualization of relative tissue stiffness Spectral Doppler General • Operates in PW, HPRF and CW modes • TrackPad steerable Doppler available with all imaging probes – max steering angle is probe dependent • Selectable Doppler frequency for enhanced optimization • High-quality, real-time duplex or triplex operation in all Doppler modes, CW and PW, and for all velocity settings • Frame rate control for optimized use of acquisition power between spectrum, 2D and color Doppler modes in duplex or triplex modes • Very fast and flexible spectrum analysis with an equivalent DFT rate of 0.2 ms • Automatic Spectrum Optimization (ASO) provides a single press, automatic, real-time optimization of PW or CW spectrum scale, and baseline display • Dynamic gain compensation for display of flows with varying signal strengths over the cardiac cycle to help improve ease of use • Dynamic reject gives consistent suppression of background – user-selectable in real-time, digital replay or image clipboard recall • Digital replay for retrospective review of spectral Doppler data • Several top-bottom formats, side-by-side format and time-motion-only format – can be adjusted in live or digital replay • Selectable horizontal scroll speed: 1, 2, 3, 4, 6, 8, 12, 16 seconds across display – can be adjusted in live or digital replay	• Adjustable spectral Doppler display parameters: gain, reject, compress, color maps – can be adjusted in live or digital replay • User-adjustable baseline shift – in live, digital replay and image clipboard recall • Adjustable velocity scale (depending on probe and setting) • Wall filters with range 10-2000 Hz (velocity scale dependent) • Angle correction with automatic adjustment of velocity scale - in live, digital replay and image clipboard recall • Auto Doppler angle • Stereo speakers mounted in the front panel • Display annotations of frequency, mode, scales, Nyquist limit, wall filter setting, angle correction, acoustic power indices • Compound in duplex PW/HPRF Doppler • Automatic HPRF Doppler maintains its sensitivity even for shallow depths and with the highest PRF's • Digital velocity tracking Doppler employs processing in range and time for high-quality spectral displays • Adjustable sample volume size of 1-16 mm (probe dependent) • Maximum sample volume depth 30 cm CW Doppler • Highly sensitive steerable CW available with all phased array probes • Tissue velocity Doppler Contrast Imaging (optional) LVO Contrast (accessed through QuickApps) • Enables contrast applications intended for imaging of the left ventricle • LV harmonic contrast imaging(3Sc-RS probe) enhances delineation of the LV border in combination with ultrasound contrast agents. The new implementation of GE Healthcare's Coded Phase Inversion (CPI) provides high-resolution detection of contrast in the LV cavity and excellent suppression of myocardial tissue signals

Table 14-6: Scanning Parameters

Contrast Low MI (optional) Contrast Low MI imaging is enabled by the Advanced Contrast option. Contrast Low MI is a preset that enables real-time continuous imaging of microbubbles using a low enough MI to generate return signals from the bubbles without destroying them. The user can choose between two types of transmit techniques controlled by the Frequency rotary: Power Modulation and Pulse Inversion, each with different characteristics that may affect imaging performance depending on the type of microbubbles being used. • A high MI Flash feature is available to rapidly destruct bubbles. Other controls are also available for image acquisition optimization • Imaging can be performed in live or with ECG triggering • The contrast intensity can be quantified using the QAnalysis package. • The option may not be available in all countries Vascular/Abdominal Contrast (optional) Vascular contrast – enables contrast applications intended for vascular (9L-RS) and abdominal (C1-5-RS) contrast imaging. The option may not be available in all countries. • Vascular contrast (9L-RS) – coded phase inversion enables excellent detection and resolution of vascular contrast imaging Tissue Velocity Imaging Tissue Velocity Imaging Mode • Myocardial Doppler imaging with color overlay on tissue image • Tissue Doppler data can be acquired in background during regular 2D imaging • The velocity of myocardial segments after entire heart cycle can be displayed in one single image • Tissue color overlay can be removed to show just the 2D image, still retaining the tissue velocity information • Quantitative profiles for TVI, tissue tracking, strain and strain rate can be derived • Time markers for valve events derived from any TM mode help simplify understanding of signals in velocity traces or curved anatomical M-mode Tissue Tracking Mode • Real-time display of the time integral of TVI for quantitative display of myocardial systolic displacement • Myocardial displacement is calculated and displayed as a color-coded overlay on the grayscale and M-mode image - different colors represent different displacement ranges	Tissue Synchronization Imaging Mode (option, enabled by Advanced QScan) • Parametric imaging which gives information about synchronicity of myocardial motion • Myocardial segments colored according to time to peak velocity, green for early and red for late peak • Waveform trace available to obtain quantitative time to peak measurement from TSI Image • Available in live scanning, as well as an offline calculation derived from tissue Doppler data • Additional features in combination with multi-dimensional imaging option • Simultaneous acquisition of tri-plane TSI images covering all standard segments in apical views (with 6VT-D probe) • Efficient segment specific TSI time measurements • Immediate bull's eye report • Automatic calculated TSI synchrony indexes • TSI surface mapping • LV synchronization report template • CRT programming protocol Strain/Strain Rate Mode(optional, enabled by Advanced QScan)) • Tissue deformation (strain) and rate of deformation (strain rate) are calculated and displayed as real-time, color-coded overlay on the 2D image • Cine compound calculates and displays cineloops generated from a temporal averaging of multiple consecutive heart cycles • Anatomical M-mode and curved anatomical M-mode displays (SI and SRI) Physiological Traces • Integrated three-lead ECG module • Automatic QRS complex detection with user ability to modify QRS trigger positions • External ECG lead input • Internally generated respiratory trace using ECG leads • ECG lead selection • Adjustable ECG QRS markers Automatic Optimization • Optimize B-mode image to help improve contrast resolution, gain, TGC and grayscale • Auto Spectral Optimize (ASO)- dynamic adjustments of baseline, and PRF (on live image) and angle correction

Table 14-7: Measurement and Analysis (M&A)

<u>Measurement and Analysis (M&A)</u> • Personalized measurement protocols allow individual set and order of M&A items • Measurements can be labeled seamlessly by using protocols or post assignments • Measurements assignable to protocol capability • Parameter annotation follow ASE standard • Seamless data storage and report creation • User-assignable parameters • Comprehensive set of adult and pediatric cardiac measurements and calculations to help assess dimensions, flow properties and other functional parameters of the heart • Comprehensive set of shared service measurements and calculations covering vascular, abdominal, obstetrics and other application areas • Configuration package to set up a customized set and sequence of measurements to use, defining user-defined measurements and changing settings for the factorydefined measurements • Stress echo support allowing wall motion scoring and automatic stress level labeling of measurements • Stress echo is directly accessible from the system control panel with a dedicated button • Support for measuring on DICOM images • AI-based Cardiac Auto 2D Measurement (option) enables automated quantification of the most common distance measurements performed on parasternal LAX 2D images, with minimum user guidance • AI-based Spectrum Recognition (option) enables automated recognition of the most common Doppler spectra and automatically starts the Auto Doppler measurement (where available), or opens the applicable manual measurement • Cardiac Auto Doppler automatically provides Doppler measurement results for the most common parameters with minimal user guidance	• Automatic Doppler trace functionality for use in non-cardiac applications in both live and replay • Worksheet allows user to review, edit and delete performed measurements • Reporting support allowing a configurable set of measurements to be shown in the exam report • DICOM SR export of measurement data <u>Measurements/Calculations Supported:</u> • General 2D Mode measurements/calculations • General M Mode measurements/calculations • General Doppler Mode measurements/calculations • General Color Flow Mode measurements/calculations • General Color M Mode measurements/calculations • OB measurements/calculations • GYN measurements/calculations • Vascular measurements/calculations • Urological measurements/calculations • Abdominal measurements/calculations • Pediatric measurements/calculations • Cardiac measurements/calculations • Small parts measurements/calculations

Table 14-8: Privacy & Security

Virus Protection To reduce virus vulnerability, Vivid <i>iq</i> is configured with a minimal set of open ports and with all network services not actively used by the system closed down. This helps to significantly reduce the risk of a virus attack on Vivid <i>iq</i>. GE is continuously judging the need for additional actions to reduce vulnerability of equipment; this includes vulnerability scanning of our products and evaluation of new security patches for the 3rdparty technology used. Microsoft® (and other) security patches that address serious issues with Vivid <i>iq</i> will be made available to customers after GE verification of those patches. Whitelisting - Prevents non-listed applications from running - To improve protection against potentially harmful software User Policies - Secure and advanced user password and login scheme according to user's password requirements	LDAP - Users can log in to the system by using the same user credentials as used for domain connected computers Disc Encryption - Optional encryption of the scanner's E drive containing patient identifiable data User Management - Last login information - Customer configurable login banner Microsoft OS Patches - OS vulnerability patches are distributed as part of regular SW maintenance releases during the life cycle of the product.

Table 14-9: Probe Preset Indications for Use on Vivid *iq* (v206) (Preset View)

Group	Preset	Intended Use/ Indication for Use	Probes																			
			3Sc-RS	M5Sc-RS	6S-RS	12S-RS	6Tc-RS	6VT-D	P2D-RS	9T-RS	10T-D	ICE Probe [*]	9L-RS	12L-RS	ML6-15-RS	L4-20t-RS	L8-18i-RS	4C-RS	C1-5-RS	E8Cs-RS	8C-RS	
Cardiac																						
	Cardiac_U	Cardiac , Transesophageal [1]	x	x			x	x														
	Cardiac_E	Cardiac , Transesophageal [1]	x	x			x	x														
	Cardiac_C	Cardiac	x	x																		
	Cardiac_A	Cardiac	x	x																		
	Cardiac	Cardiac							x												x	
	Exercise	Cardiac	x	x																		

Table 14-9: Probe Preset Indications for Use on Vivid iq (v206) (Preset View)

Group	Preset	Intended Use/ Indication for Use	Probes																		
			3Sc-RS	M5Sc-RS	6S-RS	12S-RS	6Tc-RS	6VT-D	P2D-RS	9T-RS	10T-D	ICE Probe [*]	9L-RS	12L-RS	ML6-15-RS	L4-20t-RS	L8-18i-RS	4C-RS	C1-5-RS	E8Cs-RS	8C-RS
	LVOContrast	Cardiac , Transesophageal [1]	x	x			x	x													
	LVOStress	Cardiac	x	x																	
	FATE	Cardiac	x	x																	
	Contrast Low MI	Cardiac		x																	
	Coronary	Cardiac , Transesophageal [1]	x	x	x	x	x	x													
	Carto	Intracardiac and Intraluminal										x									
	ICE	Intracardiac and Intraluminal										x									
	Epicardial	Intraoperative															x				
Pediatric																					
	Pediatric	Cardiac , Pediatric	x	x	x																
	Pediatric	Cardiac , Transesophageal								x	x										
	Neonates	Cardiac , Transesophageal									x										
	Cardiac	Cardiac , Transesophageal									x										
	Infant	Cardiac, Pediatric			x																
	Neonates	Cardiac, Pediatric			x	x															
	Pediatric Abdominal[2]	Abdominal , Pediatric			x								x	x	x	x		x	x		x
	Neonatal Abdominal[3]	Abdominal , Pediatric																			x

Table 14-9: Probe Preset Indications for Use on Vivid *iq* (v206) (Preset View)

Group	Preset	Intended Use/ Indication for Use	Probes																		
			3Sc-RS	M5Sc-RS	6S-RS	12S-RS	6Tc-RS	6VT-D	P2D-RS	9T-RS	10T-D	ICE Probe [*]	9L-RS	12L-RS	ML6-15-RS	L4-20t-RS	L8-18i-RS	4C-RS	C1-5-RS	E8Cs-RS	8C-RS
	Pediatric Abdominal	Transcranial[4], Neonatal Cephalic			x							x									
	Pre-Term	Transcranial[4], Neonatal Cephalic				x															
	Neohead	Neonatal Cephalic										x	x	x							
	Neohead	Transcranial, Neonatal Cephalic				x														x	
	Pre-Term	Abdominal				x															
	TCD	Neonatal Cephalic			x																
Fetal / Obstetrics																					
	Fetal Heart	Fetal / Obstetrics	x	x	x																
	Fetal Echo	Fetal / Obstetrics, Transvaginal[5]															x	x	x		
	OB1	Fetal / Obstetrics, Transvaginal[5]															x	x	x		
	OB23	Fetal / Obstetrics															x	x			
	ED-OB1	Fetal / Obstetrics, Transvaginal[8]	x	x													x	x	x		
	ED-OB1	Transvaginal																	x		
Urology																					
	Prostate	Urology															x	x			
	Prostate	Urology, Transrectal																	x		
Thoracic/Pleural																					
	Lung	Thoracic/Pleural	x	x	x	x						x	x	x		x	x	x		x	
Vascular																					

Table 14-9: Probe Preset Indications for Use on Vivid *iq* (v206) (Preset View)

Group	Preset	Intended Use/ Indication for Use	Probes																		
			3Sc-RS	M5Sc-RS	6S-RS	12S-RS	6Tc-RS	6VT-D	P2D-RS	9T-RS	10T-D	ICE Probe [*]	9L-RS	12L-RS	ML6-15-RS	L4-20t-RS	L8-18i-RS	4C-RS	C1-5-RS	E8Cs-RS	8C-RS
	Carotid	Peripheral Vascular										x	x	x	x						
	Carotid_C	Peripheral Vascular										x	x								
	LEA	Peripheral Vascular										x	x								
	LEV	Peripheral Vascular										x	x								
	UEA	Peripheral Vascular										x	x								
	UEV	Peripheral Vascular										x	x								
	ED-LEV	Peripheral Vascular										x	x	x							
	ED-VA	Peripheral Vascular										x	x	x		x					
	Vascular	Peripheral Vascular										x			x	x					x
	Vascular_C	Peripheral Vascular																			x
	Trans-Cranial Doppler[6]	Transcranial, Adult Cephalic	x	x																	
	Contrast	Peripheral Vascular										x									
Abdominal																					
	Abdomen[7]	Abdominal	x	x								x					x	x			
	Abdomen2	Abdominal															x	x			
	Renal	Abdominal	x	x													x	x			
	FAST	Abdominal	x	x	x												x	x			x
	Gyn	Abdominal, Transvaginal[5]															x	x	x		
	Aorta	Abdominal															x	x			

Table 14-9: Probe Preset Indications for Use on Vivid *iq* (v206) (Preset View)

Group	Preset	Intended Use/ Indication for Use	Probes																		
			3Sc-RS	M5Sc-RS	6S-RS	12S-RS	6Tc-RS	6VT-D	P2D-RS	9T-RS	10T-D	ICE Probe [*]	9L-RS	12L-RS	ML6-15-RS	L4-20t-RS	L8-18i-RS	4C-RS	C1-5-RS	E8Cs-RS	8C-RS
	Contrast	Abdominal																x			
MSK																					
	MscSkel	Musculo-skeletal Conventional Musculo-skeletal Superficial											x	x	x	x	x				
	Nerves	Musculo-skeletal Conventional											x	x							
	Superficial	Musculo-skeletal Superficial													x						
	Nerves-Superficial	Musculo-skeletal Superficial												x	x		x				
	ED-MSK	Musculo-skeletal Conventional Musculo-skeletal Superficial											x	x	x						
	Spine	Musculo-skeletal Conventional, Musculo-skeletal Superficial															x	x		x	
	Nerves	Small organ											x	x							
	Nerve-Deep	Musculo-skeletal Conventional															x	x			
	Nerves-Superficial	Small organ											x	x	x		x				
	Nerve -Average	Small organ											x	x	x						
	Nerve -Deep	Small organ											x	x	x						
	Superficial	Small organ													x						
	Spine	Small organ																		x	
Small organ																					
	Thyroid	Small organ											x	x	x	x					

Table 14-9: Probe Preset Indications for Use on Vivid *iq* (v206) (Preset View)

Group	Preset	Intended Use/ Indication for Use	Probes																			
			3Sc-RS	M5Sc-RS	6S-RS	12S-RS	6Tc-RS	6VT-D	P2D-RS	9T-RS	10T-D	ICE Probe [*]	9L-RS	12L-RS	ML6-15-RS	L4-20t-RS	L8-18i-RS	4C-RS	C1-5-RS	E8Cs-RS	8C-RS	
	Thyroid_C	Small organ											x	x								
	SmallParts	Small organ											x	x		x						
	Breast	Small organ												x	x							
Small organ																						
	Rodent	Cardiac				x																
	Rodent	Small organ														x						

Features/Specifications (continued)

Note:[*] Including of AN 8F, AN 10F, Soundstar 3D 10F, Soundstar eco 8F, Soundstar eco 10F probes.

[1] Transesophageal is only for 6Tc-RS, 6VT-D.

[2] Displayed in preset list as PedAbd

[3] Displayed in preset list as NeoAbd

[4] Only for 6S-RS, 12S-RS

[5] Only for E8Cs-RS

[6] Displayed in preset list as TCD

[7] Displayed in 3Sc-RS and M5Sc-RS preset list as Abdominal

[8] Only for E8Cs-RS

Clinical Measurement Accuracy

Basic Measurements

The following information is intended to provide guidance to the user in determining the amount of variation or measurement error that should be considered when performing clinical measurements with this equipment. Error can be contributed by equipment limitations and improper user technique. Be sure to follow all measurement instructions and develop uniform measurement techniques among all users to minimize the potential operator error. Also, in order to detect possible equipment malfunctions that could affect measurement accuracy, a quality assurance (QA) plan should be established for the equipment that includes routine accuracy checks with tissue mimicking phantoms.

Please be advised that all distance and Doppler related measurements through tissue are dependent upon the propagation velocity of sound within the tissue. The propagation velocity usually varies with the type of tissue, but an average velocity for soft tissue is assumed. This equipment is designed for, and the accuracy statements listed on are based on, an assumed average velocity of 1540 m/s. The percent accuracy when stated applies to the measurement obtained (not the full scale range). Where the accuracy is stated as a percent with a fixed value, the expected inaccuracy is the greater of the two.

Basic Measurements (continued)

Table 14-10: System Measurements and Accuracies

Measurement	Units	Useful Range	Accuracy	Limitations or Conditions
Depth	mm	Full Screen	$\leq 10\%$	NA
Angle	degree	Full Screen	$\leq 5\%$	NA
Distance:				
Axial	mm	Full Screen	$\leq 5\%$	TEE Probe
Axial	mm	Full Screen	$\leq 5\%$	Linear Probes
Axial	mm	Full Screen	$\leq 5\%$	Convex Probes
Axial	mm	Full Screen	$\leq 5\%$	Sector Probes
Distance:				
Lateral	mm	Full Screen	$\leq 5\%$	TEE Probe
Lateral	mm	Full Screen	$\leq 5\%$	Linear Probes
Lateral	mm	Full Screen	$\leq 5\%$	Convex Probes
Lateral	mm	Full Screen	$\leq 5\%$	Sector Probes
Circumference:				
Trace	mm	Full Screen	$\leq 10\%$	TEE Probe, Linear Probes, Convex Probes, Sector Probes
Ellipse	mm	Full Screen	$\leq 5\%$	TEE Probe, Linear Probes, Convex Probes, Sector Probes
Area:				
Trace	mm ²	Full Screen	$\leq 5\%$	TEE Probe, Linear Probes, Convex Probes, Sector Probes
Ellipse	mm ²	Full Screen	$\leq 5\%$	TEE Probe, Linear Probes, Convex Probes, Sector Probes
Time	s	Timeline Display	$\leq 5\%$	M, AMM, Curved AMM, CMM
Slope	mm/s	Timeline Display	$\leq 10\%$	M, AMM, Curved AMM, CMM

Table 14-10: System Measurements and Accuracies (Continued)

Measurement	Units	Useful Range	Accuracy	Limitations or Conditions
Doppler SV Position	mm	Full Screen	$\leq +2$ mm	PWD
Doppler Velocity	cm/s	From 0 to 100 cm/s From 100 to 130 cm/s	$\leq 15\%$ $\leq 10\%$	PWD, CWD
Doppler Angle Correction	cm/s	From 0-80°	$\leq 5\%$	PWD

Clinical Calculation Accuracy

Estimate the overall inaccuracy of a combined measurement and calculation by including the stated inaccuracy from the basic measurement accuracy statements.



CAUTION

Diagnostic errors may result from the inappropriate use of clinical calculations. Review the referenced source of the stated formula or method to become familiar with the intended uses and possible limitations of the calculation.

Calculation formulas and databases are provided as a tool to assist the user, but should not be considered an undisputed database, in making a clinical diagnosis. The user is encouraged to research the literature and judge the equipment capabilities on an ongoing basis in order to assess its utility as a clinical tool.

System Care and Maintenance

Overview

Refer to Section 10 of the Vivid *iq* Service Manual for any additional maintenance guidance.



Ensure that you follow the cleaning procedure and use the cleaning agents provided in this manual.



Ensure that the system is cleaned/disinfected before it is delivered to the service personnel.



The user must ensure that safety inspections are performed at least every 12 months according to historical data. Refer to the Service manual, Chapter 10.

Only trained persons are allowed to perform the safety inspections mentioned above.

Technical descriptions are available on request.



Do not perform system care and maintenance in the patient environment.

To ensure that the unit constantly operates at maximum efficiency we recommend that the following procedures be observed as part of the customer's internal routine maintenance program.

Expected Service Life Description

The expected service life for the Vivid *iq* system and probes is identified in table.

Table 14-11: Expected Service Life

Equipment/Accessory	Expected Service Life
Vivid <i>iq</i> system	The expected service life for the Vivid <i>iq</i> is at least seven (7) years from the manufacturing date under the provision of regular maintenance by authorized service personnel.
Vivid <i>iq</i> probes	The expected service life for the Vivid <i>iq</i> probes meets or exceeds five (5) years from the date the probe is placed in service, under the provision that the customer follows the care instructions provided on the Probe Care Card that accompanies the Vivid <i>iq</i> instructions for Use.

Maintenance Schedule

Follow this Maintenance Schedule to maintain optimum system function and patient care:

Table 14-12: Vivid *iq* Maintenance Schedule

Monthly	Weekly	Daily	After Each Patient
Inspect the following on a monthly basis: • Connectors on cables for any mechanical defects. • Entire length of electrical and power cables for cuts or abrasions. • Equipment for loose or missing hardware. • Control panel and keyboard for defects. • Casters for proper movement and locking operation.	Clean and disinfect the following on a weekly basis: • Back Body Cover • Top Table • Lower Table Multiple Probe Box • Upper Column • Lower Column	Clean and Disinfect the following areas on a daily basis: • Front Body Cover • Trackpad • LCD Monitor • Operator Panel • Probe Lock/Release Button • ECG Adapter Cable	Clean and Disinfect the following after each patient: • Probe • Biopsy Bracket, as applicable. Additionally, Clean and Disinfect any area on the system that has visible contamination from the previous exam Note: Biopsy Accessories must be cleaned and disinfected or disposed of after each patient. Refer to the Probes Chapter, for probe cleaning, disinfection and inspection.



CAUTION

To avoid electrical shock hazard, do not remove panels or covers from console. This servicing must be performed by qualified service personnel. Failure to do so could cause serious injury.

If any defects are observed or malfunctions occur, do not operate the equipment but inform a qualified service person. Contact a Service Representative for information.



CAUTION

The system does not support automated cleaning from design's perspective.

Maintenance Schedule (continued)



CAUTION

When performing cleaning and disinfection procedures, to prevent the risk of system damage, always observe the following precautions:

- Use only cleaning and disinfection materials and solutions as recommended in the procedures described below.
- Do not spray any liquid directly onto the Vivid *iq* covers, LCD Display or control panel. In case of an accidental spill, please wipe immediately and clean the surface and around keys.
- Do not allow any chemical agents to drip or seep into device openings or connections.
- Use only recommended cleaners or disinfectants on system surfaces. Immersion-type disinfectants are not approved for use on system surfaces.
- DO NOT scratch or press on the panel with any sharp objects, such as pencils or pens, as this may result in damage to the panel.
- Prior to cleaning, turn OFF power to the system and disconnect the mains cable. Remove all the peripherals from the system.
- Do not clean any ports of the system, such as USB ports, ECG connector port, probe ports, Ethernet Network port, HDMI port, etc.
- After cleaning, please inspect the system including functionality by live scan. If any defects are observed or malfunctions occur, do not operate the equipment but inform a qualified service person. Contact a Service Representative for information.



WARNING

To avoid electrical shock, before cleaning, disconnect the system from the power supply and remove all the peripherals from the system.



WARNING

Hospital cleaning staff is not allowed to do system cleaning and disinfecting work.

Cleaning and Disinfecting the system

These cleaners/disinfectants can be used anywhere on the console (Operator Panel, Monitor, etc.), except for the probes. Refer to 'Cleaning and Disinfecting the Probe' on page 12-32 for probe disinfectant information and web links.

Always consult the cleaner or disinfectant manufacturer's instructions for proper use of their product. Wear appropriate personal protective equipment (PPE) as indicated by the manufacturer.

Appropriate cleaners/disinfectants for the console that have been validated for compatibility are shown below:

NOTE: Please refer to 'Cleaners and Disinfectants of the Cart' in *Vivid iq Mobile Cart User Instruction* to get the validated cleaners/disinfectants for Cart.

Table 14-13: Appropriate Cleaners/Disinfectants

No.	Product	Manufacturer	Type	Cleaning agents/ Disinfectants
1.	Cidex OPA	Advanced Sterilization Products	Solution	Disinfectant/Cleaner
2.	PDI Sani-Cloth Plus Germicidal Disposable Cloth (low Alcohol)	PDI Healthcare	Wipe	Disinfectant
3.	PDI Super Sani-Cloth Plus Germicidal Disposable Cloth (high Alcohol)	PDI Healthcare	Wipe	Disinfectant
4.	PDI Sani-Cloth HB(Germicidal, Alcohol free)	PDI Healthcare	Wipe	Disinfectant
5.	Sporicidin (Phenol)	Sporicidin International	Solution	Disinfectant
6.	DisCide - Recommended for clarity (63% ISOPROPYL)	Palmero healthcare	Solution	Disinfectant
7.	Asepti-Wipe II	ECOLAB INC.	Wipe	Disinfectant
8.	Cavicide Surface Cleaner/ Disinfectant	Metrex Research, Inc.	Solution	Disinfectant
9.	Clorox Disinfecting Wipes	Clorox	Wipe	Disinfectant
10.	Metrix Caviwipes	Metrex Research, Inc.	Wipe	Disinfectant
11.	Soap water		NA	Cleaning agent
12.	Revital-ox RESERT	STERIS	Solution	Disinfectant
13.	Tristel trio wipes(include below 3 wipes)	Tristel	Wipe	

Table 14-13: Appropriate Cleaners/Disinfectants

No.	Product	Manufacturer	Type	Cleaning agents/ Disinfectants
	Pre-Clean Wipe	Tristel	Wipe	Cleaning agent
	Tristel Sporicidal Wipes	Tristel	Wipe	Disinfectant
	Rinse Wipe	Tristel	Wipe	
14.	70% isopropyl alcohol	McKesson	Solution	Disinfectant/Cleaner



WARNING

All cleaners and disinfectants **NOT** on this list are **unapproved** by GE. Failure to follow guidelines could result in damage to the device.



CAUTION

When processing the operator control panel, make sure not to spill or spray any liquid on the controls, into the system cabinet, or in the probe connection receptacle.



CAUTION

To avoid liquids entering the product, **DO NOT** spray any liquid directly onto the surfaces. **ALWAYS** use a cloth or wipe.



CAUTION

Diligent cleaning of the console reduces the risk of spreading infection from person to person, and also helps to maintain a clean working environment.



CAUTION

After cleaning, please inspect the system including functionality by live scan. If any defects are observed or malfunctions occur, do not operate the equipment but inform a qualified service person. Contact a Service Representative for information.

Console

Cleaning the Vivid iq Console

The Vivid iq Console includes the Monitor, Monitor Frame, and Operator Panel. For Probes Reprocessing, Refer to 'Cleaning and Disinfecting the Probe' on page 12-32 for probe disinfectant information and web links.

Always clean visible soil from surfaces first before disinfecting the Console.

Follow the cleaning/disinfecting frequency suggested in 'Maintenance Schedule' on page 14-29.

To clean the system,

1. Moisten a soft, non-linting cloth with a mild, general purpose, non-abrasive soap and water solution or approved cleaning/disinfecting agent.

NOTE: *The cloth/wipe should be damp, not dripping wet and running. Moisture should not drip into the crevices anywhere on the console.*

NOTE: *Refer to Table 14-13 on page 14-31 for a list of compatible solutions to be used on the Console.*

2. Use a gentle wiping action to clean any surface on the console.



HINTS

A scrubbing action with the wipe may be necessary to help remove stubborn soil from the surfaces. However be careful with this action over services and gaps in the surface to prevent liquid from being scraped off the wipe and entering the product.

3. Wipe off excess cleaning agents.

NOTE: *Do not spray any liquid directly into the unit.*

NOTE: *DO NOT scratch or press on the panel with any sharp objects, such as pencils or pens, as this may result in damage to the panel.*

Disinfecting the Vivid iq Console

Effective Disinfection is always a balance between safe inactivation of infectious agents and undesirable side effects. Due to the generally uneven and irregular surface of Ultrasound consoles, a comprehensive surface disinfection process cannot be recommended by the manufacturer.

For disinfectants to be effective, the surface must first be clean. Refer to 'Cleaning the Vivid iq Console' on *page 14-33*.

ALWAYS follow the manufacturer's instructions concerning the use of the disinfectant and follow the contact time to be sure the disinfectant's kill claims are accomplished.

Follow the cleaning/disinfecting frequency suggested in 'Maintenance Schedule' on *page 14-29*.

Disinfect the desired surfaces of the console. To prevent cross contamination, surfaces that are often touched during exams should be disinfected after every patient. To disinfect the system,

1. Moisten a sterile non-linting cloth with a liquid disinfectant or remove pre-moistened disinfectant wipe from the container.



If a cleaner/disinfectant wipe was used to clean off visible soil per the above section, a second, fresh cleaner/disinfectant product should be used for the disinfectant step.

2. Wet the surfaces by gently applying the cloth or wipe. Avoid high pressure or squeezing the wipe to avoid having the liquid enter the gaps and cervices of the Console. Scrubbing is not necessary in the disinfecting step; evenly applying the liquid is the goal.
3. Let the surface remain wet for the appropriate contact time.
4. If the surface does not remain wet for the full contact time, apply an additional application of the disinfectant, as necessary, to extend the time.
5. After the contact time has expired, remove excess liquid with a dry sterile cloth.
6. To avoid disinfectant buildup, or to remove disinfectant residue which may cause skin irritation, perform a rinse step with a sterile damp cloth.

Monitor and Monitor Frame

Monitor

To clean the Monitor:

1. Moisten a soft, non-linting folded cloth with a mild, general purpose, non-abrasive soap and water solution.

NOTE: *The cloth should be damp, not dripping wet.*

2. Wipe down the top, front, back, and both sides of the monitor.

3. Wipe off excess cleaning agents with a non-linting cloth.

NOTE: *Never use thinner, benzene, alcohol (ethanol, methanol, or isopropyl alcohol), abrasive cleaners, or other strong solvents, as these may cause damage to the monitor.*

Monitor Frame

To clean the monitor frame:

1. Moisten a soft, non-abrasive folded cloth with a mild, general purpose, non-abrasive soap and water solution.

NOTE: *The cloth should be damp, not dripping wet.*

2. Wipe down the top, front, back, and both sides of the monitor frame.

3. Wipe off excess cleaning agents.

NOTE: *DO NOT scratch or press on the panel with any sharp objects, such as pencils or pens, as this may result in damage to the panel.*

For disinfection of the monitor frame, refer to 'Disinfecting the Vivid iq Console' on *page 14-34*.

Probe Cleaning Notes

When cleaning/disinfecting probes, take care **NOT** to damage the Console with a solution that is approved for the probe but that **IS NOT APPROVED** for the Console. Refer to Table 14-13 on page 14-31 for a list of acceptable solutions to be used on the Console. Refer to the Probes Chapter, for probe cleaning and disinfecting instructions.



CAUTION

NEVER use any cleaner or disinfectant containing alcohol.

Probe shall not stay in probe holder on the Ultrasound system during cleaning/disinfection. If you use a spray cleaner, spray **AWAY** from the Ultrasound system. Spray can damage the TGC controls.



Figure 14-1. DO NOT Spray a Probe While in its Holder

To clean the physical keys and power button

NOTE: *Diligent cleaning of the physical keys and button will reduce the risk of spreading infection from person to person, and also helps to maintain a clean working environment.*

1. Use a cotton swab to clean around the physical keys. Use a toothpick to remove solids between the physical key and the cabinet surface.

When cleaning the operator control panel, make sure not to spill or spray any liquid on the physical keys, into the system cabinet, or in the probe connection receptacle. In case of an accidental spill, please wipe immediately and clean the surface and around keys.

2. In the event that disinfection is required or any stubborn stains remain, absorb a small quantity of isopropyl rubbing alcohol on a soft, dust-free cloth. Wipe the surface of the console. Please ensure that no residue of liquid drips or remains on the keys to ensure proper cleaning and function. Allow to dry.



CAUTION

Do not use any kinds of cleaning agents to clean any connectors or ports of the system, including probe connector, USB port, HDMI port, LAN port, ECG port, E4D port, power input port, etc.

For disinfection of the physical keys and power button, refer to 'Disinfecting the Vivid iq Console' on *page 14-34*.

Cleaning the Cart power box air filter

Clean the Cart power box's air filter to ensure that a clogged filter does not cause the power box to overheat and reduce power box performance and reliability. Please refer to 'Cleaning the Cart power box air filter' in Vivid *iq* Mobile Cart User Instruction for details.

Cleaning the cart probe holder

Please refer to 'Cleaning the Cart probe holder' in Vivid *iq* Mobile Cart User Instruction for details.

Cleaning the probes

Refer to the Probes chapter, section for probe cleaning and disinfecting instructions.

Peripherals

Clean the peripherals in accordance with the respective manufacturer's directions.

Prevention of static electricity interference

Interference from static electricity can damage electronic components in the system. The following measures help to reduce the likelihood of electrostatic discharge:

- Wipe the surface of the console and the touch screen with lint-free tissue or a soft cloth dampened with anti-static spray on a monthly basis.
- Spray carpets with anti-static spray because constant walking on carpets in or near the scanning room may be a source of static electricity.

Quality Assurance

Introduction

A good Quality Assurance Evaluation program consists of periodic systematic actions that provide the user with adequate confidence that their diagnostic ultrasound system will produce consistently high quality images and quantitative information.

Therefore, it is in the best interests of every ultrasound user to routinely monitor equipment performance.

The frequency of Quality Assurance evaluations should be based on user's specific needs and clinical practice.

Periodic monitoring is essential in order to detect the performance changes that occur through normal aging of system components. Routine equipment evaluations may also reduce the duration of exams, number of repeat exams, and maintenance time required.

For details on system and peripheral routine preventive maintenance instructions, See 'System Care and Maintenance' on *page 14-27 for more information.*

Typical Tests to Perform

Quality assurance measurements provide results relating to system performance. Typically these are:

- Axial Measurement Accuracy
- Lateral Measurement Accuracy
- Axial and Lateral Resolution
- Penetration
- Functional & Contrast Resolution
- Gray Scale Photography.

With these tests, a performance baseline can be set at installation with the phantom in your department. Future test results can be compared to the baseline in order to maintain a record of system performance trends. The phantom shown is shown as a representative example of a phantom. You can select from any number of phantoms available on the market.

Frequency of tests

Quality assurance tests are used to determine whether a scanner is providing the same level of performance from day to day.

The frequency of testing varies with the amount of system usage and modes to be tested. It is recommended that the user perform quality assurance tests at least every three months or every 400 patient studies. Tests should also be performed when a question about system performance exists.

A mobile system may require more frequent tests.

Image quality should also be tested immediately after the following events:

- Service calls
- System upgrades/modifications
- Dropped probe, power surge, etc.

Phantoms

Quality Assurance Evaluations may be done with phantoms and test objects that are applicable to the parameters being evaluated or to the user's clinical practice.

Typical phantoms are composed of material that acoustically mimic human tissue. Pins, anechoic and echogenic targets are physically positioned to provide information for a variety of tests.

The RMI 403GS phantom is shown in the illustration below as a representative example of a phantom.

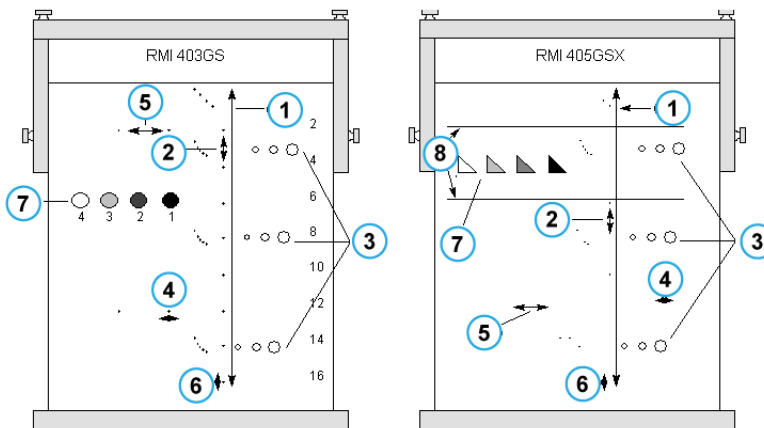


Figure 14-2. Representative Phantom Example

1. Penetration
2. Axial Distance Measurement
3. Functional Resolution
4. Lateral Resolution
5. Lateral Distance Measurement
6. Axial Resolution
7. Contrast Resolution and Gray Scale Photography
8. Gray Scale Plane Targets

Baselines

An absolute necessity for a quality assurance program is establishing baselines for each test or check. Baselines are established after the system has been verified to be working properly at installation or after a repair. If a probe or major assembly is replaced, new baselines should be generated.

Baselines can be made by adjusting system parameters to prescribed levels or to the best possible image. The key factor to remember is reproducibility. The same conditions must be reproduced for each periodic check.

All system parameters not displayed on the monitor should be recorded for the permanent record.

Periodic Checks

Periodic checks should be performed in accordance with your facility's quality assurance requirements. For the data to be valid, periodic checks should mimic the baseline setup parameters.

The resulting image, when scanning the phantom exactly as before, should be recorded and compared to the baseline. When a matching image is obtained, it can be assumed that the system performance has not degraded from the baseline.

If a significant difference between the baseline and periodic check is noted, double check the system setup and repeat the test. If the difference between the baseline and periodic check persists, contact a local Service Representative.

Failing to reproduce the control settings as in the baselines will introduce errors in the data and potentially invalidate the results.

Results

Lack of standardization among test instruments, the wide range of acceptance criteria, and incomplete knowledge regarding the significance of certain performance parameters prohibit the establishment of absolute performance criteria for these tests.

Quality Assurance Evaluation results should be compared to previously-recorded results.

Performance trends can then be detected. Unacceptable performance or diminishing trends should be identified for maintenance or repair before a malfunction or inappropriate diagnosis occurs.

The user should determine the best method for recording and archiving the baseline and periodic checks. In most cases the choice is hard copy.

It is important to maintain good consistent records for inspections that may arise, as well as to detect system performance trends.

System Setup

The user should tailor the tests to their particular needs. It is certainly not necessary to make all checks with all probes. A representative example, with the probes used most often by the customer, should be adequate in judging system performance trends.

Use a gray scale phantom as the scan object for the tests. Commercial phantoms are supplied with its own operator manual. Be familiar with proper phantom operating procedures prior to use for quality assurance evaluations.

- Adjust image monitor. Brightness and contrast should be set to the normal viewing of a good gray scale image.
- Check all recording devices for proper duplication of image monitor. Ensure that what is seen is what is recorded.
- Annotate non-displayed image processing controls.
- Set TGC slide pots to center (detent) position.
- Place focal zone marker(s) in area of interest for an optimum image.

Test Procedures

The following are recommended Quality Assurance tests. A brief description of the test, the benefit it provides and steps to accomplish the test are supplied. The importance of recording scan parameters and consistent record keeping cannot be stressed enough. Reproducibility to monitor system trends is the key to quality assurance evaluations. Using the system's dual image display format is often very convenient and saves recording media.

Axial distance measurements

Description

Axial measurements are the distance measurements obtained along the sound beam. See Figure 14-2 for more information.

Benefit

The accurate measurement of the size, depth and volume of a structure is a critical factor in determining a proper diagnosis. Most imaging systems use depth markers and/or electronic calipers for this purpose.

Method

Axial distance should be measured in the near, mid and far fields as well as in zoom. If necessary, different depths or fields of view can be tested.

Procedure

To measure axial distance:

1. Scan a test phantom with precisely-spaced vertical pin targets. Adjust all scan controls, as necessary, for the best image of the pin targets to typical depths for the probe being used.
2. Press **Freeze** to stop image acquisition and perform a standard distance measurement between the pins at different points in the image. Record all images for archiving.
3. Scan the vertical pins in zoom or at different depth/scale factors.
4. Press **Freeze** to stop image acquisition; repeat the distance measurements between pins and record the images for archiving.
5. Document the measurements for reference and future comparison.

Contact a Service Engineer if vertical measurements differ by more than 1.50% of the actual distance.

Lateral distance measurements

Description

Lateral measurements are distance measurements obtained perpendicular to the axis of the sound beam. See Figure 14-2 for more information.

Benefit

The purpose is the same as vertical measurements. Precisely-spaced horizontal pin targets are scanned and results compared to the known distance in the phantom.

Method

Lateral distance should be measured in the near, mid and far fields as well as in zoom. If necessary, different depths of fields of view can be tested.

Procedure

To measure lateral distance:

1. Scan a test phantom with precisely-spaced horizontal pin targets. Adjust all scan controls, as necessary, for the best image of the pin targets from side to side.
2. Press **Freeze** to stop image acquisition and perform a standard distance measurement between the pins at different points in the image. Record all images for archiving.
3. Scan the horizontal pins in zoom or at different depth/scale factors.
4. Press **Freeze** to stop image acquisition; repeat the distance measurements between pins and record the images for archiving.
5. Document the measurements for reference and future comparison.

Contact a Service Engineer if horizontal measurements differ by more than 3mm or 3% of that depth, whichever is greater.

Axial resolution

Description

Axial resolution is the minimum reflector separation between two closely-spaced objects to produce discrete reflections along the axis of the sound beam. It can also be monitored by checking the vertical size of known pin targets. See Figure 14-2 for more information.

Axial resolution is affected by the transmitting section of the system and the probe.

Benefit

In clinical imaging, poor axial resolution displays small structures lying close together as a single dot. This may lead to improper interpretation of the ultrasound image.

Procedure

To measure Axial resolution:

1. Scan a test phantom with precisely-spaced vertical pin targets.
2. Adjust all scan controls, as necessary, for the best image of the pin targets to typical depths for the probe being used.
3. Press **Freeze** to stop image acquisition.
4. Perform a standard distance measurement of the pin vertical thickness at different points in the image. Record all images for archiving.
5. Scan the vertical pins in zoom or at different depth/scale factors.
6. Press **Freeze** to stop image acquisition; repeat the vertical thickness measurements of the pins and record the images for archiving.
7. Document the measurements for reference and future comparison.

Axial resolution should remain stable over time. Contact a Service Engineer if any changes are observed.

Lateral resolution

Description

Lateral resolution is the minimum reflector separation between two closely spaced objects to produce discrete reflections perpendicular to the axis of the sound beam. It can also be monitored by checking the horizontal size of known pin targets. See Figure 14-2 for more information.

Lateral resolution is dependent upon the beam width produced by the probe. The narrower the beam, the better the lateral resolution.

The beam width is affected by the frequency, degree of focusing, and distance of the object from the face of the probe.

Benefit

Clinically, poor lateral resolution will display small structures lying close together as a single dot. This may lead to improper interpretation of the ultrasound image.

Procedure

To measure lateral resolution:

1. Scan a test phantom with precisely-spaced horizontal pin targets.
2. Adjust all scan controls, as necessary, for the best image of the pin targets from side to side.
3. Press **Freeze** to stop image acquisition and perform a standard distance measurement of the horizontal thickness of a pin at different points in the image. Record all images for archiving.
4. Scan the horizontal pins in zoom or at different depth/scale factors.
5. Press **Freeze** to stop image acquisition; repeat the horizontal thickness measurements of the pins and record the images for archiving.
6. Document the measurements for reference and future comparison.

Pin width should remain relatively constant over time ("1mm). Dramatic changes in pin width may indicate beamforming problems. Contact a Service Engineer if beam width changes consistently over 2 to 3 periodic tests.

Penetration

Description

Penetration is the ability of an imaging system to detect and display hypoechoes from small objects at large depths. See Figure 14-2 for more information.

Penetration can be affected by the system's:

- Transmitter/receiver
- Degree of probe focusing
- Attenuation of the medium
- Depth and shape of reflecting object
- Electromagnetic interference from local surroundings.

Benefit

Weak reflecting echoes are commonly produced from the internal structure of organs. Definition of this tissue texture is important in the interpretation of the ultrasound findings.

Method

Scan a phantom to see how echoes begin to fade as depth is increased. The maximum depth of penetration is the point at which homogeneous material in the phantom begins to lose brightness.

Procedure

To measure penetration:

1. Set the front panel TGC slide pots to their center (detent) position.
2. Gain and acoustic output can be adjusted, as necessary, since these values are displayed on the monitor.
3. Scan a test phantom along the vertical pin targets to typical depths for the probe being used.
4. Perform a standard distance measurement from the top of the image displayed to the point at which homogeneous material in the phantom begins to lose brightness.
5. Document the depth measurement for reference and future comparison.

Contact a Service Engineer if the depth of penetration shifts more than one centimeter (1cm) when using the same probe and same system settings.

Functional resolution

Description

Functional resolution is an imaging system's ability to detect and display the size, shape, and depth of an anechoic structure, as opposed to a pin target. See Figure 14-2 for more information.

The very best possible image is somewhat less important than reproducibility and stability over time. Routine tests at the same settings should produce the same results.

Benefit

The data obtained will give a relative indication of the smallest structure the system is capable of resolving at a given depth.

Procedure

To measure functional resolution:

1. Set the front panel TGC slide pots to their center (detent) position.
2. Gain and acoustic output can be adjusted as necessary, since these values are displayed on the monitor.
3. Scan a test phantom with a vertical row of anechoic cyst targets to typical depths for the probe being used.
4. Evaluate the cysts at various depths for a good (round) shape, well-defined borders and no fill in. Remember, TGC slide pots are centered and should remain fixed. This may NOT provide optimal cystic clearing.
5. Document all results for future reference and comparison.

Contact a Service Engineer if a greatly distorted image is obtained.

Contrast resolution

Description

Contrast resolution is the ability of an imaging system to detect and display the shape and echogenic characteristics of a structure. See Figure 14-2 for more information.

Specific values measured are less important than stability over time. Routine tests at the same settings should produce the same results.

Benefit

A correct diagnosis is dependent upon an imaging system's ability to differentiate between a cystic or solid structure versus echo patterns from normal surrounding tissue.

Method

A phantom with echogenic targets of different sizes and depths should be used.

Procedure

To measure contrast resolution:

1. Set the front panel TGC slide pots to their center (detent) position. Set dynamic range to 54 db.
2. Gain and acoustic output can be adjusted, as necessary, since these values are displayed on the monitor.
3. Scan a test phantom with echogenic targets at the depths available.
4. Evaluate the echogenic targets for contrast between each other and between the surrounding phantom material. Remember, TGC slide pots are centered and should remain fixed. This may NOT provide an optimal scan image.
5. Document all results for future reference and comparison.

Contact a Service Engineer if the echogenic characteristics or shapes of the targets appear distorted.

Gray Scale photography

Description

Poor photography will cause loss of low level echoes and the lack of contrast between large amplitude echoes. See Figure 14-2 for more information.

Benefit

When photographic controls and film processors are properly adjusted, hypoechoes, as well as hyperechoes, are accurately recorded on film.

Procedure

1. Adjust the camera according to the manufacturer's instructions until the hard copy and video display are equal.
2. Scan the phantom and it's echogenic contrast targets.
3. Make a hard copy photograph of the display and compare it to the image on the video monitor for contrast and weak echo display.
4. Document all results for future reference and comparison.

Contact a Service Engineer if camera cannot duplicate what is on the image monitor.

NOTE: *Optimization of brightness/contrast controls on the display monitor is imperative in order to make sure that the hardcopy and monitor look alike.*

The display monitor is adjusted first. The hardcopy camera or printer is adjusted to match the display monitor.

Setting up a Record Keeping System

Preparation

The following is needed:

- Quality Assurance binder.
- Hard copy or electronic file of images.
- Quality Assurance Checklists.
- Display the following information while testing quality assurance:
 - Acoustic Output
 - Gain
 - Depth
 - Probe
 - Dynamic Range
 - Set up new patient to be the name of the test.
- Annotate the following:
 - Any control where its value is **NOT** displayed.
 - Significant phantom information.

Record Keeping

Complete the following:

1. Fill out the Ultrasound Quality Assurance Checklist for each probe, as scheduled.
2. Make a hard copy or archive the image.
3. Compare images to baseline images and acceptable values.
4. Evaluate trends over previous test periods.
5. File hard copy or electronic file of images and checklist in Quality Assurance binder.

Ultrasound Quality Assurance Checklist

Table 14-14: Ultrasound Quality Assurance Checklist (Part 1)

Performed By		Date
System		Serial Number
Probe Type	Probe Model	Serial Number
Phantom Model	Serial Number	Room Temperature
Acoustic Output	Gain	Focal Zone
Gray Map	TGC	Depth
Monitor Setting		
Peripheral Settings		
Other Image Processing Control Settings		

Table 14-15: Ultrasound Quality Assurance Checklist (Part 2)

Test	Baseline Value Range	Tested Value	Image Hardcopy/Archived	Acceptable? Yes/No	Service Called (Date)	Date Resolved
Vertical Measurement Accuracy						
Horizontal Measurement Accuracy						
Axial Resolution						
Lateral Resolution						
Penetration						
Functional Resolution						
Contrast Resolution						
Gray Scale Photography						

Supplies/Accessories

Introduction



CAUTION

DO NOT connect any probes or accessories without approval by GE.

Not all features, products, probes or peripherals described in this document may be available or cleared for sale in all markets.

The user or the operator should never install/replace the internal peripheral. Service representatives authorized by GEHC will install/replace the internal peripheral.

Contact the distributor, GE affiliate or sales representative for approved peripherals. For HCATs, contact your sales person.

The following supplies/accessories have been verified to be compatible with the system:

Peripherals

Table 14-16: Peripherals and Accessories

Accessory	Unit
USB3.0 Disk	Each
1TB mobile HDD	Each
Wireless USB adapter A6210/A8000	Each
ICECord-RS with ferrite filter	Each
Vivid iq EP lab accessory kit	Each
View-X	Each
Vivid iq multi probe port box	Each
Charge box with 3 batteries	Each
TEE Bag	Each
Ergonomic wrist rest	Each
Vivid iq new Adapter	Each
Rolling Bag	Each
FOOT SWITCH -MED GP26	Each
P2D holder	Each
Isolated HDMI Splitter	Each
HDMI to s-video adaptor	Each
Vivid compact battery	Each
Sage inclined supporter	Each
Ethernet protection cable	Each
Transcend DVD Writer kit	Each

Probes

Table 14-17: Probes and Accessories

Probe	HCAT	Biopsy Guide	Biopsy Guide HCAT
3Sc-RS	H45041DL	3Sc-RS biopsy kit	H46222LC
M5Sc-RS	H44901AG	M5S biopsy kit	H45561FC
9L-RS	H40442LL	9L-RS Biopsy kit	H4906BK
ML6-15-RS	H40462LM	ML6-15 Biopsy Kit	H40432LJ
4C-RS	H40462LA	4C-RS Biopsy Kit	E8385NA
C1-5-RS	H40462LA	C1-5-RS Biopsy kit	H40432LE
12L-RS	H40402LY	12L Multi Angle Biopsy Starter Kit	H40432LC
		Infinite 12L biopsy kit	H48392LT
E8Cs-RS	H48062AF	E8Cs-RS Biopsy Kit	E8385MJ
L4-20t-RS	H48062AJ	L4-20t Verza biopsy starter kit	H45201BLF
10T-D	H44901AH	NA	NA
12S-RS	H44901AB	N/A	N/A
6S-RS	H45021RP	N/A	N/A
8C-RS	H40402LS	N/A	N/A
6VT-D	H45561TA	N/A	N/A
6Tc-RS	H45551ZE	N/A	N/A
P2D	H45551CA	N/A	N/A
L8-18i-RS	H40462LF	N/A	N/A
9T - RS	H45531YM	N/A	N/A
ICECord-RS	H45021YE	N/A	N/A

System self-test

System malfunction

The ultrasound unit is designed for reliable operation and consistent, high-quality performance. Automatic self-testing facilities are provided to monitor system operation and to detect malfunction as soon as possible, thereby eliminating unnecessary downtime. The detection of any serious malfunction may result in immediate interruption of the unit operation.

In the event of error or system malfunction the user may save locally or export a log file to a removable media as described below and contact authorized service personnel.

In addition, system malfunctions can be bookmarked, enabling creation of a log file specific to that event.

Bookmarking a system malfunction

- If a system malfunction is observed, press **Alt - B**.
A bookmark will be created when creating a log file.



Figure 14-3. Log is bookmarked

Generating a log file

1. Press **Alt - D** on the alphanumeric keyboard.
The *Problem description dialogue* window is displayed (see Figure 14-4).
2. Type in a description of the problem. Notes should be made regarding the selected probe, the imaging mode and the application that was being used at the time of malfunction. If applicable, try to describe the button or key pushing sequence that immediately preceded the problem.
Check the mention *System lockup* if applicable.

3. Select the destination where to save or export the log file.
If **Store locally** is selected, the log file is saved to the local hard disk.
If a removable media is selected, the current and previously saved log files are exported to the selected media.

NOTE: To export to a shared folder on a network, a remote path must be defined (see 'Default remote path setting' on page 10-129).

4. Press **Save and Export**.
A Zip file (named "logfile_<date>_<time>.zip") is created.

Generating a log file (continued)

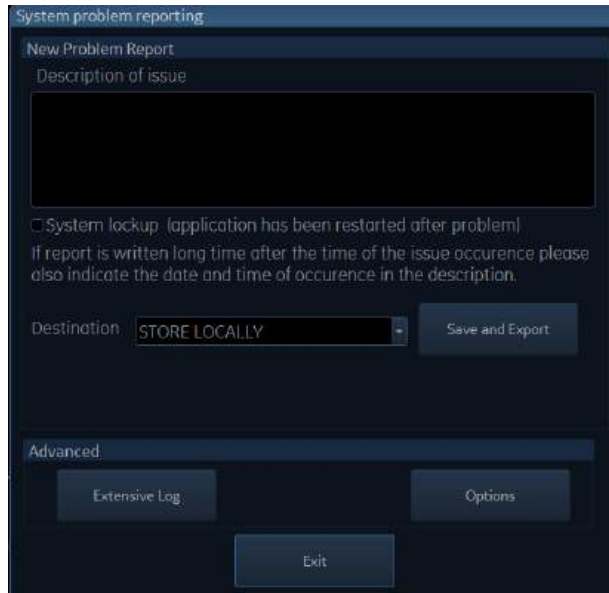


Figure 14-4. The Problem description dialogue window

Advanced log options

Extensive Log

Extensive Log enables the creation of a log file containing additional information for the selected functionality.

Options

Options enables creation of a log file based on a selected bookmark or for a user configurable time frame. Different type of information can be selected to be part of the log file.

eDelivery - Software update

Introduction

As part of the product lifecycle management, GE regularly analyzes and integrates software updates from our third party vendors into our products. These are typically released as part of regular updates or software releases.

The user can update to the latest software in either of two ways:

- Through the GE service platform on the ultrasound system. This requires Insite RSvP connectivity. See 'Software update via Insite Remote Service Platform (RSvP)' on *page 14-64*.
- Download the latest software from an end-user portal to a local storage location and install it on the ultrasound system. See 'Software update via End-User Portal' on *page 14-72*.

Software update via Insite Remote Service Platform (RSvP)

Software update for the system becomes available for download and installation through the GE Service platform.

A user who is not logged in as ADM (administrator) can perform the download, but installation is only available to those with administrator rights.



CAUTION

Please backup presets and database before installation of the software (see 'Data Backup and Restore' on *page 10-101*).

Remote software download should not change user presets or affect customer database; however, it is always best practice to ensure patient data and preset are backed up before proceeding with any software installation.

NOTE: *Please allow approximately one hour for complete software download (the download time may vary due to network connection speed). Please allow approximately one hour for complete installation.*

NOTE: *Software upgrade through the GE service platform may not be available in all markets.*

Software download and installation

1. Log on as **ADM**.
2. Ensure the Agent Configuration is correctly configured.

NOTE: *Refer to Service Manual or contact your Service Representative for Agent Configuration information.*

3. Press the **Download** button from the tray menu (Figure 14-9) or go to **Configure > About** page to press **Check updates** button (Figure 14-10).

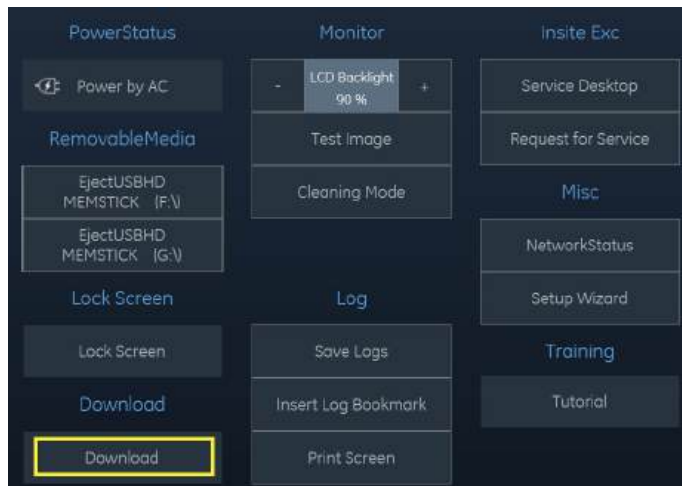


Figure 14-5. Press Download Button

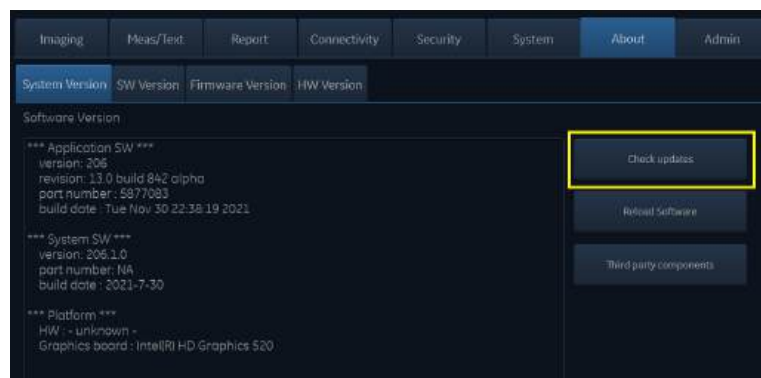


Figure 14-6. Press 'Check Updates' Button

Software download and installation (continued)

4. If there is no update package available, a message will be shown to inform the user. You can press the **Close** button and try again until the arrow  turns green .

NOTE: *There is an icon on the right corner of the tray menu to illustrate the download connection status.*



Figure 14-7. Download Available Button

The icon  indicates the last query was unavailable. You may press it to initiate another query.

The icon  indicates that new software is available for download.

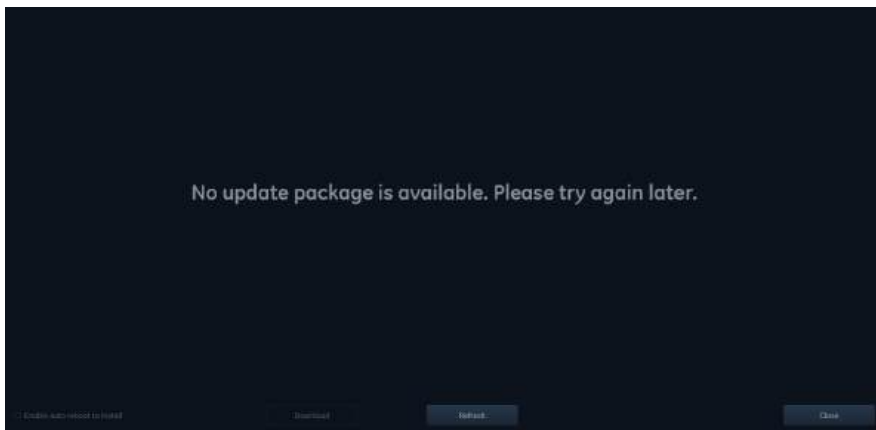


Figure 14-8. No update package is available

5. Available software updates are displayed in the list. If you want to refresh the query for available updates, press **Refresh**.

Software download and installation (continued)

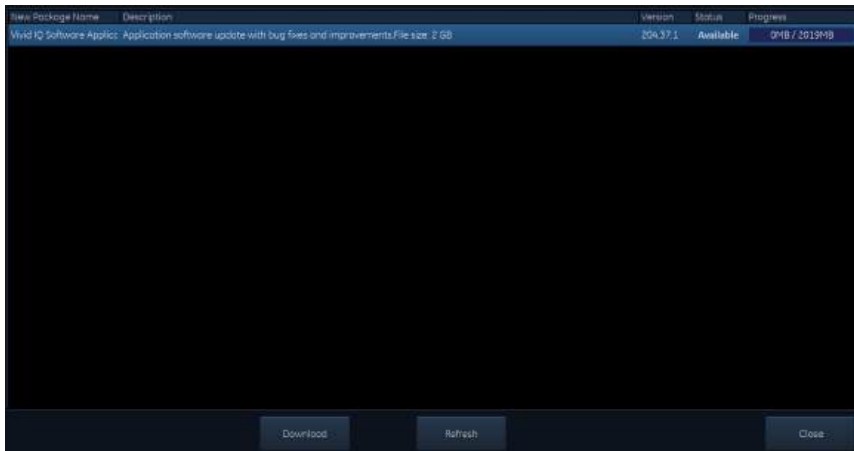


Figure 14-9. Software Available in the List

6. A window will pop up and ask for confirmation of refresh. Press **Yes**.

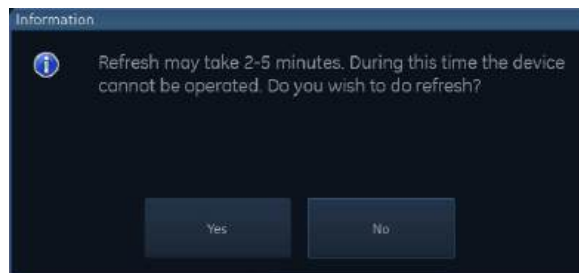


Figure 14-10. Refresh Confirmation

7. A dialogue informs that the refreshed list of available updates is being queried.

Software download and installation (continued)

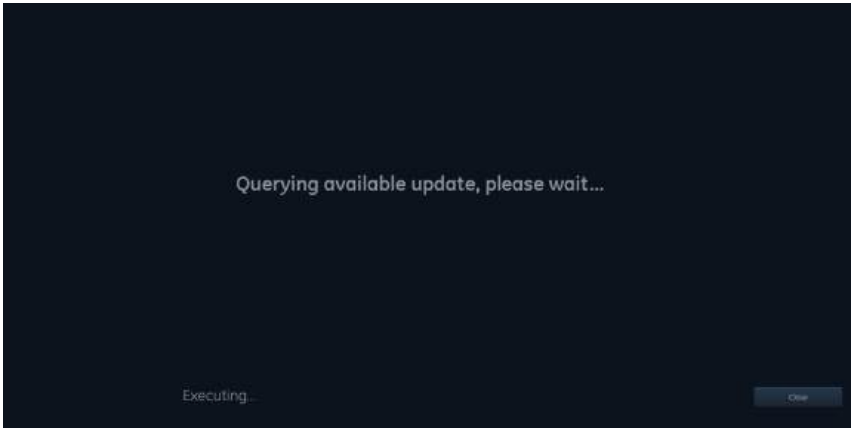


Figure 14-11. Querying Available Update

- 8. Select the desired software and press **Download** to download the software, or press **Close** to exit the window.

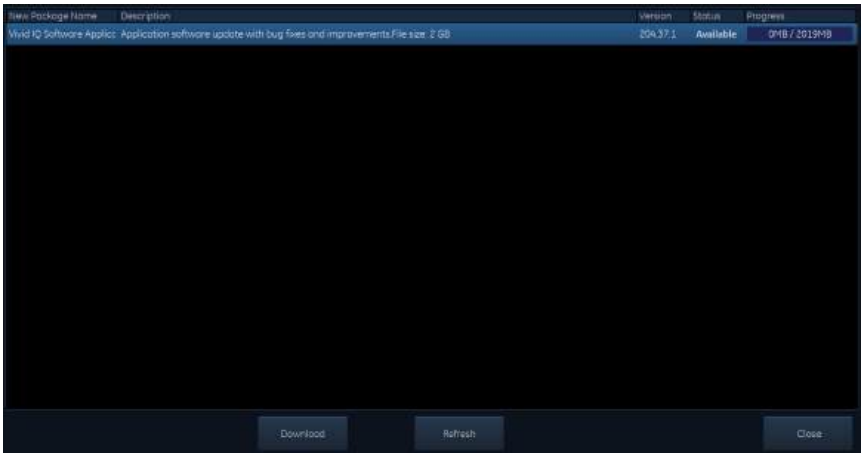


Figure 14-12. Press Download Button

Software download and installation (continued)

NOTE: *If the system doesn't have enough space for download and installation, please contact GE service representative*



Figure 14-13. No Space Error

9. During the software download process, the status will be displayed as “Downloading”. You can press **Pause** to suspend the download or press **Cancel** to exit the download.

NOTE: *During the software download, the ‘Close’ button is disabled. If you want to go back to scanning page, please press **Pause** to stop the download process first and then press the ‘Close’ button.*

- Once the download process is suspended, press the **Resume** button to recover the download process from the point where it is stopped.
- If there is an error during the downloading process, press the **Retry** button to recover the download process from the beginning.

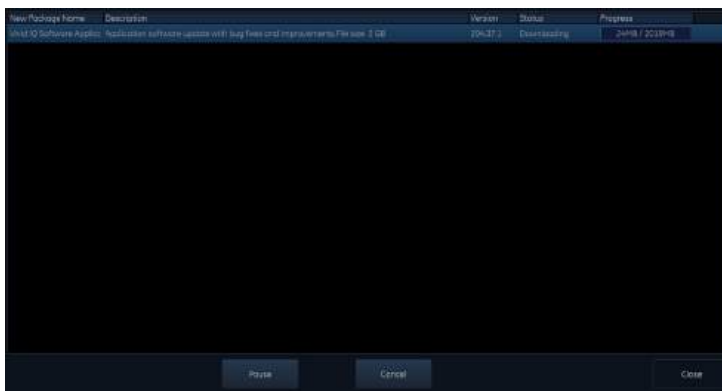


Figure 14-14. Software is Downloading

Software download and installation (continued)

10. When the download process finishes, the software is ready to be installed on the ultrasound system. Press **Install** to start the installation.

NOTE: Please wait for some time (around three times or less) to let the device reboot automatically if you are installing the software package.

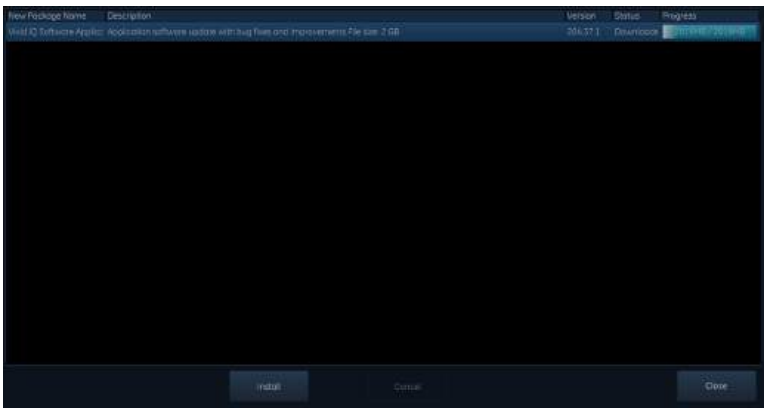


Figure 14-15. Press the Install Button

11. The system will reboot several times to complete the installation.

NOTE: Power cut-off or system shutdown during the download may lead to data loss.

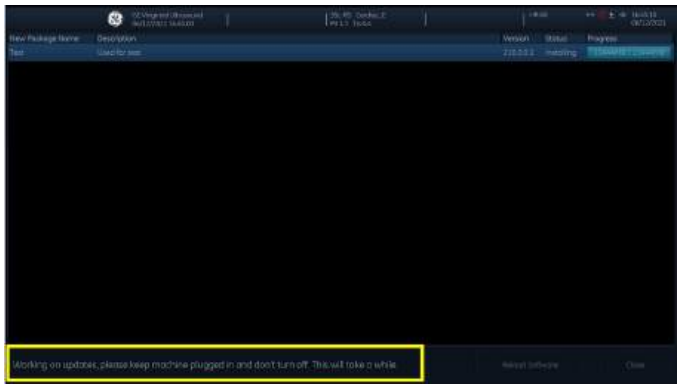


Figure 14-16. Warning During Installation

Software download and installation (continued)

NOTE: *A typical full installation may take up to 60 minutes.*

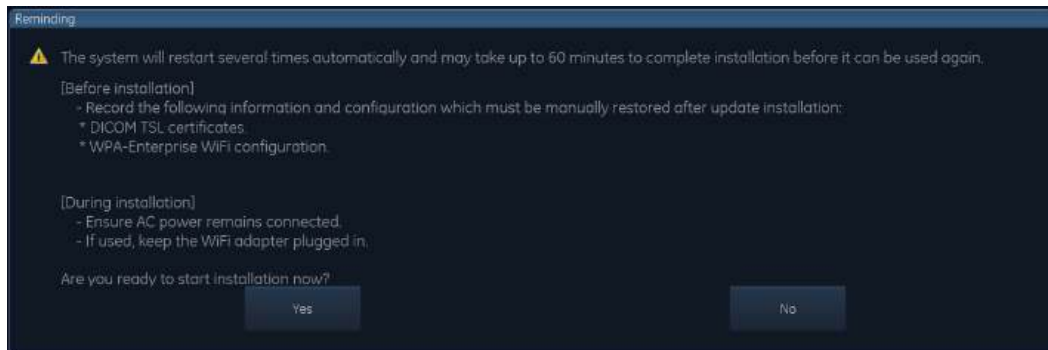


Figure 14-17. Installation warnings

12. When the software installation is complete and the system is rebooted, a *Reminder after Installation* window is displayed.



Figure 14-18. Reminder after Installation Window

Software update via End-User Portal

Customers entitled to eDelivery updates get a customer account to download software within the End-User Portal.

User accounts are created based on e-mail addresses provided by the customer at the point of sale. These e-mail addresses are the log-in credential for the End-User Portal along with a temporary password provided to the user through e-mail. When logging in to the End-User Portal the first time, the user is prompted to change the password and enter a secret question and answer for password retrieval.

Follow the below instructions to download software from the portal:

1. Log on to the portal website which is provided to end user via a welcome email:
<https://gehealthcare.flexnetoperations.com/flexnet/operationsportal>
2. Log in using the user name (e-mail) and password.

The image shows a web browser window displaying the GE Healthcare login page. At the top left is the GE logo, and to its right is the text "GE Healthcare". Below this, the word "Login" is displayed in blue. There are three input fields: "Username", "Password", and a dropdown menu currently showing "English (United States)". Below the input fields are two links: "Forgot password?" and "Register". To the right of these links is a blue "Log in" button.

Figure 14-19. Login Window

Software update via End-User Portal (continued)

- 3. The Software and License Delivery dashboard is displayed. Downloads can be found by browsing the products under “Your Downloads”.

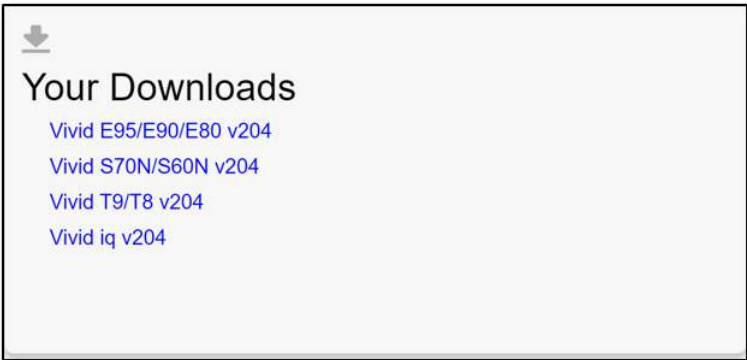


Figure 14-20. Software and License Delivery Page

- 4. Select the desired software to enter the Downloads page.

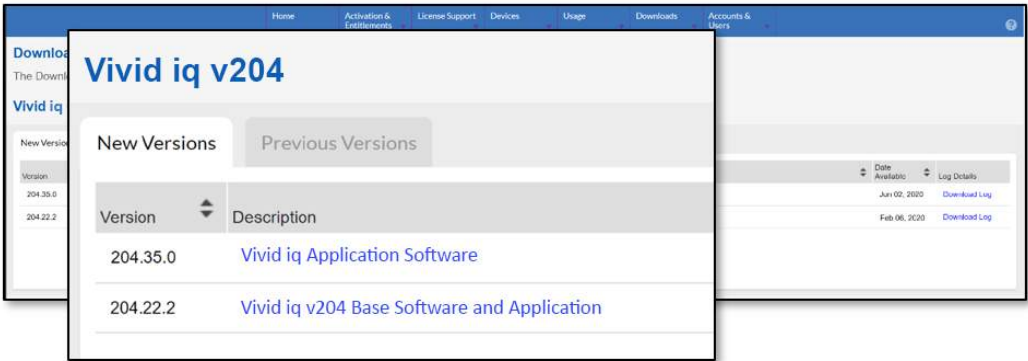


Figure 14-21. Downloads Page

Software update via End-User Portal (continued)

- 5. Check the box in front of the file you want to download and click the *Download Selected Files* button. Save the file in a local storage location (i.e. USB flash drive).

NOTE: If you are unable to download using the 'Download Selected Files' button, you can directly click the '.7z' file.

NOTE: Ensure that the USB is formatted as NTFS format so that the eDelivery package can be successfully copied into it.



Figure 14-22. Downloads Page

- 6. Load the software on the ultrasound system from the selected storage location. Refer to the Basic Service Manual for detailed installation procedures.

Loading the Software

To load a software onto the Vivid iq,

1. Power off the Vivid iq and insert the USB Flash Drive into a rear USB port.

NOTE: *Ensure that the system is USB Device Enabled (check Config->Service page).*

NOTE: *Ensure that the USB is formatted as NTFS format so that the eDelivery package can be successfully copied into it.*

2. Power on the Vivid iq. The software program files will be loaded onto the Vivid iq automatically, following several screen prompts:

- a. Select **Install SW...** on the Start Application screen.

NOTE: *If by accident you try to load a software that is not compatible with the software on the Vivid iq, error messages will indicate “The package present in media is not compatible. Please contact GE Service” and “Software installation is not started”.*

Start Application

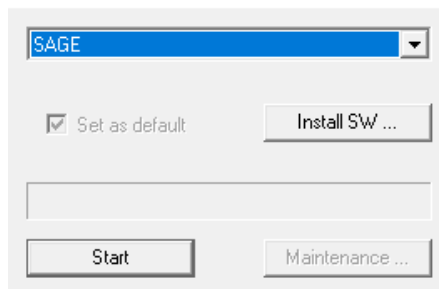
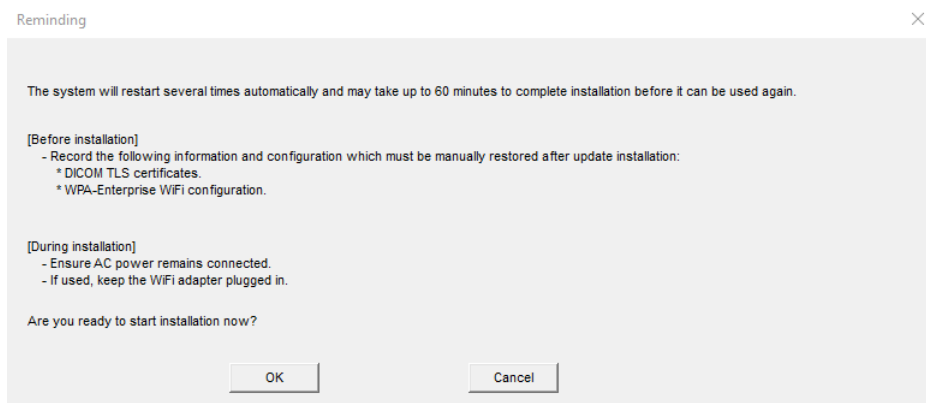


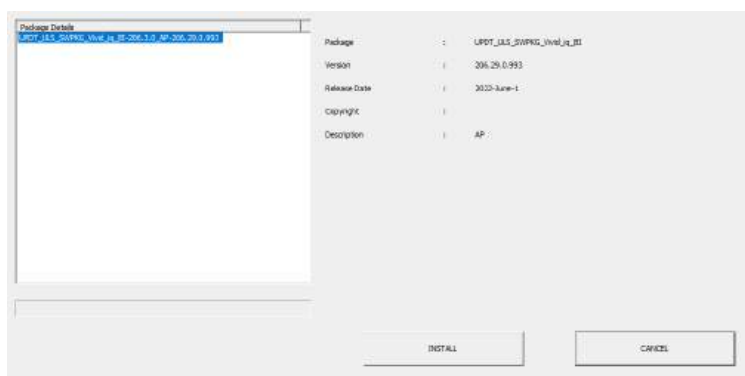
Figure 14-23. Select Install SW...

Loading the Software (continued)

- b. At the Reminding dialog, select '**OK**'.



- c. Select **Install** on the third screen where the latest software updates for ultrasound scanner application installation will start.



Loading the Software (continued)

- d. When ready, the device will reboot automatically. Before the system is restarted, remove the USB stick from the ultrasound device.



- NOTE:** *Depending on the content of the update, for the full software which contains the operating system, patches and application software, the operating system will be installed first, then patches, and finally followed by the application software.*
- NOTE:** *The ultrasound device may restart multiple times during update.*
- NOTE:** *Installation time depends on the type of update. A complete update with full software and application will take approximately 1 hour. No action is needed until the installation is complete.*

Loading the Software (continued)

- e. When the installation is complete, a *Reminder after Installation* window is displayed.



Reload Software

Software Reload displays versions of the base image, application software currently installed on the Vivid iq. Software Reload provides specific software versions for users to reload.

To reload the software onto the Vivid iq:

1. Press **Config** on the shortcut bar and log on as administrator if required.
2. Press the **Download** button at the top right of the display screen (Figure 14-24), or go to **About** page to press **Reload Software** button (Figure 14-25).

NOTE:

If you choose 'Download' button to reload software, make sure the agent configuration has been successfully configured (Refer to Service Manual or contact your Service Representative for Agent Configuration information), and there is no software downloading/downloaded, otherwise the Reload Software button will be hidden in download page.

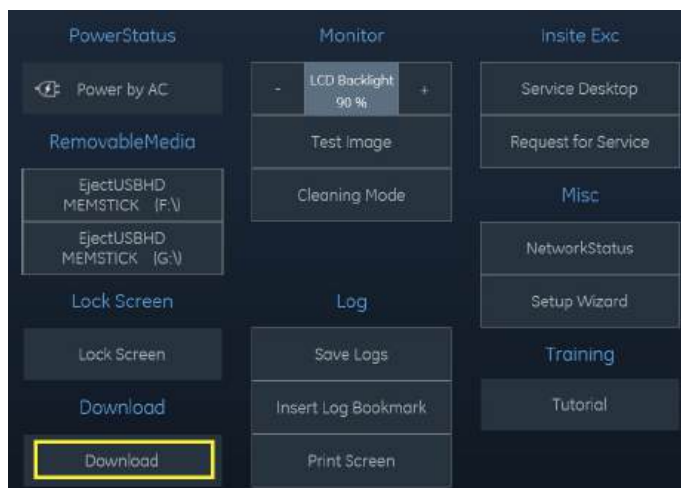


Figure 14-24. Press Download Button

Reload Software (continued)

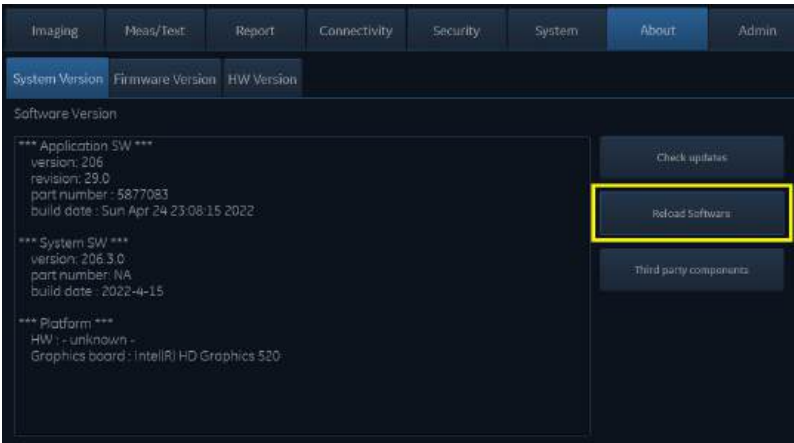
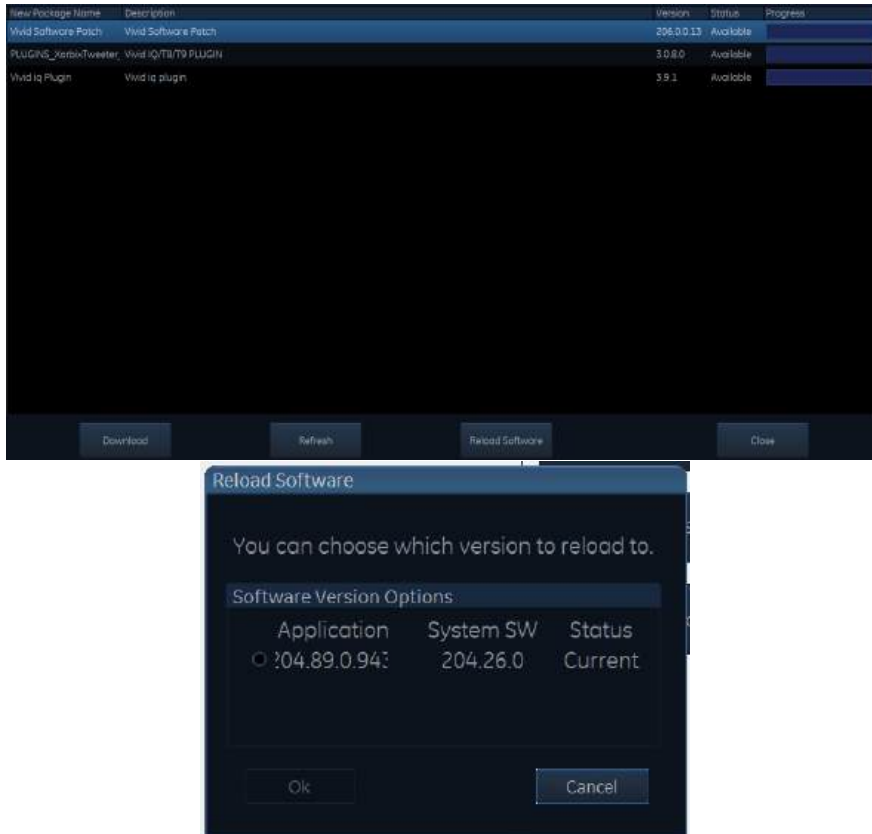


Figure 14-25. System Version Sheet

Reload Software (continued)

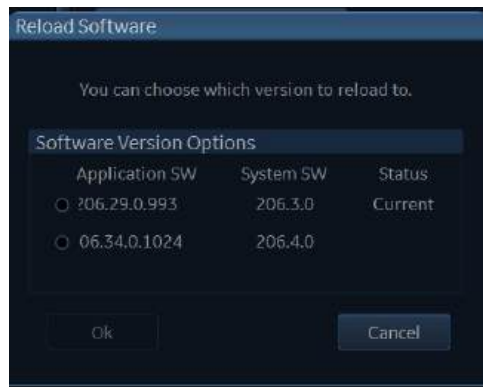
- Select **Reload Software** to enter the operation page. In the pop-up window, select the software version needed, then click **OK**.

By default, the current installed software version is displayed. The user can reload the current software version to rollback software changes to the initial installed state.

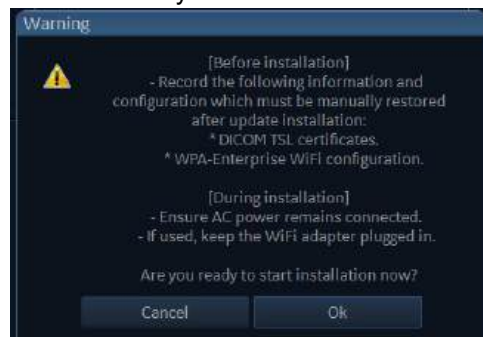


Reload Software (continued)

3. After a new full software package is installed, a new software version will be displayed as current version. The user can then select to reload current version or previous version, with the version in use marked as the “current” version..



4. If a previous version being is selected to reload, a warning window will pop up to remind the user to back up some configuration manually.



- Then, the system will restart automatically.

NOTE: *The system keeps maximum 2 versions of software for reload. When a newer version is installed, the earliest version is removed permanently.*

Chapter 15

Appendix

This chapter describes:

‘Scan Assist Pro Creator’ on page 15-2

‘Running Apps’ on page 15-18

‘Privacy and Security’ on page 15-21

Scan Assist Pro Creator

Overview

The Scan Assist Pro Creator is used to build customized Protocols that can be imported onto the Vivid *iq*. These Protocols automate many of the steps normally performed manually by the user, thereby reducing the number of user actions and the amount of time to perform an exam.

The Scan Assist Pro Creator tool can be used both on the scanner and as an off scanner tool. Where there are differences in behavior, this user manual uses the term “on scanner” to indicate when the tool is running on the scanner and “off scanner” to indicate when the tool is running off the scanner.

Protocol export from Vivid *iq* and off scanner installation of the Scan Assist Pro Creator

The installation of the Scan Assist Pro Creator on a PC can be done after exporting the installation file from the Vivid *iq*.

The factory and user-defined Protocols can also be exported for editing with the Scan Assist Pro Creator.

1. Insert the USB media to save the files.

NOTE: *CD/DVD are not supported for this function.*

2. Press **Config** on the Shortcut bar. Log on if required. Then press **Imaging -> Scan Assist Pro**.

The *Scan Assist Pro* sheet is displayed.

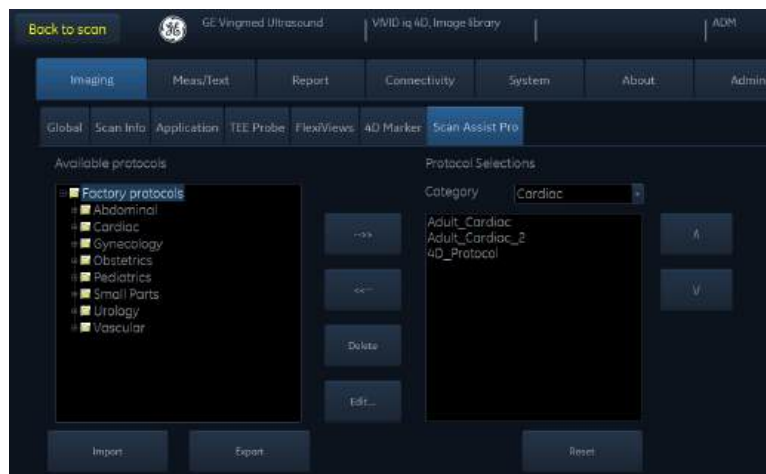


Figure 15-1. The Scan Assist Pro sheet

Protocol export from Vivid iq and off scanner installation of the Scan Assist Pro Creator (continued)

3. Select **Export** from the *Scan Assist Pro* sheet.
The *Export Protocols* window is displayed.

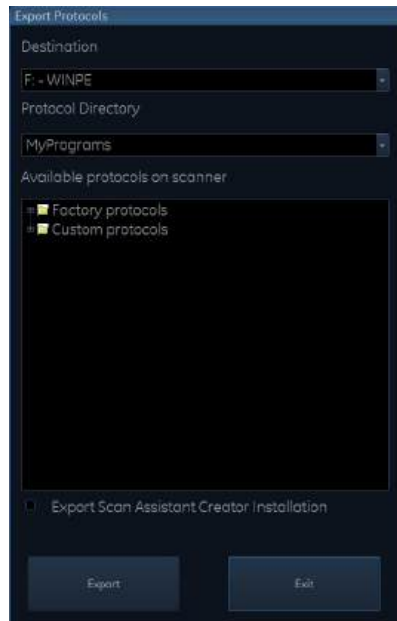


Figure 15-2. Export Protocols

4. In the *Destination* field, select the media to store the files on.
5. In the *Protocol Directory* field, select an existing folder or enter the name of a new folder. The Protocols will be stored to that location.
6. Highlight the Protocol(s) to be exported. If a folder is highlighted, all Protocols in the folder are selected.

Make sure that the option **Export Scan Assist Pro Creator Installation** is checked.

The installation file for the Scan Assist Pro Creator will be stored to a separate folder named ScanAssistantCreatorSetup (Figure 15-3).

Protocol export from Vivid iq and off scanner installation of the Scan Assist Pro Creator (continued)

7. Select **Export**.

The Protocols and the Scan Assist Pro Creator installation file are exported.

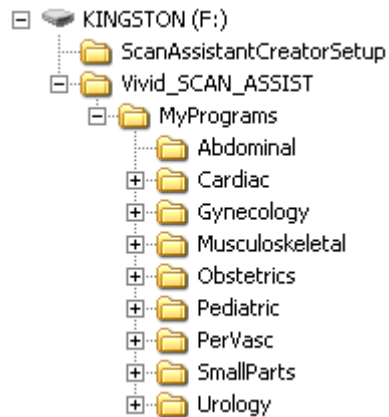


Figure 15-3. Export folder structure

Installation of the Scan Assist Pro Creator

1. Insert the USB media mentioned above into the computer.
2. Double-click on the **Setup.exe** file located in the ScanAssistantCreatorSetup folder and follow the instructions on screen to install the Scan Assist Pro Creator.

Starting Scan Assist Pro Creator

Off scanner

1. Double-click on the **Scan Assist Pro Creator** icon on the computer desktop to start the Protocol.

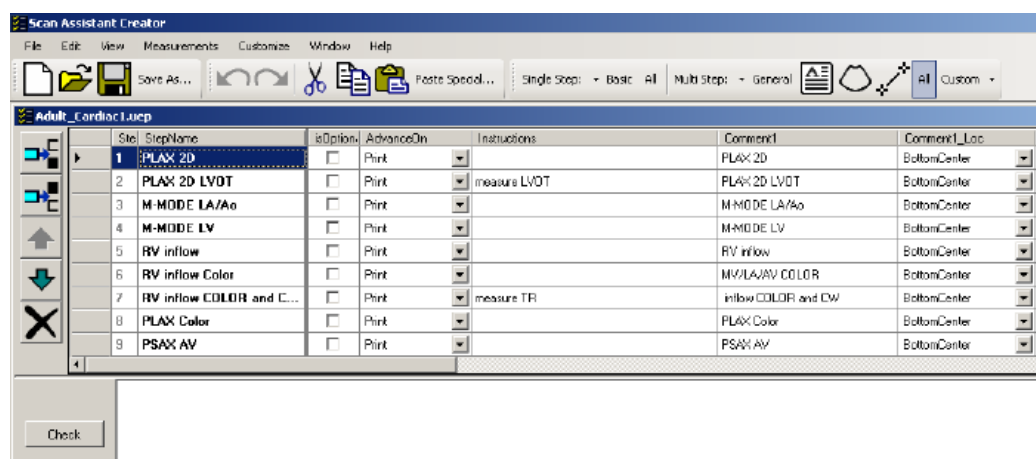


Figure 15-4. Scan Assist Pro Creator screen

On scanner

1. Press **Config** on the Shortcut bar. Log on if required. Then press **Imaging -> Scan Assist Pro**.
The *Scan Assist Pro* sheet is displayed (Figure 15-1, page 15-3).
2. To edit an existing Protocol, select the Protocol in the *Available Protocols* field on the left-hand side of the *Scan Assist Pro* sheet.
3. Select **Edit** to start the Scan Assist Pro Creator.

File handling

Off scanner directory structure

When using Scan Assist Pro Creator off scanner, it is important to organize the Protocols in a way that will make it easy to import them onto the scanner. All Protocols must be stored in a VIVID_SCAN_ASSIST directory. Within this directory, one or more user-specified directories can be created. Within each of these user-specified directories are the category directories (Abdominal, Cardiac, etc.) that hold the actual Protocols.

To specify the directory structure:

1. In the Scan Assist Pro Creator, select **File/Directory**.
The *Directory configuration* window is displayed.

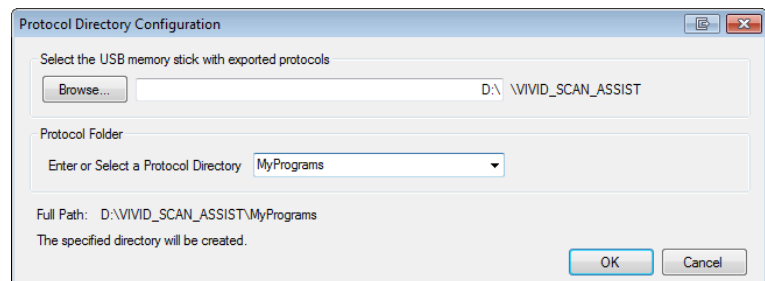


Figure 15-5. The Directory configuration window

2. Select the location of the VIVID_SCAN_ASSIST directory and select or create a user Protocol subdirectory.

File extensions

Factory defined Protocols have an .ep (exam protocol) extension while user-defined Protocols have an .uep (user exam protocol) extension. Both factory and user-defined Protocols can be read into the Scan Assist Pro Creator, but only user-defined Protocols are created. If a factory Protocol is read into the Scan Assist Pro Creator and then edited, it is saved as a user-defined Protocol.

Creating new Protocols

A Protocol is made up of a series of steps. Each step has various attributes that need to be defined. Protocols can be made from scratch or by modifying an existing Protocol.

To create a new Protocol:

1. Select either:
 - **File/New (Ctrl+n)** to start a new Protocol.
 - **File/Open (Ctrl+o)** to open an existing Protocol (.ep or .uep)
2. Select **View/Single step: All** to display all the attributes for the first step.
3. Adjust the attributes for the current step. See 'Step attributes' on *page 15-13* for a description of the attributes.
4. Once done press  to add a new step below the first step (or select the next step if editing an existing Protocol) and adjust the attributes for this new step as required.
5. Other possible adjustments:
 - Select  (**Ctrl+Up Arrow**)/ (**Ctrl+Down Arrow**) to move a step.
 - Select  to delete selected step(s).
6. When all steps are created, press **Check** to verify the Protocol.

Any invalid attribute settings reported should be corrected and the Protocol rechecked.

Measurements in Protocols

Because there are many measurements available on the Vivid *iq* and because the measurement package is highly customizable, there is some special handling for measurements.

To set up a measurement step in a Protocol:

1. Press **Measurements** and select a measurement category and optionally a measurement subcategory.

The measurements available for the attributes *Measure 1* to *Measure 3* and *Vessel* are limited to the measurements available in the category or subcategory selected.

2. Select the desired *Measure trigger* parameter (see 'Measurement attributes' on page 15-16).

NOTE: *To configure a Vessel measurement, leave the Measure trigger attribute to **None**.*

3. Select the desired measurements for *Measure 1*, *Measure 2* and *Measure 3*.

Saving Protocols

1. Select **File/Save (Ctrl+s)**

NOTE: Select **File/Save as** to save the Protocol with a different name.

If the Protocol was not checked, a dialog is displayed giving the opportunity to check the Protocol for errors before saving.

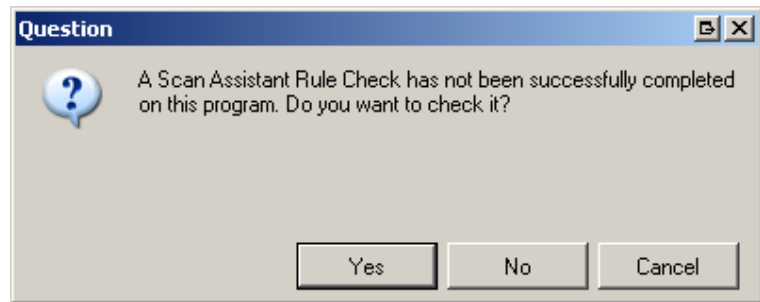


Figure 15-6. Protocol check dialog

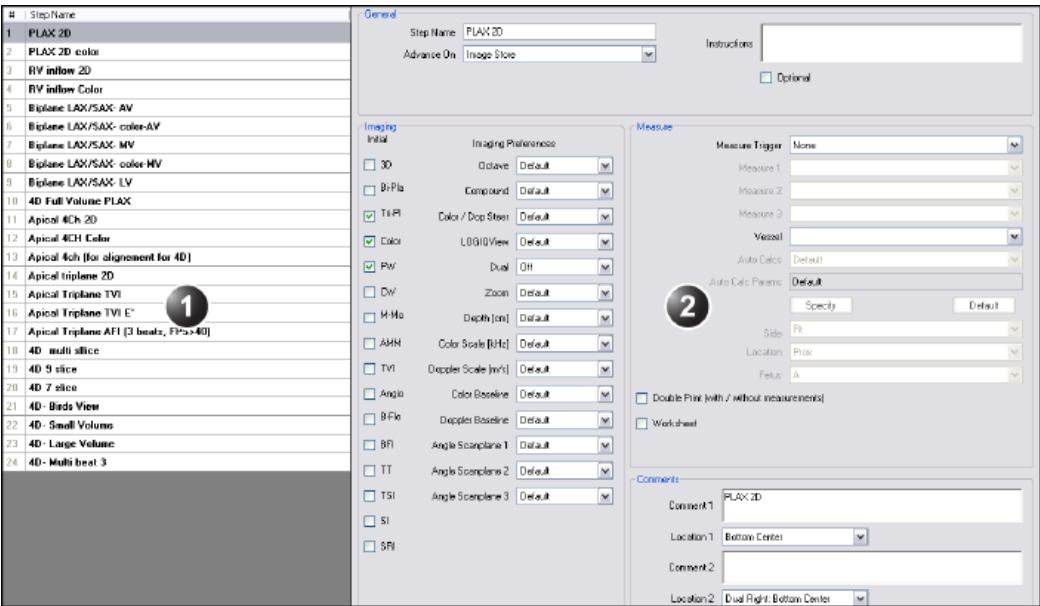
2. Select:
 - **Yes** to check the Protocol before saving it.
 - **No** to bypass the Protocol check.
 - **Cancel** to cancel the save request.

Views

A Protocol is made up of a series of steps. Each step is made up of various step attributes. The step and step attribute data can be viewed in many ways using the Scan Assist Pro Creator. The different ways to look at the data are called Views. The view of choice is selected from the View Menu or from toolbar.

Single step views

There are two Single step views: Basic and All. The Basic view shows the most common attributes of the selected step. The All view shows all of the attributes of the selected step.



1. List of all steps in the Protocol
2. Attributes for the selected step

Figure 15-7. Single step view (All)

Multi step views

Multi step views show the step attributes for all the steps in a Protocol. There are six Multi step views: General, Comment, Scan, Measure, Custom and All.

#	Step Name	Optional	Advance On	Instructions	Comment 1	Location 1	Comment 2	Location 2	3D	BtPla	TrnPlv	Color	Pw/
1	PLAX 2D	☐	Image Slope		PLAX 2D	Bottom Center		Dual Right Bottom	☐	☐	☐	☐	☐
2	PLAX	☐	Image Slope	measure LVDT	PLAX 2D LVDT	size		Dual Right Bottom	☐	☐	☐	☐	☐
3	M-MODE	☐	Image Slope		M-MODE LV/ke	center		Dual Right Bottom	☐	☐	☐	☐	☐
4	M-MODE LV	☐	Image Slope		M-MODE LV/	Bottom Center		Dual Right Bottom	☐	☐	☐	☐	☐

1. List of all steps in the Protocol
2. Attributes for all steps in the Protocol

Figure 15-8. Multi step view (All)

The information displayed in each multi step view is configurable.

1. Select **Customize/Views**.
The Customize multi step views window is displayed.
Each tab represents a different Multi step view. Within a tab, the checked boxes are the step attributes that are displayed in that Multi step view.
2. For each Multi step view check the attributes to be displayed.
3. Select **Save**.

Step attributes

Scan Assist Pro allows the user to program the steps in an exam and to program certain attributes for each step. The attributes are what give the Scan Assist Pro Protocol behavior. The tables below provide a description of all attributes.

General attributes

Name	Input	Description
Step name	Any text	Name of the step that appears in the Scan Assist Pro window.
Advance on	Img. Store	Advance to the next step after pressing Img. Store on the Control panel.
	Img. Store & Unfreeze	Advance to the next step after pressing Img. Store and Unfreeze on the Control panel.
	Img. Store & user selection	Advance to next step after pressing Img. Store on the Control panel and Down arrow on the keyboard.
Instructions	Any text	Notes displayed in the Scan Assist Pro window when the step is active. Hint: the probe and application required for this Protocol should be entered in the <i>Instruction</i> field of the first step.
Optional	☒	An optional step is given a check mark during Protocol execution even if no image is acquired.

Comment attributes

Name	Input	Description
Comment 1 Comment 2	Any text	User annotation associated with the step. When editing in a Multi step view, use Alt+Enter to create a new line.
Location 1 Location 2	Top Left Middle Left Bottom Left Top Center Bottom Center Top Right Mid Right Bottom Right	Location of the annotation on screen.

Imaging attributes

Name	Input	Description
Initial modes	☒	Scanning mode associated with the step. Some scanning modes may be combined (e.g PW Doppler and Color Flow).
Octave	Off	Octave is off.
	On	Octave is on.
	Default	Octave not specified.
Compound	Off	Compound is off.
	On	Compound is on.
	Default	Compound is not specified.
Color/Doppler steer	Left	Color/Doppler steered to the left.
	Center	Color/Doppler not steered.
	Right	Color/Doppler steered to the right.
LogiqView	Off	LogiqView is off.
	On	LogiqView is on.
	Default	LogiqView not specified.
Dual	Off	Single screen display
	Left Active	Dual screen display is on with the left image active.
	Right Active	Dual screen display is on with the right image active.
	Simultaneous	Displays 2D and Color mode side-by-side.
Zoom	Off	Zoom is off.
	On	Zoom is on.
	Default	Zoom is not specified.
Depth	Default	Depth is not specified.
	1 – 30 cm	Adjust Depth.
Color Scale	Default	Color Scale is not specified.
	0.25 – 14 kHz	Adjust Color Scale.
Doppler Scale	Default	Doppler Scale is not specified.
	0.05 – 13 m/s	Adjust Doppler Scale.

Name	Input	Description
Color Baseline	Default	Color Baseline is not specified.
	0 – 20	Adjust Color Baseline.
Doppler Baseline	Default	Doppler Baseline is not specified.
	0 – 20	Adjust Doppler Baseline.
Angle Scan plane 1 – 3	Default	Scan plane is not specified.
	0 – 355 deg.	Adjust scan plane.

Measurement attributes

Name	Input	Description
Measure trigger	Measure key	Start Measure 1 attribute when Measure is pressed on the Control panel.
	Freeze key	Start Measure 1 attribute when Freeze is pressed on the Control panel.
	Img. Store key	Start Measure 1 attribute when Img. Store is pressed on the Control panel.
	None	Measurement not triggered by the Protocol. Vessel measurements are available when Measure trigger is set to None (see below).
Measure 1 Measure 2 Measure 3	Various measurements	Specify the measurement to perform. Select a measurement category from the <i>Measurement</i> menu.
Vessel	Various Doppler vessel measurements	Specify the vessel measurement to perform. Vessel measurement is available only if <i>Measure trigger</i> is set to None . The list of available measurements is dependent of the category selected in the <i>Measurement</i> menu.
Auto Calcs	Default	Auto Calcs state is not specified.
	Off	Auto Calcs state is set to off.
	Frozen	Auto Calcs state is set to Frozen.
	Live	Auto Calcs state is set to Live.

Name	Input	Description
Auto Calc Params	Various Auto Calc parameters	Specify the Auto Calc parameters to be used. Press Specify and select the Auto Calc parameters from the <i>Auto Calc parameter</i> selection window. Press Default to set the Auto Calc parameter selection to default.
Side	Rt Lt None	Set the side measurement qualifier to either Right or Left. Note: the side measurement qualifier is not set by the Protocol.
Location	Prox Mid Dist None	Set the location measurement qualifier to either Proximal, Middle or Distal. Note: the location measurement qualifier is not set by the Protocol.
Fetus	A, B, C or D	The fetus measurement qualifier is set to either Fetus A, B, C or D.
Double Save (with/without measurements)	☒	The image is stored twice, once with measurements and once without.

Running Apps

Launchpad

Apps is the button that lists third-party apps together in a panel. This panel is called Launchpad and it displays third-party software apps installed for use with the Vivid *iq* software as buttons in a grid view. The launchpad lets the user launch an app and do measurements and analysis the app supports.

Apps

An app is a separate software application having a particular intended use and performance as designed and offered by its legal manufacturer. Qualified apps are separately purchased through the GE Healthcare Marketplace website and installed. The offered apps are designed and manufactured by a responsible third-party legal manufacturer, and verified to be compatible with Vivid *iq*. In the Vivid *iq* Launchpad the installed apps are represented by app name, name of the legal manufacturer, license information, and the logo of the legal manufacturer on the app buttons. For the user instructions, please check the user manuals of the third-parties.

The user can explore more apps that are verified to be compatible with Vivid *iq*, and thus offered through the GE Healthcare Marketplace website. Apps are available on the subscription-based model and can be ordered from the webpage. Orders must be made by an individual with a user account that is enabled to purchase software on behalf of the organization. The app will download and install automatically after completing an order on the webpage, provided that the ultrasound system is connected to the internet. A working internet connection is necessary to acquire license when an app is activated. The Vivid *iq* may ask for internet connection in regular basis to check the user's subscriptions.

Activating an App

After the first purchase, a code is provided to the user via email. This code is used to connect the Vivid *iq* to the user's account on the GE Healthcare Marketplace.

1. Go to **Config -> Admin -> System Admin**
2. Add the code in the text box *License Server Id*
3. Press **Refresh**

The list of Apps currently installed on the Vivid *iq* is visible under *Installed App* (see Figure15-9) and their license status is updated after pressing Refresh (with a new License Server Id) or when the Vivid *iq* is restarted.

NOTE: *Internet access is required for the license activation to be successful.*



Figure 15-9. App License fields in Config

Starting an App from the launchpad

While in the imaging tab:

1. Press **Apps** on the shortcut bar.

All compatible Apps that are already installed on the Vivid iq will be visible on the screen. Apps without a valid license will be greyed out.

NOTE:

Only Apps compatible with the chosen image mode will be visible.

Figure 15-10 presents presents example apps for illustrative purposes only.

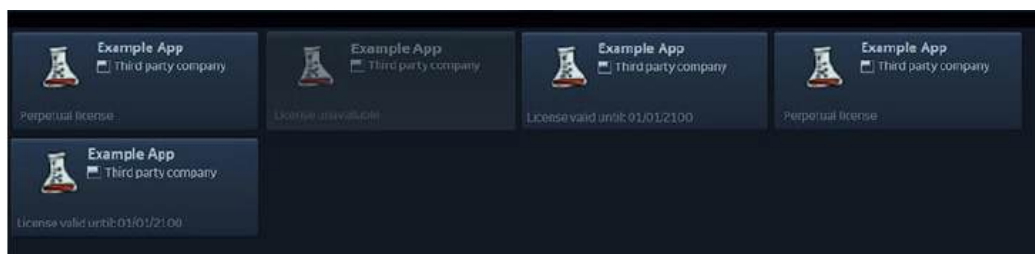


Figure 15-10. Example Apps with various license statuses

2. Press on the desired available App to start it.

Privacy and Security

Potential Hazardous Situations Resulting from Failures of the IT Network

Hazardous situations

The following general hazardous situations have been identified as potentially hazardous as a result of the IT network failing to provide the required characteristics specified above.

- Delayed or impaired access to images or other exam information or patient data.
- Permanent loss of images or other exam information or patient data.
- Corruption of images or other exam information or patient data.
- LAN connection loss during operation may cause loss of data, and damage data integrity.

Warning

In addition to the hazardous situations identified above, connection of the Vivid Ultrasound System and EchoPAC Software Only to a network that includes other equipment could result in other unidentified risks to patients, operators or third parties. The responsible organization should identify, analyze, evaluate and control these risks on an ongoing basis including after changes to the network such as those listed below, which could introduce new risks and require additional analysis.

- Changes in network configuration
- Connection of additional items to the network
- Disconnecting items from the network
- Update of equipment connected to the network
- Upgrade of equipment connected to the network

MDS² Introduction

The “Manufacturer Disclosure Statement for Medical Device Security” MDS² is provided as a statement of the security and privacy capabilities using a well-known standard disclosure format.

Please see “MDS² for Vivid E95/E90/E80/S70N/S70/S60N/S60 version 204”, “MDS² for Vivid iq version 204”, “MDS² for Vivid T8/T9 version 204”, “MDS² for EchoPAC Software Only version 204” and “MDS² for EchoPAC Plug-in version 204”.

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