

## Regulatory Requirement

This product complies with regulatory requirements of the following European directive 93/42/EEC as amended by 2007/47/EC concerning medical devices.



 **NOTE:**

Some options are not available on some models!

This manual is subject to change without prior notice and without legal obligation attached!

**Revision History**

<b>Revision</b>	<b>Date</b>	<b>Reason for change</b>
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**Effective Chapters/Pages**

Basic Operator's Manual

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# Chapter 1

## System Safety and Maintenance

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## 1.1 Safety Overview

This section discusses measures to ensure the safety of both the operator and patient.

To ensure the safety of both operator and patient, please read the relevant details in this chapter carefully before operating this system. Disregarding the WARNINGS or violation of relevant rules may result in personal injury or even loss of life for operator or patient.

Users should observe the following PRECAUTIONS:

- This system complies with Type BF general equipment, and the EN60601-1 standard. Please follow Section 1. "System Safety" in the user's manual to use this system properly.
- Do not modify this system in any way. Necessary modifications must be made only by the manufacturer or its designated agents.
- This system has been fully adjusted at the factory. Do not adjust any fixed adjustable parts.
- In the event of a malfunction, turn off the system immediately and inform the manufacturer or its designated agents.
- The power cable of the system should only be connected to a grounded power socket. Do not remove the ground cable for any reason.
- Only connect this system, either electronically or mechanically, with devices that comply with the EN60601-1 standard. Recheck the leakage current and other safety performance indices of the entire system to avoid potential system damage caused by leakage from a current superposition.
- The system does not incorporate any specialized protective measures in the event it is configured with high-frequency operation devices. The operator should use CAUTION in these types of applications.
- The system should be installed only by personnel authorized by the manufacturer. Do not attempt to install the system yourself.
- Only an authorized service engineer may perform maintenance.
- Only a qualified operator, or someone under qualified supervision, should use the system.
- Do not use this system in the presence of flammable substances or an explosion may occur.
- Do not continuously scan the same part of a patient or expose the patient to prolonged scanning. Doing so may harm the patient.
- When using the system for ultrasound testing, use only qualified ultrasound gel that complies with system standards.
- Do not use the switch at the back of the unit for normal shut down. Always use the power-on button in the keyboard area
- Do not unplug probe when the system is in active operation. Doing so may damage the probe. Always go to EXAM screen when need to remove the probe.

- To prevent from arm or neck injury, the operator should not stay at the same position for too long during patient scanning without taking break.
- Do not put liquid on top of the main unit.
- *The unit has build-in screen saver to avoid the tic mark on the display. It is not recommended to constantly turning on and off the unit.*
- *To dispose of this product properly, please call your local service department.*

## 1.2 Symbol Used

Refer to **Appendix A**.

## 1.3 Biological Safety

This product, as with all diagnostic ultrasound equipment, should be used only for valid reasons and should be used both for the shortest period of time and at the lowest power settings necessary ( **ALARA** - As Low As Reasonably Achievable) to produce diagnostically acceptable images.

The AIUM offers the following guidelines:

**Clinical Safety Quoted from AIUM**  
**Approved March 26, 1997**

*Diagnostic ultrasound has been in use since the late 1950s. Given its known benefits and recognized efficacy for medical diagnosis, including use during human pregnancy, the American Institute of Ultrasound in Medicine herein addresses the clinical safety of such use:*

*There are no confirmed biological effects on patients or instrument operators caused by exposures from present diagnostic ultrasound instruments. Although the possibility exists that such biological effects may be identified in the future, current data indicate that the benefits to patients of the prudent use of diagnostic ultrasound outweigh the risks, if any that may be present.*

### **Heating:**

Elevating tissue temperature during obstetrical examinations creates medical concerns. At the embryo development stage, the rise in temperature and the length of time exposed to heat combine to determine potential detrimental effects. Exercise CAUTION particularly during Doppler/Color exams.

The Thermal Index (TI) provides a statistical estimate of the potential temperature elevation (in centigrade) of tissue temperature. Three forms of TI are available: TIS, for soft tissue exposures; TIB, for instances when bone lies near the beam focus; and TIC, for the heating of bone situated close to the transducer.

### **Cavitation:**

Cavitation may occur when sound passes through an area that contains a cavity, such as a gas bubble or air pocket (in the lung or intestine, for example). During the process of cavitation, the sound wave may cause the bubble to contract or resonate. This oscillation may cause the bubbles to explode and damage the tissue. The Mechanical Index (MI) has been created to help users accurately evaluate the likelihood of cavitation and the related adverse effects.

## 1.4 Scanning Patients and Education

The Track-3 or IEC60601-2-37 output display standard allows users to share the responsibility for the safe use of this ultrasound system. Follow these usage guidelines for safe operation:

- In order to maintain proper cleanliness of the transducers, always clean them between patients.
- Always use a new disinfected sheath on all EV/ER probes during every exam.
- Continuously move the probe, rather than staying in a single spot, to avoid elevated temperatures in one part of the patient's body.
- Move probe away from the patient when not actively scanning.
- Understand the meaning of the TI, TIS, TIB, TIC, and MI output display, as well as the relationship between these parameters and the thermal/cavitation bioeffect to the tissue.
- Expose the patient to only the very lowest practical transmit power levels for the shortest possible time to achieve a satisfactory diagnosis (ALARA - As Low As Reasonably Achievable).

### 1.4.1 Safe Scanning Guideline

1. Ultrasound should only be used for medical diagnosis and only by trained medical personnel.
2. Diagnostic ultrasound procedures should be done only by personnel fully trained in the use of the equipment, in the interpretation of the results and images, and in the safe use of ultrasound (including education as to potential hazards).
3. Operators should understand the likely influence of the machine controls, the operating mode (e.g. B-mode, color Doppler imaging or spectral Doppler) and probe frequency on thermal and cavitation hazards.
4. Select a low setting for each new patient. Output should only be increased during the examination if penetration is still required to achieve a satisfactory result, and after the Gain control has been moved to its maximum value.
5. Maintain the shortest examination time necessary to produce a useful diagnostic result.
6. Do not hold the probe in a fixed position for any longer than is necessary. It should be removed from the patient whenever there is no need for real-time imaging or spectral Doppler acquisition. The freeze frame and Cine loop capabilities allow images to be reviewed and discussed without exposing the patient to continuous scanning.
7. Do not use endo-cavity probes if there is noticeable self heating of the probe when operating in the air. Although applicable to any probe, take particular care during trans-vaginal exams during the first eight weeks of gestation.
8. Take particular care to reduce output and minimize exposure time of an embryo or fetus when the temperature of the mother is already elevated.

9. Take particular care to reduce the risk of thermal hazard during diagnostic ultrasound when exposing: an embryo less than eight weeks after gestation; or the head, brain or spine of any fetus or neonate.
10. Operators should continually monitor the on-screen thermal index (TI) and mechanical index (MI) values and use control settings that keep these settings as low as possible while still achieving diagnostically useful results.  
In obstetric examinations, TIS (soft tissue thermal index) should be monitored during scans carried out in the first eight weeks after gestation, and TIB (bone thermal index) thereafter. In applications where the probe is very close to bone (e.g. transcranial applications), TIC (cranial thermal index) should be monitored.

MI > 0.3	There is a possibility of minor damage to neonatal lung or intestine. If such exposure is necessary, reduce the exposure time as much as possible.
MI > 0.7	There is a risk of cavitation if an ultrasound contrast agent containing gas micro-spheres is being used. There is a theoretical risk of cavitation without the presence of ultrasound contrast agents. The risk increases with MI values above this threshold.
TI > 0.7	The overall exposure time of an embryo or fetus should be restricted in accordance with Table 1.1 below as a reference.

TI	Maximum exposure time (minutes)
0.7	60
1.0	30
1.5	15
2.0	4
2.5	1

**Table 1.1:** Maximum recommended exposure times for an embryo or fetus

11. Non-diagnostic use of ultrasound equipment is not generally recommended. Examples of non-diagnostic uses of ultrasound equipment include repeated scans for operator training, equipment demonstration using normal subjects, and the production of souvenir pictures or videos of a fetus.  
For equipment of which the safety indices are displayed over their full range of values, the TI should always be less than 0.5 and the MI should always be less than 0.3. Avoid frequent repeated exposure of any subject.  
Scans in the first trimester of pregnancy should not be carried out for the sole purpose of producing souvenir videos or photographs, nor should their production involve increasing the exposure levels or extending the scan times beyond those needed for clinical purposes.
12. Diagnostic ultrasound has the potential for both false positive and false negative results. Misdiagnosis is far more dangerous than any effect that might result from the ultrasound exposure. Therefore, diagnostic ultrasound should be performed only by those with sufficient training and education.

### 1.4.2 Understanding the MI/TI Display

Track-3 follows the Output Display Standard for systems which include fetal Doppler applications. The acoustic output will not be evaluated on an application-specific basis, but the global maximum de-rated  $I_{spta}$  must be  $\leq 720 \text{ mW/cm}^2$  and either the global maximum MI must be  $\leq 1.9$  or the global maximum de-rated  $I_{sppa}$  must be  $\leq 190 \text{ W/cm}^2$ . An exception is for ophthalmic use, in which case the  $TI = \max(TIS_{as}, TIC)$  is not to exceed 1.0;  $I_{spta.3} \leq 50 \text{ mW/cm}^2$ , and  $MI \leq 0.23$ . Track-3 gives the user the freedom to increase the output acoustic power for a specific exam, and still limit output acoustic power within the global maximum de-rated  $I_{spta} \leq 720 \text{ mW/cm}^2$  under an Output Display Standard.

For any diagnostic ultrasonic systems, Track-3 provides an Output Indices Display Standard. The diagnostic ultrasound systems and its operator's manual contain the information regarding an ALARA (As Low As Reasonably Achievable) education program for the clinical end-user and the acoustic output indices, MI and TI.

The MI describes the likelihood of cavitation, and the TI offers the predicted maximum temperature rise in tissue as a result of the diagnostic examination.

In general, a temperature increase of 2.5°C must be present consistently at one spot for 2 hours to cause fetal abnormalities. Avoiding a local temperature rise above 1°C should ensure that no thermally induced biologic effect occurs.

When referring to the TI for potential thermal effect, a TI equal to 1 does not mean the temperature will rise 1 degree C. It only means an increased potential for thermal effects can be expected as the TI increases. A high index does not mean that bioeffects are occurring, but only that the potential exists and there is no consideration in the TI for the scan duration, so minimizing the overall scan time will reduce the potential for effects. These operator control and display features shift the safety responsibility from the manufacturer to the user. So it is very important to have the Ultrasound systems display the acoustic output indices correctly and the education of the user to interpret the value appropriately.

#### **$R_F$ : De-rating factor**

In Situ intensity and pressure cannot currently be measured. Therefore, the acoustic power measurement is normally done in the water tank, and when soft tissue replaces water along the ultrasound path, a decrease in intensity is expected. The fractional reduction in intensity caused by attenuation is DENOTED by the de-rating factor  $R_F$ ,

$$R_F = 10^{(-0.1a \cdot f \cdot z)}$$

Where  $a$  is the attenuation coefficient in  $\text{dB cm}^{-1} \text{ MHz}^{-1}$ ,  $f$  is the transducer center frequency, and  $z$  is the distance along the beam axis between the source and the point of interest.

De-rating factor  $R_F$  for the various distances and frequencies with attenuation coefficient  $0.3 \text{ dB cm}^{-1} \text{ MHz}^{-1}$  in homogeneous soft tissue is listed in the following table. An example is if the user uses 7.5MHz frequency, the power will be attenuated by .0750 at 5cm, or  $0.3 \times 7.5 \times 5 = -11.25 \text{ dB}$ . The De-rated Intensity is also referred to as '.3' at the end (e.g.  $I_{spta.3}$ ).

Distance (cm)	Frequency (MHz)			
	1	3	5	7.5
1	0.9332	0.8128	0.7080	0.5957
2	0.8710	0.6607	0.5012	0.3548
3	0.8128	0.5370	0.3548	0.2113
4	0.7586	0.4365	0.2512	0.1259
5	0.7080	0.3548	0.1778	0.0750
6	0.6607	0.2884	0.1259	0.0447
7	0.6166	0.2344	0.0891	0.0266
8	0.5754	0.1903	0.0631	0.0158

**$I' = I \cdot RF$  Where  $I'$  is the intensity in soft tissue,  $I$  is the time-averaged intensity measured in water.**

**Tissue Model**

Tissue temperature elevation depends on power, tissue type, beam width, and scanning mode. Six models are developed to mimic possible clinical situations.

<b>Thermal Models</b>	<b>Composition</b>	<b>Mode</b> <sup>o</sup>	<b>Specification</b> <sup>o</sup>	<b>Typ. app</b>
1TIS	Soft tissue	Unscanned	Large aperture(>1cm <sup>2</sup> )	Liver PW
2TIS	Soft tissue	Unscanned	Small aperture(<1cm <sup>2</sup> )	Pencil-Probe
3TIS	Soft tissue	Scanned	Evaluated at surface	Breast color
4TIB	Soft tissue and bone	Scanned	Soft tissue at surface	Muscle color
5TIB	Soft tissue and bone	Unscanned	Bone at focus	Fetus-head PW
6TIC	Soft tissue and bone	Unscanned /Scanned	Bone at surface	Trans-Cranial

**Soft tissue**

Describes low fat content tissue that does not contain calcifications or large gas-filled spaces.

**Scanned: (auto-scan)**

Refers to the steering of successive burst through the field of view, e.g. B and color mode.

**UnScanned**

Emission of ultrasonic pulses occurs along a single line of sight and is unchanged until the transducer is moved to a new position. For instance, the PW, CW and M mode.

**TI**

TI is defined as the ratio of the In Situ acoustic power ( $W_3$ ) to the acoustic power required to raise tissue temperature by 1oC ( $W_{deg}$ ),

$$TI = W_3 / W_{deg}$$

Three TIs corresponding to soft tissue (TIS) for abdominal; bone (TIB) for fetal and neonatal cephalic; and cranial bone (TIC) for pediatric and adult cephalic, have been developed for applications in different exams.

An estimate of the acoustic power in milliwatts necessary to produce a 1 °C temperature elevation in soft tissue is:

$$W_{deg} = 210 / fc$$

for model 1 to 4, where  $fc$  is the center frequency in MHz.

$$Wdeg = 40 \cdot K \cdot D$$

for model 5 and 6, where K (beam shape factor) is 1.0, D is the aperture diameter in cm at the depth of interest

## MI

Cavitation is more likely to occur at high pressures and low frequencies in pulse ultrasound wave in the tissue, which contains the bubble or air pocket (for instance, the lung, intestine, or scan with gas contrast agents). The threshold under optimum conditions of pulsed ultrasound is predicted by the ratio of the peak pressure to the square root of the frequency.

$$MI = Pr' / \sqrt{fc}$$

Pr' is the de-rated (0.3) peak rare-fractional pressure in Mpa at the point where PII is the maximum, and fc is the center frequency in MHz. PII is the Pulse Intensity Integral that the total energy per unit area carried by the wave during the time duration of the pulse.

The peak rare-fractional pressure is measured in hydrophone maximum negative voltage normalized by the hydrophone calibration parameter.

## Display Guideline

For different operation modes, different indices must be displayed. However, only one index needs to be shown at a time. Display is not required if maximum MI is less than 1.0 for any setting of the operating mode, or if maximum TI is less than 1.0 for any setting of the operating mode. For TI, if the TIS and TIC are both greater than 1.0, the scanners need not be capable of displaying both indices simultaneously. If the index falls below 0.4, no display is needed. The display increments are no greater than 0.2 for index value less than one and no greater than 1.0 for index values greater than one (e.g. 0.4, 0.6, 0.8, 1, 2, 3).

## Display and Report in Different Mode

### For B-Scan Mode

Only display and report MI, and start from 0.4 if maximum MI > 1.0

### For Color Mode

Only display and report TIS or TIB and start from 0.4 if maximum TI > 1.0

### For Doppler Mode

Only display and report TIS or TIB and start from 0.4 if maximum TI > 1.0

Below is a simple guideline for the user when TI exceeds one limit exposure time to 4(6-TI) minutes based on the *National Council on Radiation Protection. Exposure Criteria for Medical Diagnostic Ultrasound: I. Criteria Based on Thermal Mechanisms. Report No.113 1992:*

## Operator Control Features

The user should be aware that certain operator controls may affect the acoustic output. It is recommended to use the default (or lowest) output power setting and compensate using Gain control to acquire an image. Other than the output power setting in the soft-menu, which has the most direct impact on the power; the PRF, image sector size, frame rate, depth, and focal position also slightly affect the output power. The default setting is normally around 70% of the allowable power depending on the exam icon.

## 1.5 Environmental Requirements

The following environmental conditions are within system tolerances for operation:



Relative Humidity: 30%~75%, no condensation  
Temperature: 10°C~ 40°C  
Atmosphere Pressure: 700~1060hPa

Strong radiation sources or powerful electromagnetic waves (e.g. electromagnetic waves from radio broadcasting) may result in image ghosting or noise. The system should be isolated from such radiation sources or electromagnetic waves.

## 1.6 Transport and Storage Environmental Requirements

The following environmental transport and storage conditions are within system tolerances:

Temperature: -20°C~ 55°C  
Relative Humidity: 20% ~90 %, no condensation  
Pressure: 700~1060hPa

## 1.7 Electrical Requirements

### Power Requirements:

110-120VAC  
220-230VAC

### Power Consumption:

330VA

### Main unit voltage

Maintain a fluctuation range of less than  $\pm 10\%$  or the system may be damaged.

### Grounding

Before connecting the power cable, connect the attached ground protection cable to a specialized grounding device.

### Note:

- Please ensure that the power requirements are satisfied. Only use power lines that meet the system guidelines—failure to follow these procedures may result in system damage.
- Voltage level may vary in different geographic locations. Adjust the voltage rating on the rear panel according to your local voltage level.
- Use only the power button on the side panel to turn on or off the unit. Mains power switch on the rear panel should be always ON unless prior to transport or maintenance or service of the equipment.

## 1.8 Electrical Safety

Only trained health professionals should operate this system. This equipment complies with the following standards:

- The equipment conforms with the following regulations for electrical safety,
  - IEC 60601-1: 1988+A1:1991+A2:1995, Medical Electrical Equipment Part 1: General Requirements For Safety, Class I, BF, continuous operation
  - IEC 60601-2-37: 2001 + A1:2004 + A2:2005, Medical Electrical Equipment Part 2-37: Particular Requirements For The Safety Of Ultrasonic Medical Diagnostic And Monitoring Equipment
- The equipment conforms with the following EMC/EMI standards: IEC60601-1-2: 2001+A1: 2004, Class A (CE)

**For maximum safety, adhere to these guidelines:**

- Proper grounding of the system is critical to avoid electrical shock. For protection, ground the system with a three-conductor cable, and plug the system into a hospital-grade receptacle or outlet.
- Do not remove or entangle the grounding wire.
- Do not remove the protective covers of the system. These covers protect users from hazardous voltages. Only authorized service technicians can make replacements of the parts inside the system.
- Never use this system while inflammable gas is present!
- Devices must be powered from a receptacle marked "hospital grade" before being connected to the system directly. In case "hospital grade" receptacles are not available, use isolation transformers instead.

## 1.9 Transducer Maintenance

The transducers/probes provided with the system are durable and have reliable performance. These precision instruments should be inspected daily and handled with care. Please observe the following PRECAUTIONS:

- Do not drop the transducer on the hard surface. This can damage the transducer elements and compromise the electrical safety of the transducer.
- Avoid kinking or pinching the transducer cable.
- Use only approved ultrasound coupling gels.
- Follow the instructions for cleaning and disinfecting the probes.

**Disinfecting Surface Transducers**

- Disconnect the transducer from the system.
- Wipe all surfaces with isopropyl alcohol solution and air dry.
- Clean all surfaces of the probe and cable with soft cloth.
- Allow the transducer to air dry prior to storage or further use.

The following statement from AIUM outlines instructions for cleaning the intracavitary transducer:

**Guidelines for Cleaning and Preparing Endocavitary Ultrasound  
Transducers between Patients from AIUM**  
*Approved June 4, 2003*

The purpose of this document is to provide guidance regarding the cleaning and disinfection of transvaginal and transrectal ultrasound probes.

All sterilization/disinfection represents a statistical reduction in the number of microbes present on a surface. Meticulous cleaning of the instrument is the essential key to an initial reduction of the microbial/organic load by at least 99%. This cleaning is followed by a disinfecting procedure to ensure a high degree of protection from infectious disease transmission, even if a disposable barrier covers the instrument during use.

Medical instruments fall into different categories with respect to potential for infection transmission. The most critical level of instruments are those that are intended to penetrate skin or mucous membranes. These require sterilization. Less critical instruments (often called "semi-critical" instruments) that simply come into contact with mucous membranes such as fiber optic endoscopes require high-level disinfection rather than sterilization.

Although endocavitary ultrasound probes might be considered even less critical instruments because they are routinely protected by single use disposable probe covers, leakage rates of 0.9% - 2% for condoms and 8%-81% for commercial probe covers have been observed in recent studies. For maximum safety, one should therefore perform high-level disinfection of the probe between each use and use a probe cover or condom as an aid in keeping the probe clean.

There are four generally recognized categories of disinfection and sterilization.

**Sterilization is the complete elimination of all forms of microbial life including spores and viruses.**

**Disinfection, the selective removal of microbial life, is divided into three classes:**

- High-Level Disinfection - Destruction/removal of all microorganisms except bacterial spores.
- Mid-Level Disinfection - Inactivation of Mycobacterium Tuberculosis, bacteria, most viruses, fungi, and some bacterial spores.
- Low-Level Disinfection - Destruction of most bacteria, some viruses and some fungi. Low-level disinfection will not necessarily inactivate Mycobacterium Tuberculosis or bacterial spores.

The following specific recommendations are made for the use of intracavitary ultrasound transducers.

Users should also review the Centers for Disease Control and Prevention document on sterilization and disinfection of medical devices to be certain that their procedures conform to the CDC principles for disinfection of patient care equipment.

## 1. CLEANING

- After removing the probe cover, use flowing water to remove any residual from the probe.

- Use a damp gauze pad or other soft cloth and a small amount of mild non-abrasive soap water to thoroughly clean the transducer.
- Use a soft bristle brush for cleaning if the residue has dried onto the probe surface. Rinse the transducer thoroughly with running water, and allow to air dry or dry with a soft cloth.

## **2. DISINFECTION**

- 1) Use liquid chemical germicide for disinfection. In order for the germicide to be effective, clean the probe thoroughly to remove all visible residues.
- 2) Using high level liquid disinfectant will ensure further statistical reduction in microbial load. Because of the potential invisible breakage of the probe sheath, additional high level disinfection with chemical germicide is necessary.

### **Examples of such high level disinfectants include but are not limited to:**

- 2.4-3.2% glutaraldehyde products (a variety of commercially available products including "Cidex," "Metricide," or "Procide").
  - Non-glutaraldehyde agents including Cidex OPA (o-phthalaldehyde), Cidex PA (hydrogen peroxide & peroxyacetic acid).- 7.5% Hydrogen Peroxide solution.
  - Common household bleach (5.25% sodium hypochlorite) diluted to yield 500 parts per million chlorine (10 cc in one liter of tap water). This agent is effective, but generally not recommended by probe manufacturers because it can damage metal and plastic parts.
  - Other agents such as quaternary ammonium compounds are not considered high level disinfectants and should not be used. Isopropanol is not a high level disinfectant when used as a wipe and probe manufacturers generally do not recommend soaking probes in the liquid.
  - The FDA has published a list of approved sterilant and high level disinfectants for use in processing reusable medical and dental devices. That list can be consulted to find agents that may be useful for probe disinfection.
- 3) You should consult the manufacturer's instructions to prepare, store and use the disinfectant.

Consult SonoScape if you are not sure about the compatibility of these agents with the probes. Many of the chemical disinfectants are potentially toxic and many require adequate precautions, such as proper ventilation, personal protective devices (gloves, face/eye protection, etc.) and rinsing before reusing the probe.

## **3. PROTECTIVE SHEATHS**

- 1) The transducer should be protected with a probe sheath. If condoms are used, they should be non-lubricated and non-medicated.
- 2) Practitioners should be aware that condoms have been shown to be less prone to leakage than commercial probe covers, and have a six-fold enhanced AQL (acceptable quality level) when compared to standard examination gloves. They have an AQL equal to that of surgical gloves.

- 3) Users should be aware of latex-sensitivity issues and have available nonlatex-containing barriers.

#### **4. ASEPTIC TECHNIQUE**

1. For the protection of the patient and the health care worker, all endocavitary examinations should be performed by the operator wearing gloves properly throughout the ultrasound diagnostic process.
2. Gloves should be used to remove the condom or other barrier from the transducer and to wash the transducer as mentioned above.
3. As the probe sheath is removed, care should be taken not to contaminate the probe with secretions from the patient. At the completion of the procedure, hands should be thoroughly washed with soap and water.

 **Note:**

- Obvious rupture in condom integrity does NOT require modification of this protocol.
- These guidelines take into account possible probe contamination due to ruptures in the barrier sheath.
- In summary, high level disinfection of the endocavity probes should be carried out routinely. Protective barrier is required for every examination to avoid potential disease transmission.
- For all chemical disinfectants, PRECAUTIONS must be taken to protect workers and patients from the toxicity of the disinfectant.

#### **Reference:**

Amis S, Ruddy M, Kibbler CC, Economides DL, MacLean AB. Assessment of condoms as probe covers for transvaginal sonography. *J Clin Ultrasound* 2000; 28:295-8.

Rooks VJ, Yancey MK, Elg SA, Brueske L. Comparison of probe sheaths for endovaginal sonography. *Obstet. Gynecol* 1996; 87:27-9.

Milki AA, Fisch JD. Vaginal ultrasound probe cover leakage: implications for patient care. *Fertil Steril* 1998; 69:409-11.

Hignett M, Claman P. High rates of perforation are found in endovaginal ultrasound probe covers before and after oocyte retrieval for in vitro fertilization-embryo transfer. *J Assist Reprod Genet* 1995; 12:606-9.

Sterilization and Disinfection of Medical Devices: General Principles. Centers for Disease Control, Division of Healthcare Quality Promotion. <http://www.cdc.gov/ncidod/hip/sterile/sterilgp.htm> (5-2003).

ODE Device Evaluation Information—FDA Cleared Sterilants and High Level Disinfectants with General Claims for Processing Reusable Medical and Dental Devices, March 2003. <http://www.fda.gov/cdrh/ode/germlab.html> (5-2003).

## **Attention!**

- These transducers are not designed to withstand thermal disinfection. Exposure to temperatures higher than 66°C (150°F) will cause permanent damage.
- Do not immerse the probe beyond its binding line.
- To clean the transducer, refer to the relevant instructions in the probe's manual.

## **1.10 System Transportation**

### **1.10.1 Moving the System**

When moving or transporting the system, take the PRECAUTIONS listed below.

Before moving the system:

1. Completely power off the system.
2. Unplug the power cord.
3. Disconnect all cables attached to the system.
4. To prevent damaging the power cord, do not pull, stretch or bend it excessively.
5. Store the probes in their carrying cases or wrap them in soft cloth or foam to prevent damage.
6. Store gel and other essential accessories in the appropriate storage cases.

### **1.10.2 Transporting the System**

Use extra care when transporting the system in a vehicle. After preparing the system as described above, take the following additional PRECAUTIONS:

- Before transporting, prepare and pack the system in the original package.
- Secure the system firmly with straps (or as directed otherwise) within the vehicle to prevent excessive vibrations during transport.
- Drive carefully to prevent vibration damage. Avoid unpaved roads, excessive speeds.

## Chapter 2

# System Specifications

### Contents

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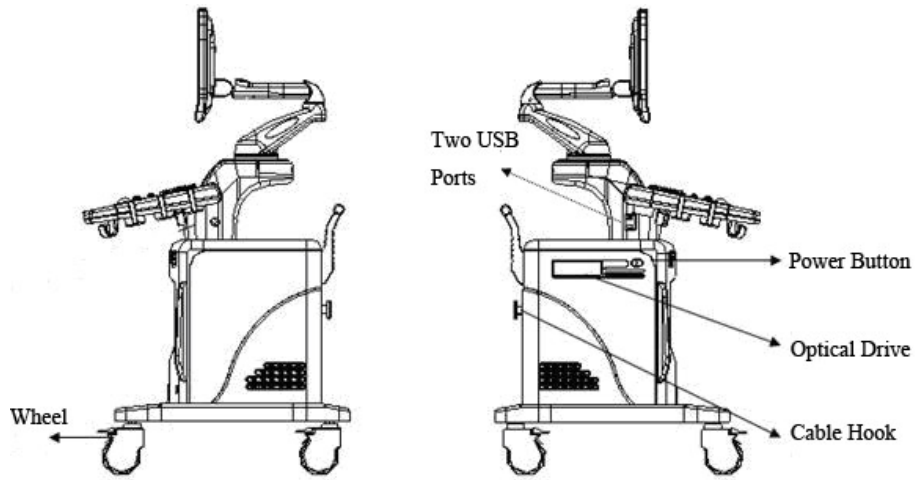
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## 2.1 System Overview

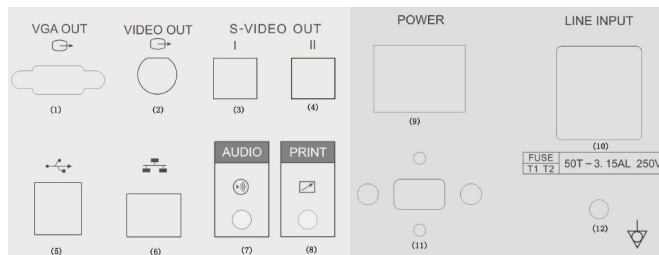




**Side View**



**Rear IO Panel**



- |     |                               |    |                    |
|-----|-------------------------------|----|--------------------|
| 1   | VGA Out                       | 2  | Video Out          |
| 3&4 | S-VIDEO                       | 5  | USB Port           |
| 6   | Ethernet Port                 | 7  | Audio Out          |
| 8   | Video Printer Controller Port | 9  | Mains Power Switch |
| 10  | Power Input Socket            | 11 | Voltage Selector   |
| 12  | Extra Ground (Earth) Point    |    |                    |

## 2.2 Application and Contraindication

### Application:

1. Abdominal
2. Vascular
3. Breast
4. Thyroid
5. Obstetrical
6. Gynecological
7. Musculo-skeletal
8. Cardiac
9. Urology

### Contraindication:

The system is not intended for OPTHALMIC use or any use that causes the acoustic beam to pass through the eye.

## 2.3 Probes and Accessories

### Supported Transducers:

- 2P1: Phased Array
- 5P1: Phased Array
- 6V1: Micro-Curved Array
- 6V3: Micro-Curved Array
- C611: Micro-Curved Array
- C344: Curved Array
- C542: Curved Array
- C362: Curved Array
- L541: Linear Array
- L741: Linear Array
- L742: Linear Array
- L743: Linear Array
- L744: Linear Array
- 10L1: Linear Array
- 10L2: Linear Array
- BCL10-5: Bi-plane Curved and Linear Array
- 7U2: Linear Array
- EC9-5: Micro-Curved Array

### Supported Peripherals

- ✧ Video printers
- ✧ Networks printers
- ✧ PC/workstation for accessing/reviewing ultrasound images
- ✧ USB2.0 removable disk drives
- ✧ Foot switch

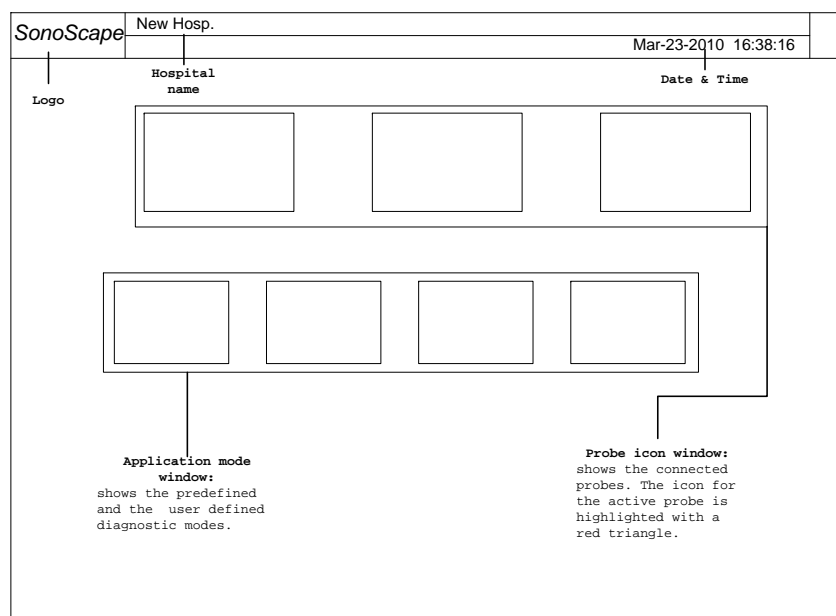
## 2.4 Physical Specifications

- Weight :** approximately 90kg
- Dimensions :** 780mm×530mm×1370mm

## 2.5 Concept of Operation

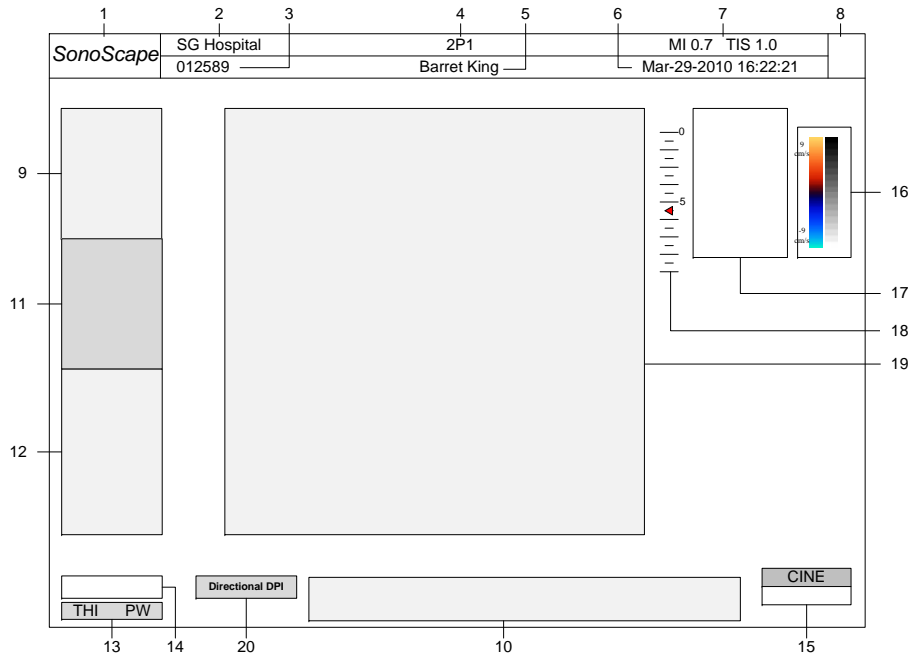
### 2.5.1 Screen Layout

The user interface of the preparation mode is shown in **Figure 2.1**.



**Figure 2.1:** EXAM screen (user interface of the preparation mode)

The user interface of the application mode is shown in **Figure 2.2**

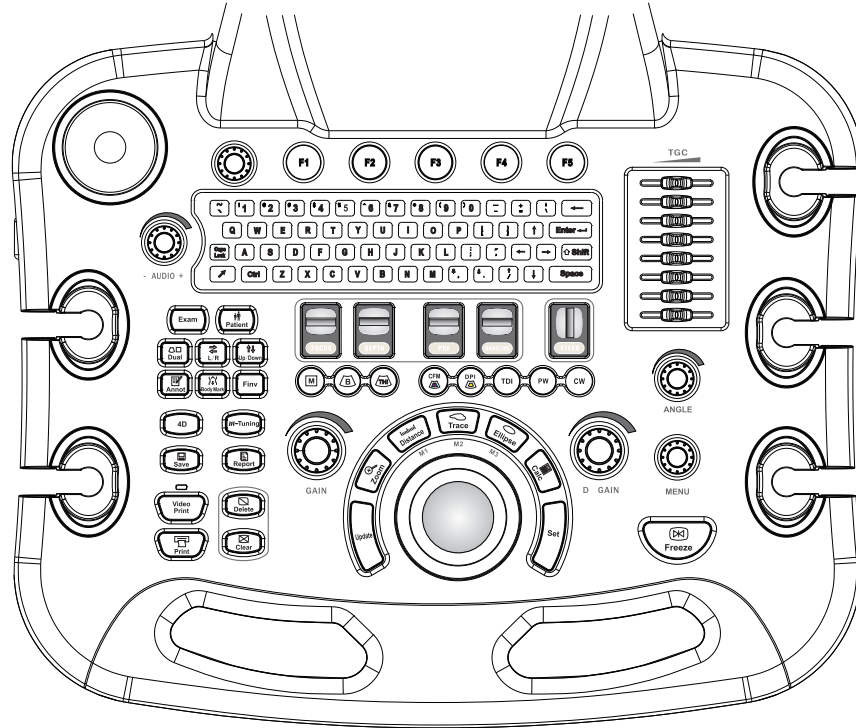


**Figure 2.2:** application mode screen

1	Logo	11	Color Image Info Spectral Doppler Image Info, or M
2	Hospital Name	12	Mode Image Info, or Context Menu
3	Patient ID	13	THI and PW/CW status
4	Probe	14	Cine playback progress indicator
5	Patient Name	15	Cine/Freeze Status
6	Date and Time	16	Gray scale / Spectrum wedge
7	Mechanical Index Thermal Index	17	Measurement results
8	Diagnostic/Application mode icon	18	Depth scale
9	2D Image Info	19	Ultrasound image area
10	function menu	20	Directional DPI indicator






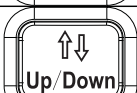



### 2.5.2 Keyboard Layout

The keyboard layout is shown in **Figure 2.3**. It consists of hard keys, knobs, a trackball, flip switches and TGC slider controls.

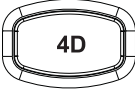



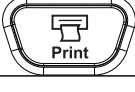


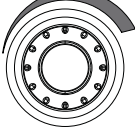
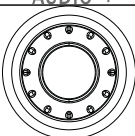


**Figure 2.3:** Keyboard layout of the system

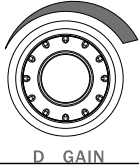




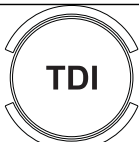
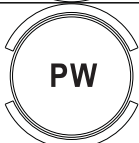
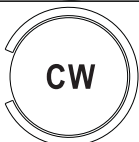
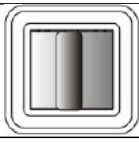

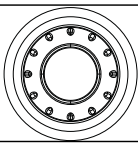
**2.5.3 Keyboard Description**

Key	Description
	EXAM press this key to return the system to the preparation mode (EXAM screen).
	Patient press this key to access the Patient Information interface.
	Dual press this key to start/end dual display.
	Flow Invert press this key to activate/deactivate the Flow Invert function in color Doppler mode.
	L/R flips the ultrasound image left/right.
	U/D flips the ultrasound image upward/downward.
	Annotation insert texts or predefined annotation items.
	Bodymark insert Bodymarks on the screen.
	Arrow located at the alphanumeric keyboard, press this key to insert an arrow symbol on the ultrasound image.

*continued on next page . . .*





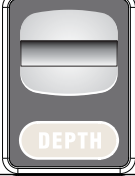




Key	Description
	4D start volume mode (3D or real time 4D mode).
	<b>m</b> -Tuning press this key during scanning to let the system automatically adjust various parameters to obtain high quality image.
	SAVE press this key during real time scan to save current application mode as new user-defined mode. press this key while the ultrasound image is frozen to save image or cine replay.
	REPORT write report for current diagnosis.
	PRINT trigger the network printers.
	DEL remove the most recently inserted annotations or Bodymarks. or redefine the route of trace.
	CLR clear the all measurements and calculations.
	AUDIO adjust the Doppler sound volume.
- AUDIO +	
	MENU press this knob to activate the context menu, turn it to change the value of the selected item.
<b>MENU</b>	

*continued on next page ...*

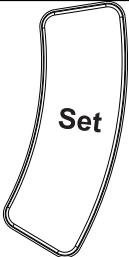


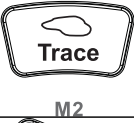


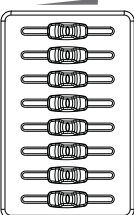
Key	Description
	D GAIN rotate this key to adjust the Doppler gain.
	GAIN rotate this key to adjust the 2D gain.
	B Mode press this key during the real time scan to start B mode imaging and remove additional modes.
	THI activate the Tissue Harmonic Imaging.
	CFM turn on/off Color Doppler Imaging, or Color Flow Mode (CFM).
	TDI turn on/off Tissue Doppler Imaging (TDI).
	PW turn on/off Pulsed Wave (PW) Doppler Imaging.
	CW turn on/off Continuous Wave (CW) Doppler Imaging.
	STEER use this key to adjust the steer angle for linear array probes.
	Function keys located at the top of the keyboard, <b>F1</b> ~ <b>F5</b> are function keys used for accessing the items in the function menu.
	Function knobs this knob is located at the top left of the keyboard; use it to adjust the value of the selected item in the function menu.

*continued on next page . . .*



Key	Description
	DPI turn on/off Doppler Power Imaging.
	M Mode turn on/off M mode imaging.
	FREEZE unfreeze/freeze the ultrasound image.
	FOCUS flip the switch up/down to change the depth position(s) of the focal zone(s).
	DEPTH increase or decrease the maximum scanning depth.
	PRF flip this switch to change the Velocity Range represented as PRF (Pulse Repetition Frequency).
	BASELINE flip this switch to shift the baseline, which enlarges the Velocity Range in one direction.
	Trackball use the trackball to move the cursor position.
	UPDATE in spectral Doppler mode or M mode, press this key to start/stop PW/CW and M traces. in 3D mode press this key to toggle the selection between 2D and 3D images.

*continued on next page ...*

Key	Description
	<p>SET this key serves as the confirmation key. to set, fixate markers and activate buttons/items marked by the cursor.</p>
	<p>ZOOM zoom ultrasound image.</p>
	<p>DIST measure the distance between two points.</p>
	<p>TRACE press this key and move the trackball to draw a trace on the ultrasound image; press <b>SET</b> to close the trace.</p>
	<p>ELLIPSE press this key and move the trackball to draw an ellipse on the ultrasound image.</p>
	<p>CALC press this key to activate the measurement menu.</p>
	<p>TGC slide the TGC control to change the gain in the corresponding 2D depth.</p>

## Chapter 3

# Starting the System

### Contents

---

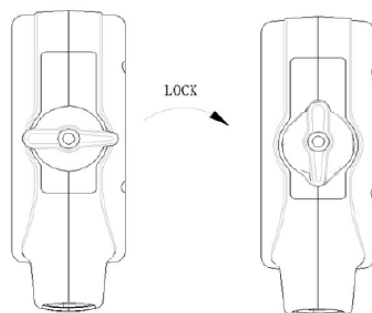
3.1	Probe Connection . . . . .	3-1
3.2	Boot Up . . . . .	3-2
3.3	General Operation Instructions . . . . .	3-2
3.4	Patient Information . . . . .	3-3
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3.8	Saving/Printing . . . . .	3-7

---

### 3.1 Probe Connection

#### **△ Attention!**

- Prior to connecting or disconnecting a probe freeze the image or enter the preparation mode (EXAM screen).
- It is unnecessary to switch the unit off.
- If a probe is disconnected while it is active scanning, a software error may occur. In this case switch the ultrasound system OFF and later ON (perform a restart).



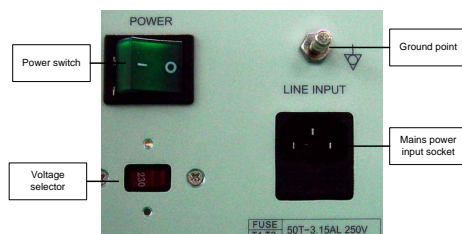
#### **Instructions:**

- Plug the probe into the probe socket.
- Switch the lock clockwise to vertical direction to lock the probe.
- If the cable is too long, you may hang it on the cable hook at the right side panel.

## 3.2 Boot Up

### Warning!

Review **Section 1.7** and **Section 1.8** for the detailed electrical requirements and for the electrical safety.



1. Adjust the voltage selector according to your local voltage level.
2. Connect the protective earth pin at the rear panel to safety ground (earth).
3. Connect the power cable to the mains power input socket at the back of the system.
4. Connect the mains power cable to a hospital grade receptacle with the proper rated voltage.
5. Switch the mains power input switch ON.

#### Note:

The mains power switch at the rear panel is normally left ON. Use the Power Switch button at the left side panel to switch on/off the system.

Turn on the system, the keyboard will be illuminated. It takes about 1 minute for the system to enter preparation mode (EXAM screen).

#### Remarks:

- If the system had been turned off abnormally, the system startup time would increase 30 to 60 seconds, during when the system goes through the HDD test.
- DO NOT plug in any external USB drive before the system startup completes, otherwise the  $\mu$ -SCAN function might be interrupted.

## 3.3 General Operation Instructions

### Typography Convention

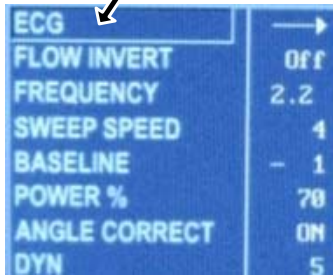
This manual employs the following typefaces to denote keys, buttons and parameters.

Keys on the control panel (keyboard) are typed in the form of **KEY**.

Buttons and items shown on the screen are typed in the form of **BUTTON**.

Image parameters are typed in the form of *parameter*.

Move the cursor over an item to select it.



**Move the Cursor Around**

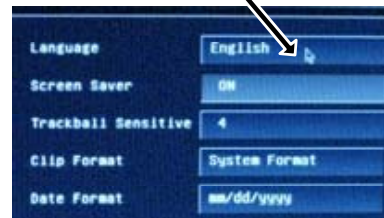
Use the trackball to move the cursor around.

The item in the context menu can be selected by moving the cursor over it. To change the value of the corresponding item, either use the left/right arrow keys or turn the **MENU** knob.

**Click Operation**

When changing system setting or performing ultrasound scanning, it involves the operation of first moving the the cursor over a certain item and then pressing the **SET** key. This operation is similar to the “click” operation on a typical PC. Similar terminology will be employed from now on: “click a button” means “move the cursor using trackball over the button and press the **SET** key”.

Click:  
Move the cursor over a button and press the SET key to activate it.



**Quick Access**

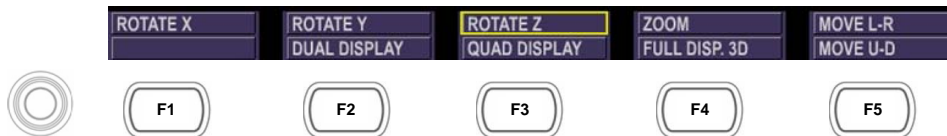
The function menu, at the bottom of the screen, shows some items in either one or two rows. These items can be selected by pressing the corresponding **Fn** key.

The item in the function menu represents function, parameter, or option. To change the value of the selected item, or to enable/disable the selected item, turn the function knob.



**Example 1:**

In the illustration above, press **F2** to select LOOP SPEED; Turn the function knob to change the value of LOOP SPEED.



**Example 1:**

In the illustration above, press **F2** twice to enable the dual display format in the 3D imaging mode. Press **F4** to select ZOOM, the zoom function is enabled. The trackball movement is now bound to the attached to zooming in/out the 3D image.

**3.4 Patient Information**

Patient information can be entered at the Patient Information window.

Press **[PATIENT]** key to open the Patient Information window. See **Figure 3.1**

SonoScape		SG Hospital																
<b>PATIENT INFORMATION</b>																		
Name:	<input type="text" value="Murray Kim"/>	ID:	<input type="text" value="02156"/>															
DOB:	<input type="text" value="09081982"/>	Weight:	<input type="text" value="76"/>															
Height:	<input type="text" value="192"/>	LMP:	<input type="text" value="mmddyy"/>															
Age:	<input type="text" value="28"/>	BSA:	<input type="text" value="2.05"/>															
Unit:	kg/cm	EDD:	<input type="text"/>															
Sex:	<input type="text" value="M"/>	Acc.#:	<input type="text" value="18329"/>															
GA:	<input type="text"/>																	
<table border="1"> <tr> <td>Local</td> <td>History</td> <td>Worklist</td> </tr> <tr> <td><input checked="" type="checkbox"/> Name</td> <td><input type="checkbox"/> ID</td> <td><input type="checkbox"/> Acc.#</td> </tr> <tr> <td colspan="3">String: <input type="text" value="u"/></td> </tr> <tr> <td>Name</td> <td>ID</td> <td>DOB</td> </tr> <tr> <td>Unknown Person</td> <td>09081565</td> <td></td> </tr> </table>				Local	History	Worklist	<input checked="" type="checkbox"/> Name	<input type="checkbox"/> ID	<input type="checkbox"/> Acc.#	String: <input type="text" value="u"/>			Name	ID	DOB	Unknown Person	09081565	
Local	History	Worklist																
<input checked="" type="checkbox"/> Name	<input type="checkbox"/> ID	<input type="checkbox"/> Acc.#																
String: <input type="text" value="u"/>																		
Name	ID	DOB																
Unknown Person	09081565																	
<b>GET WORKL IST</b>		<b>CANCEL</b>	<b>RESET</b>															
<b>SAVE</b>																		

**Figure 3.1:** Patient Information

Click on the text box and insert or edit the corresponding patient information.

 **Note:**

- Text fields next to EDD, BSA, and GA are calculated by the system using other patient data, they are not editable.
- A valid patient profile should at least have a patient ID and a patient name.
- Click RESET to reset all entries for the current patient! Click CANCEL to exit without saving.

Click SAVE button to save the current patient information.

 **Note:**

- For a newly created patient profile, the file folder for this patient is created in the File Manger.
- The ultrasound images and calculation results will be saved to the corresponding patient folder.

An existing patient profile can be searched by *Name*, *ID* or *Account Number*.

 **Note:**

- Click the Local tab. Tick Name, ID or Acc.#. Type in the *first* few letters of the *Name, ID or Account Number* you are searching for. The matched patient profiles will be listed below. Click the patient to select it.
- If the ultrasound system is connected to a worklist server, you may select a patient from worklist. Click the GET WORKLIST button to retrieve a list of patients from the server.
- History lists previously diagnosed patients.

### 3.5 Start Ultrasound Diagnosis

At the preparation mode, move the cursor over the probe icon to select the probe. The application modes for the selected probe are listed. Refer to **Figure 2.1**.

Click a diagnostic icon to start a real time scan.

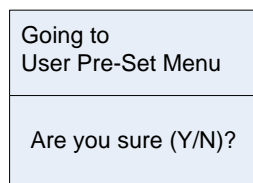
The system automatically freezes the ultrasound image if there is no user activity for more than 30 minutes.

### 3.6 Customized application mode (Create New Exam Mode)

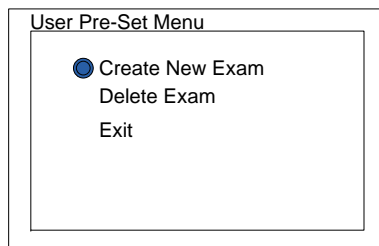
For each probe, the system has some predefined application modes for some typical applications. User can change various settings based on a predefined mode, and create a customized application mode.

**Instructions**

1. Customize imaging setting by adjusting various parameters.
2. Click the **SAVE** key during the real time scan.



3. Type **Y** and select Create New Exam.



4. Type the name for the new application mode, select OK and press SET key.
5. You can also delete customized mode by selecting "Delete Exam" in step 4. Follow the on-screen instructions to continue the deletion.

### 3.7 Annotation and Bodymark

#### 3.7.1 Annotation

Annotation items can be inserted either in the freeze mode or during the real time scan.



Press the **ANNOTATION** key to start inserting annotation.

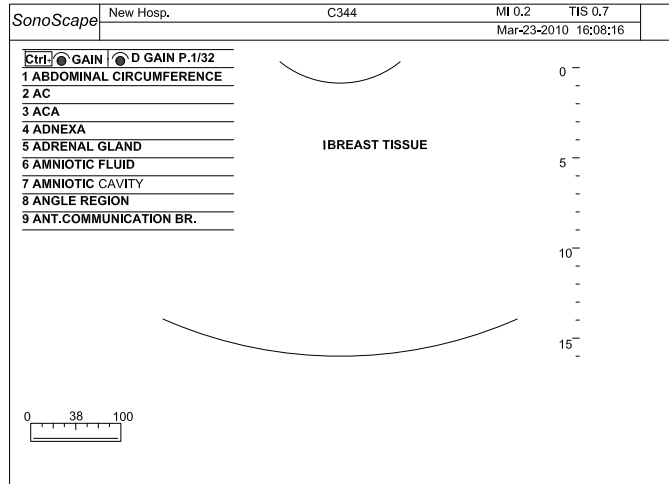


Figure 3.2: Annotation

The system predefines a large list of annotation items. User can modify/add predefined annotation items at the System Setting chapter.

**To insert predefined annotations:**

1. turn the **GAIN** knob to scroll between items, turn the **D GAIN** knob to turn to the next/previous page of annotation items.
2. highlight the annotation item and press the **UPDATE** key to select the item.
3. move the cursor to the desired position and press the **SET** key to insert the selected annotation item.

**To insert manual text:**

move the cursor to the desired position and write the text using the alphanumeric keyboard.

Press the **DEL** key to delete the last inserted item.

Press the **ANNOTATION** key again to exit the annotation mode.

Press the **CLR** key to remove all annotation items on the screen.

Annotations can be saved together with the ultrasound image; and will be cleared upon exiting current application mode.

#### 3.7.2 Bodymark

For the documentation of the ultrasound diagnosis, a collection of graphic body marks is available.

Inserting bodymark is only possible in freeze mode.



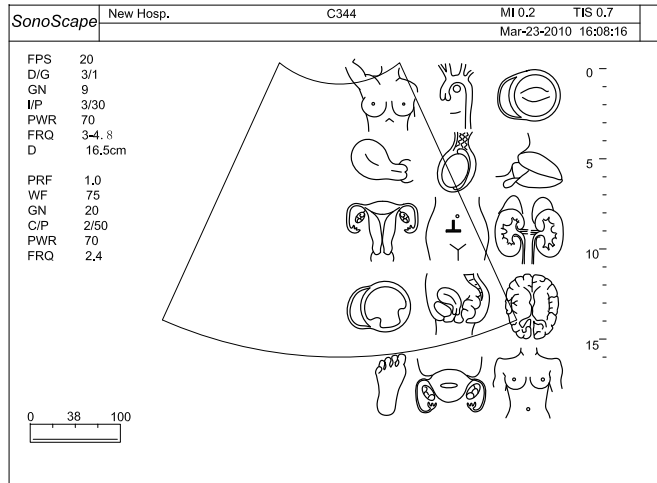



Figure 3.3: Bodymark



Press the **BODYMARK** key, a collection of the graphic body part symbols will be shown on the right half screen.

1. Use the **TRACKBALL** to move the probe maker () at the desired position on a bodymark symbol.
2. Rotate the probe marker by pressing the **Left/Right** keys next to the **TRACKBALL**.
3. Press the **SET** key to insert the bodymark.

Press the **CLR** key to remove annotations as well as bodymark.

### 3.8 Saving/Printing

For saving image/cine, refer to **Section 5.4.8**.

Network printing can be triggered by pressing **PRINT**<sup>1</sup>.

Video printing, used with thermal printers, can be triggered by pressing **VIDEO PRINT**.

<sup>1</sup>Network printers must be configured before use.



## Chapter 4

# System Setup

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---

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## 4.1 System Menu

Press **[MENU]** in the preparation mode to activate the system menu. The rest of this chapter explains how to configure the system and view the system information using the items listed in this menu.

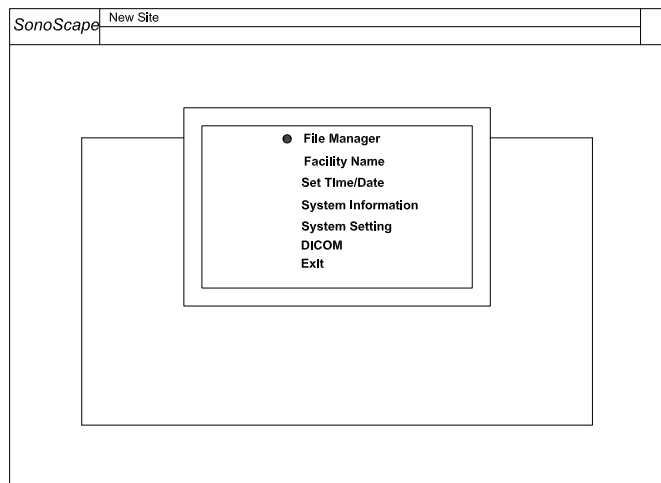


Figure 4.1: System Menu

## 4.2 File Manager

Select File Manager and press **[SET]**, the system opens

- the root directory if no patient profile is activated; or
- the patient directory if a patient profile has been activated.

Figure 4.2 illustrates the root directory of the system. Using this interface, user can access patient data stored on the hard drive and any external disk drives (USB, MO, or CD/DVD). To open a file folder in the *File Manager*, move the cursor over the directory name, press **[SET]** twice.

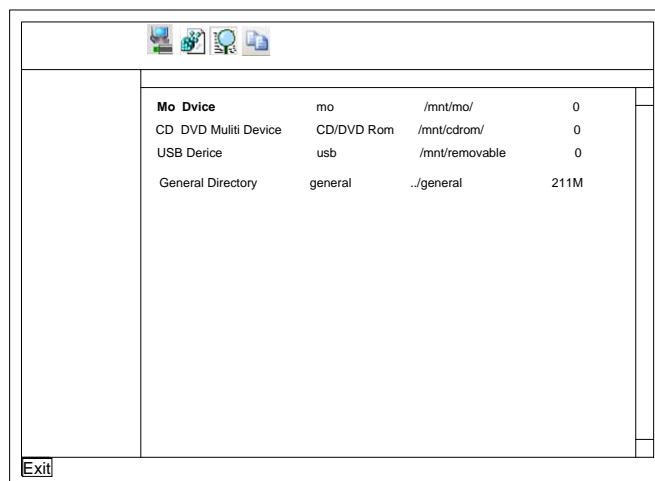
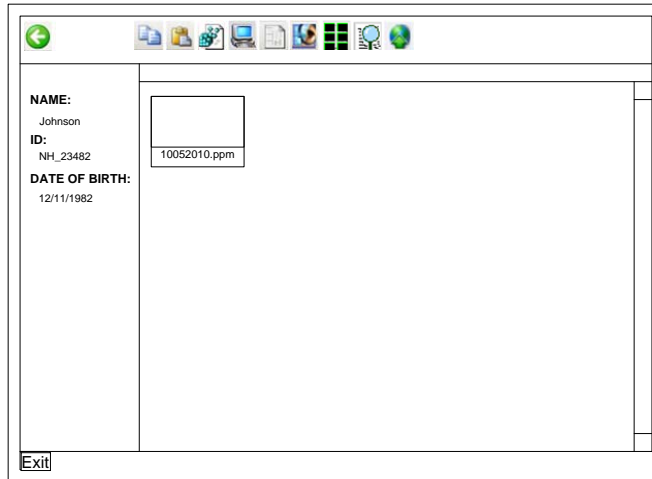


Figure 4.2: File manager: root directory



**Figure 4.3:** File manager: patient directory

**Figure 4.3** illustrates the patient directory.

The function of the icons shown in the file manager are listed in **Table 4.1**.

Icon	Action upon clicking the icon
	Go to parent directory.
	Search file by name.
	Copy the selected files to the cache.
	Paste the cached files to the current file folder.
	Delete the selected files.
	Convert the selected files to the PC format.
	Display report files only.
	Display image files only.
	Enable multi-selection.
	Display report files only.
	Export selected files to remote Service Class User (SCU).
	Load/Unload the USB drive. Note that the USB drive can be automatically unloaded upon clicking the Exit button.

**Table 4.1:** File operations

### 4.3 Facility Name

The facility/hospital name is displayed at the top left corner of the screen, next to the product logo. To rename the facility/hospital name, select Facility Name and press **SET**.

Enter new name and click OK.

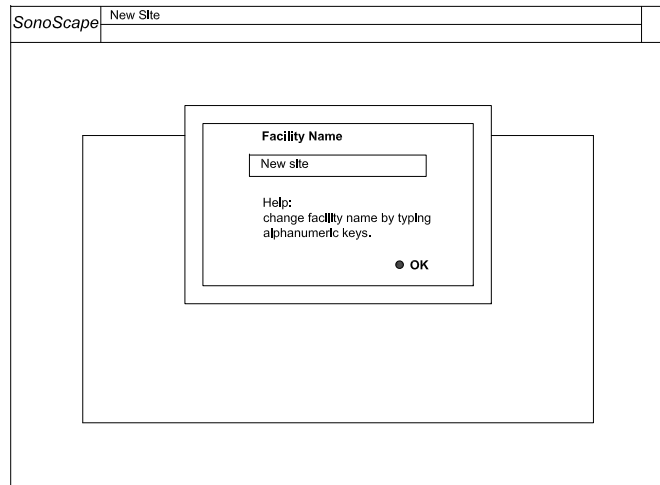


Figure 4.4: Facility name

## 4.4 Set Date and Time

Select Set Time/Date and press **SET** to set the system date and time.

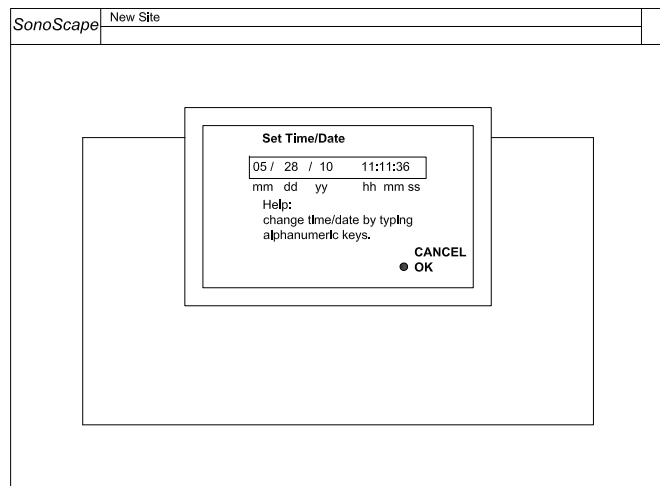


Figure 4.5: Set date and time

## 4.5 System Information

Select System Information and press **SET** to view the system information. Both the hardware and the software version numbers can be identified here. Among them, the Control Number is a unique number for the equipment; and the Software Version number designates the current software version.

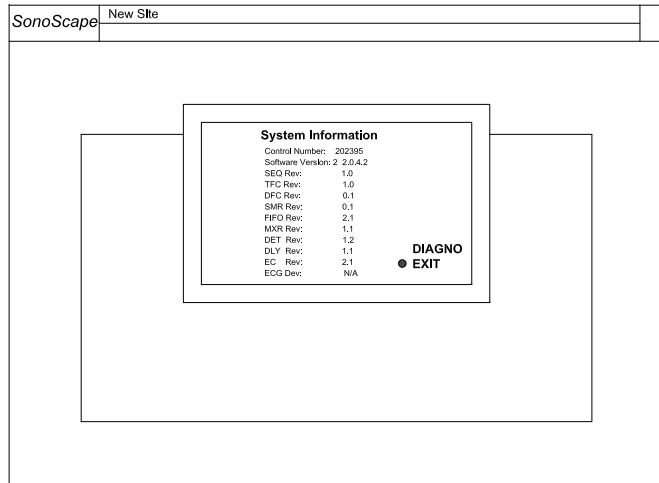


Figure 4.6: System information

### **△ Attention!**

The **DIAGNO** option shown at the *System Information* interface is for diagnosing of the system in case of malfunction. Only authorized service personals should perform this action.

## 4.6 System Setting

Select System Setting and press **SET** to configure the system. Click Exit to exit the *System Setting* interface.

### 4.6.1 General Setting

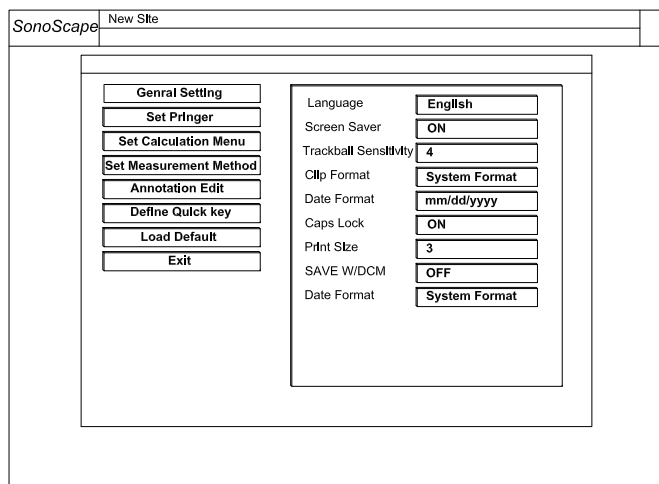


Figure 4.7: General setting

Click on the General Setting tab, the following configurations are available.

Item	Explanation
Language	Set the language of the user interface.
Screen Saver	Turn on or off the screen saver.
Trackball Sensitivity	Adjust the sensitivity for tracking the trackball movement.
Clip Format	Set the file format for saving multiple frames as video.
Date Format	Set the format for displaying the date on the screen and the ultrasound image.
Caps Lock	If this option is ON, typed letters are capitalized by default and in lower case when the <b>SHIFT</b> key is pressed.
Print Size	Set the size of the ultrasound image on the paper when printing.
SAVE w/DCM	Refer to <b>Subsection 5.4.8</b> .
Still Format	Set the file format for saving a single frame.
Screen Save	Set the time duration for the system to wait before activating the screen saver program.
Color of ROI	Set the color of the region of interest box.
Display Format	This option sets the default display format in the spectral Doppler and the M modes.

#### 4.6.2 Set Printer

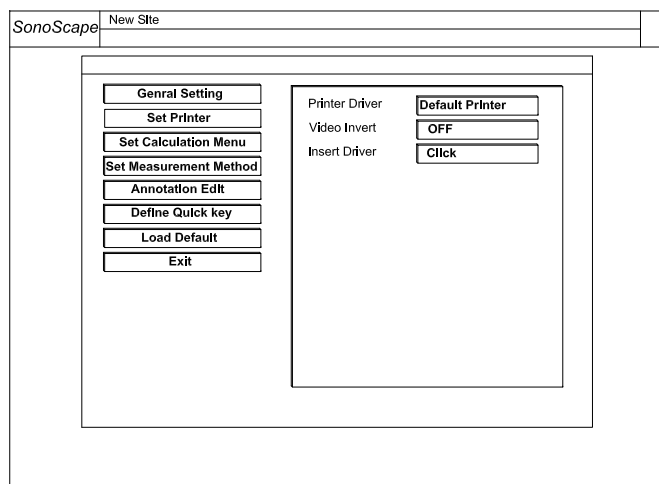


Figure 4.8: Set Printer

**Printer Driver:** Select the printer driver to match the actual printer in use.

**Video Invert:** Invert the RGB-color brightness for printing.

**Insert Driver:** Connect a USB drive or an optical disk with the printer driver file inside and click this button to install a printer driver.



### 4.6.3 Set Calculation Menu

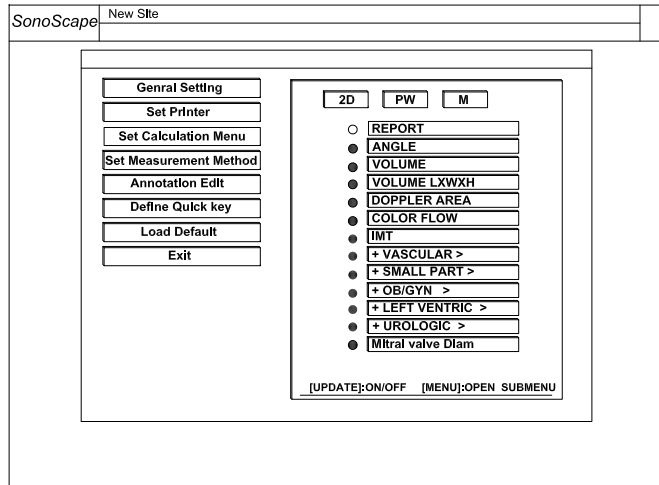


Figure 4.9: Set calculation menu

Press the Set Calculation Menu tab to configure the calculation menu which appears in the diagnosis.

**Instructions:**

- Move the cursor over an imaging mode button (**2D**, **Pw**, or **M**) and press **SET**.
- Use the arrow keys to select the calculation item.
- Press **UPDATE** to turn on or off an item.
- Press **MENU** to open or fold a submenu.

### 4.6.4 Set Measurement Method

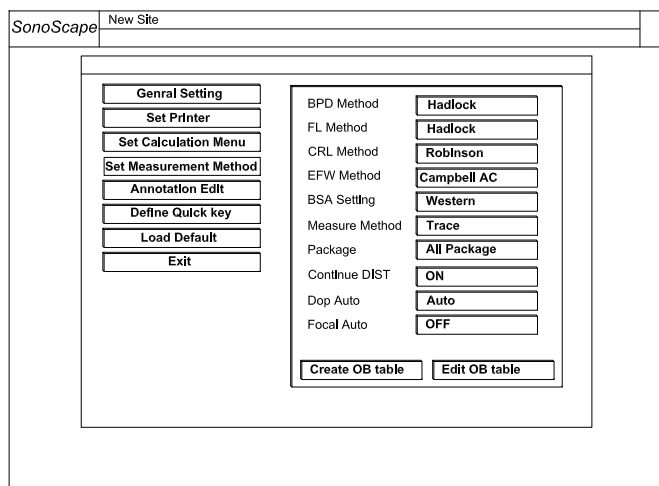


Figure 4.10: Set measurement method

Press the Set Measurement Method tab to configure the measurement method.

**Instructions:**

- Move the cursor over the parameter box, and click **SET**.
- Press the **LEFT/RIGHT** keys to change the parameter. Information about some items are provided below.

<b>Package</b>	Set it to <b>Icon Driven</b> and only the items related to the application mode will be displayed in the calculation menu. Set it to <b>All Package</b> and all the available items will be shown in the calculation menu, irrespective of the application mode.
<b>Continue DIST</b>	Set it to on, and you only need to press <b>DIST</b> once to perform multiple distance measurements.
<b>Dop Auto</b>	Set it to on, and let the system auto-adjust the acoustic focal position once the scan depth is changed.
<b>Create OB table</b>	It allows you to create your obstetric calculation tables.
<b>Edit OB table</b>	Edit user defined obstetric calculation tables.

#### 4.6.5 Annotation Edit

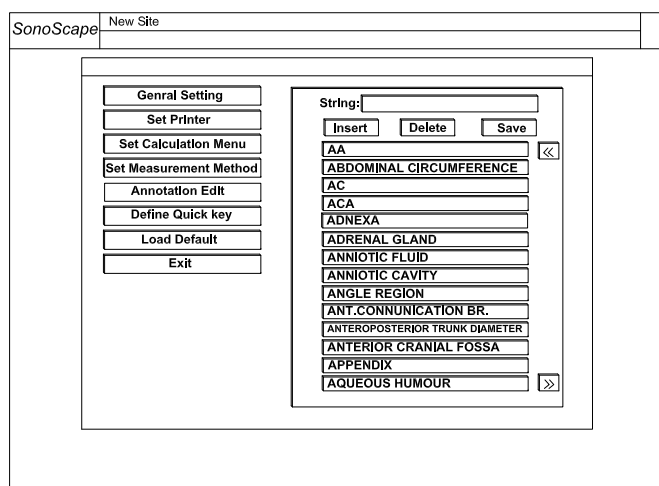


Figure 4.11: Annotation edit

User can modify the predefined annotation strings. Press the Annotation Edit tab, the available annotations and the possible operations are listed on the right half screen.

**Instructions:**

- Move the cursor over a string, press **SET** twice to start editing it. You need to click **SAVE** to save the modification.
- Press **◀** to turn the list one page up; press **▶** to turn the list one page down.
- Enter texts in the text box next to **String:**, click **Insert** and the texts will be added into the annotation list.
- Click **Delete** to remove the selected string immediately.

### 4.6.6 Define Quick Key

The numeric keys on the alphanumeric keyboard can be assigned as shortcut keys for performing measurements.

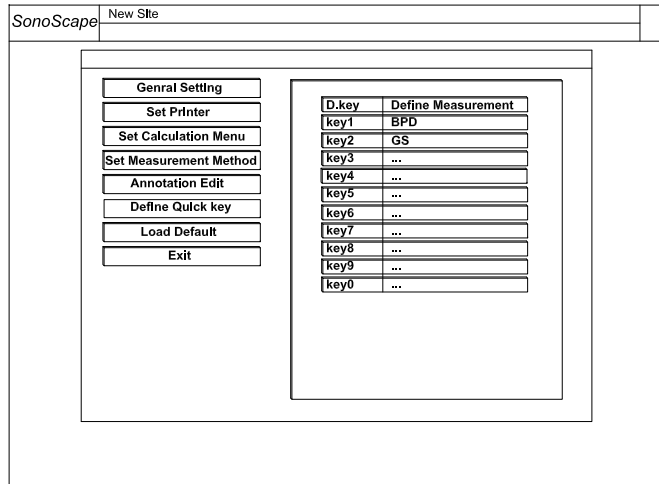


Figure 4.12: Assign shortcut keys

Click the Define Quick Key tab to define the shortcut keys. The D. Key column shows the numeric keys; the Define Measurement column shows the measurements attached to these keys.

### 4.6.7 Load Default

Click the Load Default tab. You can load or back up the user setting here.

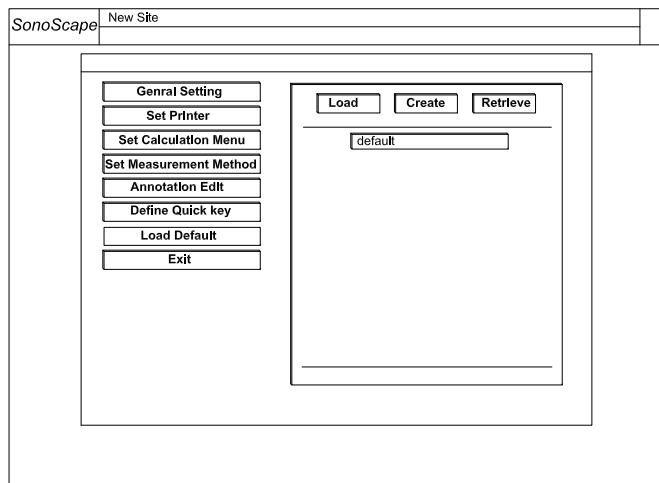


Figure 4.13: Back up or load user settings

#### Load and delete

Click the Load tab and select a setting name. The following prompt message appears,

```
Load new setting?
  continue (Y/N).
  Delete setting: [DEL]
```

Type **Y** to load the setting or type **N** to cancel. Press **DELETE** to delete the setting.

To save the current system setting as a new setting, click the Create tab. Type in the name for the setting, and click CONFIRM.

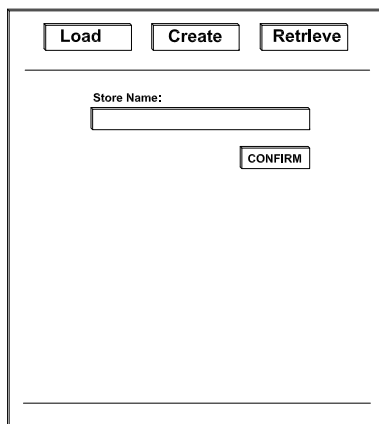


Figure 4.14: Create a user setting

To back up or retrieve the user setting and data, click the Retrieve tab.

- Click Copy user setting to USB to back up the current user setting and patient data to an external USB drive. Make sure to connect the USB drive before performing the backup.
- Click Copy USB user setting to system to copy the backup (setting and data) from the USB drive.

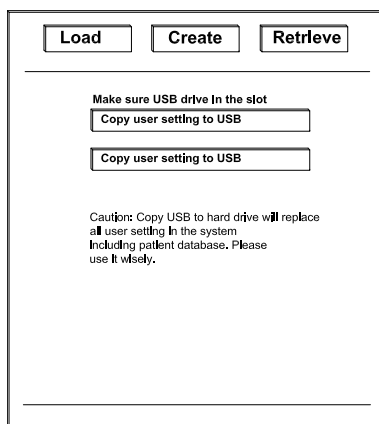


Figure 4.15: Back up or load the user setting and data

### **Warning!**

Copy backup from the USB drive overwrites the patient data on the system as well.

## 4.7 DICOM Setting

This equipment conforms with the Digital Imaging and Communications in Medicine (DICOM) standard, which is the industrial standard for the communication and management of patient data between the devices in the hospital.

Click the DICOM tab to activate the *DICOM Interface*. You can change the setting for network communication protocols here.

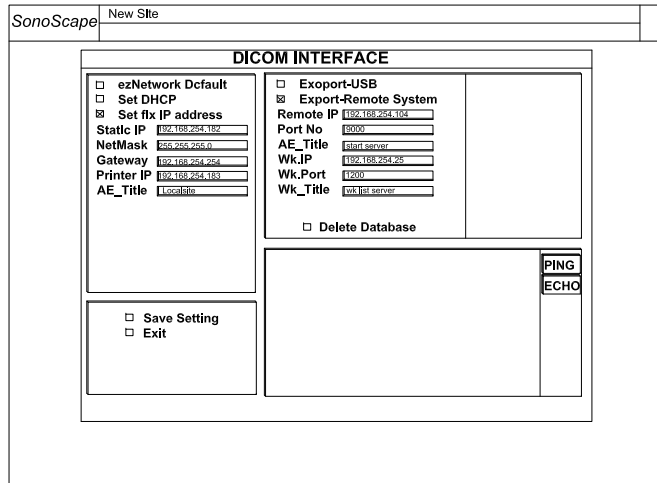


Figure 4.16: DICOM Setting

**ezNetwork Default:** Use the ezNetwork default protocol.

**Set DHCP:** Use the Dynamic Host Configuration Protocol (DHCP).

**Set fix IP address:** Set the local network parameters manually by filling the fields below.

**Static IP:** Set the local IP address.

**NetMask:** Set the local netmask address.

**Gateway:** Set the local gateway address.

**Printer IP:** Set the IP address of a network printer.

**AE\_Title:** Type in the Application Entity (AE) title of the local system here. The AE title must be unique on its network.

**Export USB:** If this option is checked, saving an ultrasound image also exports it to the external USB drive.

**Export-Remote System:** If this option is checked, saving an ultrasound image also exports it to the Service Class User (SCU).

**Remote IP:** Set the IP address of the DICOM server.

**Port No:** Set the port number of the DICOM server.

**AE\_Title:** Type in the Application Entity (AE) title of the DICOM server here. This title must be unique on its network.

**Wk.IP:** Set the IP address of the worklist server.

**Wk.Port:** Set the port number of the worklist server.

**Wk\_Title:** Type in the worklist server title here. This title must be unique on its network.

**Delete Database:** Check this to delete the database.

**PING:** To test the connection with an IP address, move the cursor over this button, enter the IP address; press this button again.

**ECHO:** Press this button to test the connection with the DICOM server and the worklist server.

**Save Setting:** Press this button to save the current setting.

**Exit:** Press this button to leave the DICOM interface without saving the settings.

# Chapter 5

## B Mode

B mode imaging is intended to provide information of anatomical structure of soft tissues.

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## 5.1 Starting B Mode



Click the application icon at the preparation mode (EXAM screen) to start a real time scan. The system enters B mode automatically. To remove any additional modes (PW/CW/CFM/DPI/M), press the **B** mode key.

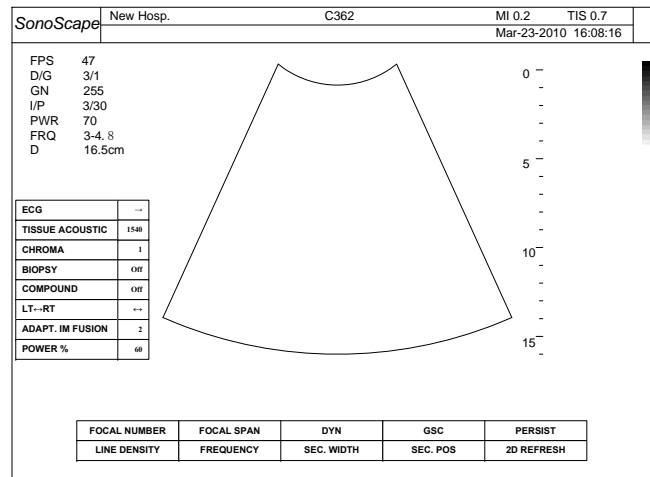


Figure 5.1: B mode

## 5.2 B Mode Image Information

B mode image information (right) is shown on the top left corner of the screen (also refer to **Figure 2.2**). It shows some parameters important for the diagnosis. The table below shows the meaning of the items listed in the 2D Image Info area.

<b>FPS</b>	13
<b>D/G</b>	160/2
<b>GN</b>	47
<b>I/P</b>	5/30
<b>PWR</b>	80
<b>FRQ</b>	3-5.2
<b>D</b>	16.5cm

FPS	number of frames per second
D/G	dynamic range (DYN) / gray scale curve
GN	2D gain
I/P	Adaptive Image Fusion / Persistence
PWR	acoustic output power (%)
FRQ	frequency range (MHz)
D	depth



### 5.3 Real Time B Mode Operation

The B mode operation for the current ultrasound image is independent of the display format (single, dual or quad). Review **Section 3.3** for the general operation instructions.

#### 5.3.1 B Mode Menus

##### Real Time CFM Mode Function Menu

The following function menu appears on the screen with the real time B mode image.

FOCAL NUMBER	FOCAL SPAN	DYN	GSC	PERSIST
LINE DENSITY	FREQUENCY	SEC. WIDTH	SEC. POS	2D REFRESH

Figure 5.2: Function menu in real time B mode

##### Real Time B Mode Context Menu



Press the **MENU** key during the real time scan, and the context menu will be shown at the Context Menu area (refer to **Figure 2.2**).

Note that some models do not support  $\mu$ -Scan function, hence the item u-Scan will not appear in the context menu for these models.

Trapezoid (short for Trapezoidal Imaging) is only available with linear array probes.

Press the **MENU** knob again to dismiss the B mode context menu.

ECG	→
TISSUE ACOUSTIC	1540
CHROMA	1
BIOPSY	Off
COMPOUND	Off
LT↔RT	↔
ADAPT. IM FUSION	2
uScan	Off
POWER %	60
TRAPEZOID	Off

Figure 5.3: B mode context menu (real time mode)

#### 5.3.2 B Gain



The B mode gain (2D gain), determines the amplifying factors for the received echoes. The echoes are amplified with the same gain value regardless of depth. The **GAIN** knob adjusts the overall brightness of the 2D image.

- Turn the **GAIN** knob clockwise to increase the 2D gain, the ultrasound image gets brighter.
- Turn the **GAIN** knob counterclockwise to decrease the 2D gain, the ultrasound image gets darker.

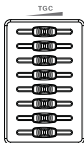
##### Remarks:

- The gain value is displayed on the screen at the 2D Image Info area (GN).
- It is possible to change the 2D Gain only when B mode is active, independent of additional modes.

#### 5.3.3 Time Gain Compensation (TGC)



The TGC are adjustable during the real time scan regardless of the imaging mode (B, CFM, PW/CW, ...) and display format (single, dual, quad).



Use the TGC slide control to adjust the gain which allows compensation for attenuation of the echoes over time (depth).

Move the slide control to the left to decrease the gain at the corresponding depth; move the slide control to the opposite direction to increase the gain at the corresponding depth.

**Remarks:**

- The default TGC compensation corresponds to the middle positions at which the slide controls are.
- Before a slide control is moved, the TGC is kept to its default value independent of the slider positions.
- TGC curve disappears when the TGC sliders is inactive for more than several seconds.

### 5.3.4 Depth



The depth range is adjustable during the real time scan regardless of the imaging mode (B, CFM, PW/CW, ...) and display format (single, dual, quad).



The depth knob controls the depth range of the ultrasound image. The system automatically adjusts the frame rate (FPS) and acoustic power indices (TI, MI ...) according to the depth.

- Flip the **DEPTH** switch downwards to increase the depth range of the 2D image and the size of image is reduced to display the entire ultrasound image.
- Flip the **DEPTH** switch upwards to decrease the depth range of the 2D image and the ultrasound image is magnified.

**Remarks:**

- The range of the scanning depth depends on the probe type. Depth is represented in unit of cm.
- The depth scale is shown on the right side of the ultrasound image.
- The current depth is displayed at the 2D Image Info area and represented by D.

### 5.3.5 Focal Zones

The focal zone determines the depth range for optimizing the concentration of the ultrasound beam.

Multiple focal zones are possible. The marker (◀) for focal zone is indicated at the depth scale.

**FOCAL NUMBER**

Use this function to change the number of focal zones.

- press **[F1]** to select FOCAL NUMBER.
- turn the function knob to change the number of focal zones.

**FOCAL NUMBER**

This function changes the span of focal zones, or equivalently the distance between the focal zones.

- press **[F2]** to select FOCAL SPAN.
- turn the function knob to change the span of focal zones.



The focal depth is adjustable during the real time scan regardless of the imaging mode (B, CFM, PW/CW, ...) and the display format (single, dual, quad).



If multiple focal zones are present, they are shifted with the same amount of depth. To change the depth position(s) of the focal zone(s):

- flip the **[FOCUS]** switch downwards to shift the focal zones to deeper locations.
- flip the **[FOCUS]** switch upwards to shift the focal zones to shallower locations.

 **Remarks:**

- The maximum number of focal zones depends on the probe in use.
- Increasing the focal number decreases the frame rate and increases the acoustic power indices.
- Increasing the focal zone depth increases the acoustic power indices.

**5.3.6 Tissue Acoustic Characteristics**

**TISSUE ACOUSTIC**

The speed of ultrasound depends on the tissue it is passing through. Tissue acoustic characteristics specifies the ultrasound speed used for measurements and calculations. Adjust this parameter to fine tune the focusing.

- select TISSUE ACOUSTIC from the context menu.
- turn the **[MENU]** knob to adjust this parameter.

 **Remarks:**

- The calculations that depends on the ultrasound velocity varies with the value of TISSUE ACOUSTIC.
- For your reference, Table 5.1 provides the sound speeds in miscellaneous tissues/organs/materials.

Tissue Type	Phase Velocity (m/s)
Air	330
Soft tissue (average)	1540
Bone, skull	2770 +/- 185
Brain Fresh	1460
Breast in vivo	1510 +/- 5
Breast Fat	1420
Breast Mass	1600
Fat, fresh	1450
Kidney	1560
Liver, fresh	1570
Blood	1570
Lung, fresh	658
Muscle	1580
Uterus	1630
Tendon	1750
Collagen	1675
Water (20°C)	1480

**Table 5.1:** Sound speeds in the different materials

### 5.3.7 Dynamic Range

#### DYN

Dynamic Range increases the adjustable range of contrast by enhancing the intensities of parts of the grayscale. It is useful for optimizing the ultrasound image texture.

- press **F3** to select DYN.
- turn the function knob to adjust the DYN setting.

#### **Remarks:**

Dynamic Range is displayed at the 2D Image Info Area on the screen (The D in D/G).

### 5.3.8 Grayscale curve

#### GSC

Brightness of each pixel is determined by the amplitude of the corresponding echo. Grayscale curve (GSC) adjusts the images by changing how the amplitude is converted to brightness.

- press **F4** to select GSC.
- turn the function knob to adjust the GSC setting.

#### **Remarks:**

Grayscale Curve is displayed at the 2D Image Info area on the screen (The G in D/G).

### 5.3.9 Persistence

#### PERSIST

Adjust the persistence value to remove speckles from 2D images and enhance the smoothness of the image.

- press **F5** to select PERSIST.
- turn the function knob to adjust the PERSIST setting.

 **Remarks:**

Persistence value is displayed at the 2D Image Info area on the screen (The P in I/P).

### 5.3.10 Chroma

#### CHROMA

The echo amplitudes are converted to pixels with different brightness. The chroma value (color tone and saturation) is mapped to the pixels. There are 13 map combinations available.

- select CHROMA from the context menu.
- turn the **MENU** knob to adjust the CHROMA setting.

### 5.3.11 Sector Width and Position

User can reduce the imaging area to the region of interest by reducing the sector width and move the sector position.

#### SEC.WIDTH

- press **F3** to select SEC.WIDTH.
- turn the function knob to change the sector width.

#### SEC.POS

- press **F4** to select SEC.POS.
- turn the function knob to change the sector position.

### 5.3.12 Line Density

#### LINE DENSITY

LINE DENSITY can be set to Low, Medium or High. Higher line density can provide better horizontal resolution, but also reduces the frame rate.

- press **F1** to select LINE DENSITY.
- turn the function knob to change the LINE DENSITY setting.

### 5.3.13 Compound Imaging

#### COMPOUND

Select this item from the context menu, turn the **MENU** knob to turn on/off the compound imaging.

- select COMPOUND from the context menu.
- turn the **MENU** knob to turn on or off the compound imaging.

### 5.3.14 Frequency Range

#### FREQUENCY

The transducer is capable of generating a broadband signal with a certain start frequency and a certain bandwidth. The higher frequency that is set, the higher the resolution and the lower the penetration.

- press **F2** to select FREQUENCY.
- turn the function knob to change the frequency value.

#### Remarks:

The frequency range is displayed at the 2D Image Info area FRQ.

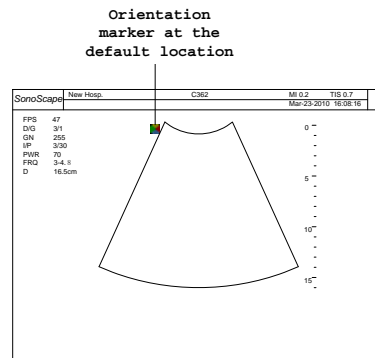
### 5.3.15 Image Orientation (Left/Right, Up/Down)

Change of the image orientation is possible with all imaging modes (real-time or frozen) independent of the display format (single, dual, quad).

#### LT↔RT

Use this function to alternate the image orientation between left and right without rotating the scan head itself. The orientation marker (📏) corresponds to the position of the first element of the array on the transducer.

- select LT↔RT from the context menu.
- turn the **MENU** knob to alternate the image orientation between left and right.



#### Remarks:

If the item **LT↔RT** is not available in the context menu, you can also use the **L/R** key to change the image left/right orientation.

#### Up/Down



Press the **U/D** key to alternate the image orientation between up and down.

### 5.3.16 Adaptive Image Fusion

#### ADAPT. IM FUSION

Adaptive image fusion provides choices of optimization methods for improving image quality through boundary enhancement, image smoothing and system optimization.

- select ADAPT. IM FUSION from the context menu.
- turn the **MENU** knob to adjust the setting for optimizing the adaptive image fusion.

 **Remarks:**

Adaptive Image Fusion is displayed at the 2D Image Info Area on the screen (The I in I/P).

### 5.3.17 $\mu$ Scan Function



The  $\mu$ Scan function is an option. If it is not installed, the uScan item will not appear in the B mode context menu.

**uScan**

The  $\mu$ Scan function allows the transducer to see in more than one direction, eliminates artifacts from the ultrasound image.

- select uScan from the context menu.
- turn the **MENU** knob to turn on or off the  $\mu$ Scan function.

### 5.3.18 Acoustic Output Power

**POWER %**

The acoustic output power of the transducer should be set to the minimum value which still provides the user with well evaluable information. Always keep the power level and the exposure time as low as reasonably achievable.

- select POWER % from the context menu.
- turn the **MENU** knob to adjust the output power.

 **Remarks:**

- The acoustic output power is displayed at the 2D Image Info Area on the screen (PWR).
- You can decrease the acoustic power indices (MI, TI) by reducing the output power of the transducer.

### 5.3.19 Trapezoidal Imaging

**TRAPEZOID**

The Trapezoidal Imaging, only available with linear array probes, increases the range of view of the ultrasound image. The TRAPEZOID item is hidden for other types of probes.

- select TRAPEZOID from the context menu.
- turn the **MENU** knob to turn on or off the trapezoidal imaging.

### 5.3.20 2D Refresh

**2D REFRESH**

If this option is left on, the B mode image (the 2D grayscale image) will be active during the B+PW/CW and the B+M modes.

- press **F5** to select 2D REFRESH.
- turn the function knob to turn on or off 2D REFRESH.

### 5.3.21 Zoom

The zoom function enlarges a selected area of the ultrasound image to full screen.

The zoom function is also available in cine mode.

- Press the **ZOOM** key, a zoom box is displayed on the image.
- Press the **SET** key, and move the trackball to move the zoom box position. Press the **SET** key again, and move the trackball to change the size of the zoom box.
- Press the **ZOOM** key to magnify the area enclosed in the zoom box.

## 5.4 B Cine Mode Operation



During the real time B mode scan, press the **FREEZE** key to freeze the image and start cine mode, or freeze mode. Recent image frame sequence will be cached and ready for review.

### Attention!

All measurements performed in the real time mode will be cleared upon pressing the **FREEZE** key.

The cine mode operation is independent of the display format (single, dual, quad).

CHROMA	LOOP SPEED	PLAY/STOP	PANORAMIC	2D REFRESH
--------	------------	-----------	-----------	------------

Figure 5.4: Function menu in B cine mode

Scroll the trackball fast forward to start playing the cine loop. Move the trackball backwards to stop the play-back.

Press the **MENU** knob and the cine mode menu (right) will appear at the context menu area (refer to **Figure 2.2**).

More cine mode operations are introduced in the following subsections.

GSC	3
CHROMA	1
LT↔RT	↔
PLAY/STOP	→
LOOP SPEED	↔
START	←
END	→
FRAME BY FRAME	....

### 5.4.1 Grayscale curve

#### GSC

- select GSC from the context menu.
- turn the **MENU** knob to adjust the GSC setting.

Refer to **Section 5.3.8** for explanations of this function.



### 5.4.2 Chroma

#### CHROMA

- press **[F1]** to select CHROMA.
- turn the function knob to change the CHROMA setting.

Refer to **Section 5.3.10**.

### 5.4.3 Image Orientation (Left/Right)

#### LT↔RT

Refer to **Section 5.3.15**.

### 5.4.4 Cine Review

#### CINE REVIEW

If the same patient has gone through the same diagnosis before, the saved images can be accessed conveniently from the cine mode menu.

- select CINE REVIEW from the context menu.
- turn the **[MENU]** knob to select the cine image for review from a list of cine images.
- press the **[SET]** key to start reviewing the selected image.

#### **Remarks:**

Press the **[FREEZE]** key to return to the real time scan immediately.

### 5.4.5 Select Image Sequence

Before starting the 3D mode or panoramic imaging, a range of image frames can be selected. The sequence is marked by a start marker and an end marker.

- Use the trackball to locate the start frame position and press the **[SET]** key.
- Use the trackball to locate the end frame position and press the **[SET]** key.

### 5.4.6 Panoramic Imaging

#### PANORAMIC

This function constructs an ultrasound image from a previous scan. The ultrasound image constructed in the panoramic imaging provides a larger range view compared to any single frame of image. Dual the scan for preparing the panoramic imaging, the transducer should be moving linearly.

- select a range of image frames (refer to **Section 5.4.5**), press **[F4]** to select PANORAMIC.
- turn the function knob to turn on or off the panoramic imaging.

### 5.4.7 Cine Playback

Cine playback operations can be performed through the cine mode context menu or the quick access menu. Items in the quick access menu can be selected by pressing the corresponding **[Fn]** keys. The cine context mode menu can be activated by pressing the **[MENU]** knob.

#### PLAY/STOP

Use the **[LEFT/RIGHT]** keys or turn the **[MENU]** knob to pause or start the playback. Alternatively, scroll the trackball horizontally fast forward to start playing the cine. Touch the trackball to stop the playback.

#### LOOP SPEED

Use the **[LEFT/RIGHT]** keys or turn the **[MENU]** knob to control the playback speed.

#### START

Press the **[LEFT]** key to move the frame marker to the start of the cine.

#### END

Press the **[RIGHT]** key to move the frame marker to the end of the cine.

#### FRAME BY FRAME

Press the **[LEFT/RIGHT]** keys to move the review the previous/next frame.

### 5.4.8 Saving Image/Cine

To save a frame as an image, press **[SAVE]** in cine mode and press **[1]**. Type in the file name and followed by the **[Enter]** key.

To save a cine sequence, mark the start and end positions of the sequence, press **[SAVE]** in cine mode and press **[2]**. Type in the file name and followed by the **[Enter]** key.

The files are saved in the patient folder if a valid patient profile (Refer to **Section 3.4.**) is active, and in the General Directory if no valid patient profile is active.

## 5.5 Dual and Quad Display Formats

The dual display and the quad display of ultrasound images facilitate the comparison of ultrasound images performed at the different time.

### 5.5.1 Dual Display Format

#### Frozen+Real Time Display Format



In the real time mode (B, CFM, PW/CW . . .), press the **[DUAL]** key to activate the dual display. The image is reduced to half of its original size and moved to the left to leave space for displaying the other image. Press the **[L/R]** key to freeze the current image and activate the display on the right.

Changing the imaging mode for the selected image is possible by pressing the corresponding key (**[B]**, **[CFM]**, **[DPI]**, . . .).

Use the **[L/R]** key to toggle between left and right for the real time display.

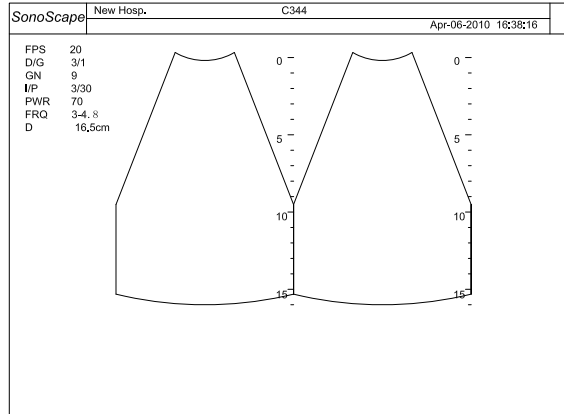


Figure 5.5: Dual display: real time B + frozen B

From **LT↔RT** in the context menu (accessed by pressing the **MENU** knob), change the left/right image orientation for the selected image.



Press the **U/D** key to alternate the up/down image orientation for the selected image.

**Dual Real Time Display Format**

Press the **DUAL** again key to:

- exit the dual display format, if within the dual display there is no color mode (CFM, or DPI, or TDI) image; or
- activate the *dual real time* display format, viz, *real time B + real time Color (CFM or DPI, or TDI)* display format, if within the dual display there is at least one color mode image.



The dual real time display format can also be activated by pressing the **DUAL** key twice at the real time color mode.

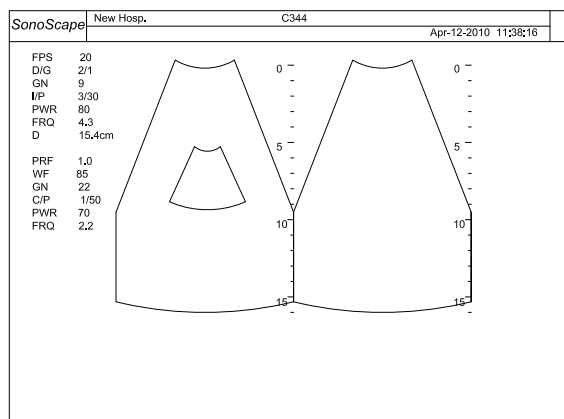


Figure 5.6: Dual display: real time CFM + frozen B

From **LT↔RT** in the context menu (accessed by pressing the **MENU** knob), change the left/right image orientations for both images.



Press the **U/D** key to alternate the up/down image orientation for both images.  
Press the **DUAL** key the third time to exit the dual color mode display.

### 5.5.2 Quad Display Format

In the real time B or color mode, press the 'numerical' **4** key at the keyboard to activate the quad display. The image is reduced to a quarter of its original size and moved to the top left to leave space for displaying other images.

Press the **L/R** key to freeze the current image and activate the display on the next quadrant (clockwise).

Changing the imaging mode for the selected image is possible by pressing the corresponding key (**B**, **CFM**, **DPI**, **TDI**).

From **LT↔RT** in the context menu (accessed by pressing the **MENU** knob), change the left/right image orientation for the selected image.



Press the **U/D** key to alternate the up/down image orientation for the selected image.

Press the 'numerical' **4** key again to exit the quad display.

## 5.6 Tissue Harmonic Imaging (THI)



Tissue reflects echoes with the received frequency (which is the 'fundamental frequency') as well as the harmonics. In THI mode, these harmonics are also picked up and analyzed.

THI gives better grayscale contrast compared to the standard B mode imaging, and also helps removing artifacts from the image. This imaging technique has been proved to be very useful for difficult-to-image patients.

Press the **THI** key to enable the THI mode, **THI** status appears at the lower left corner of the screen.

To disable the THI mode, press the **THI** key again.

#### Remarks:

- THI is available only for selected probes.
- The system automatically optimizes certain parameters (B mode gain and frequency, and acoustic output power) upon enabling THI.

# Chapter 6

## CFM Mode (Color Flow Mode)

In CFM mode, velocity information is represented as a color coded overlay on top of a 2D B mode image.

CFM can also work with other imaging modes to form duplex and triplex modes:

CFM+M (for phased array probes only)

CFM+PW/CW

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### 6.1 Starting CFM Mode



Press the **CFM** key to activate the CFM mode. The CFM sample box appears in the active 2D image.

Press the **B** key to deactivate the CFM mode, the system enters the B mode.

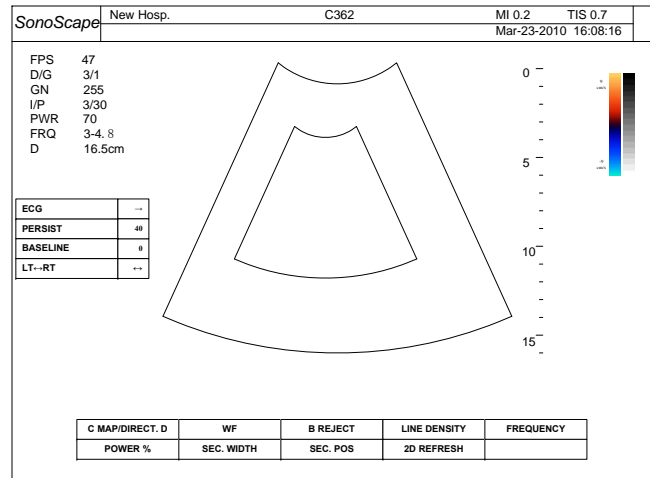


Figure 6.1: CFM mode

## 6.2 Color Image Information

The color image information for the CFM mode ultrasound is displayed at the Color Image Info area (refer to **Figure 2.2** for the location).

The meaning for the items shown in the info area are explained in the table below.

PRF	pulse repetition frequency
WF	wall filter value
GN	Doppler gain, D gain
C/P	Color Map setting / persistence value
PWR	acoustic output power (%)
FRQ	transmitted frequency (MHz)

<b>PRF</b>	<b>3.0</b>
<b>WF</b>	<b>185</b>
<b>GN</b>	<b>20</b>
<b>C/P</b>	<b>1/60</b>
<b>PWR</b>	<b>70</b>
<b>FRQ</b>	<b>5.1</b>

## 6.3 Real Time CFM Mode Operation

The CFM mode operation for the current ultrasound image is independent of the display format (single, dual or quad). Review **Section 3.3** for the general operation instructions.

### 6.3.1 CFM Menus

#### Real Time CFM Mode Function Menu

The following function menu appears on the screen with the real time CFM mode.

C MAP/DIRECT. D	WF	B REJECT	LINE DENSITY	FREQUENCY
POWER %	SEC. WIDTH	SEC. POS	2D REFRESH	

Figure 6.2: Function menu in real time CFM mode

**Real Time CFM Mode Context Menu**



Press the **MENU** key to activate the CFM mode menu which will appear at the Context Menu area (refer to **Figure 2.2**).

Press the **MENU** knob again to dismiss the CFM mode context menu.

ECG	→
PERSIST	40
BASELINE	0
LT↔RT	↔

**Figure 6.3:** Real time CFM mode context menu

**6.3.2 Adjust CFM Sample Box**

Follow the instructions below to adjust the sample box.

- Use the trackball to change the position of the sample box.
- Press the **SET** key. Use the trackball to change size of the sample box.
- Press the **SET** key again to re-adjust the position of the sample box.

**6.3.3 Pulse Repetition Frequency**



The Pulse Repetition Frequency sets the velocity range of the color flow display.

The range of the PRF depends on the probe and the application mode. Increasing the PRF range also changes the velocity scale shown on color wedge.

Flip the **PRF** switch up/down to increase/decrease the PRF range.

**Remarks:**

- The current PRF value is display at the Color Image Info area (PRF).
- The system automatically adjusts the Wall Filter setting upon changing the PRF value.

**6.3.4 Wall Filter**

Wall Filter intends to eliminate the low frequency noise generated by movements of blood vessel walls.

- press **F2** to select WF.
- turn the function knob to change the value of the filter.

**Remarks:**

- The current Wall Filter value is displayed at the Color Image Info area (WF).
- The Wall Filter is adjustable within a range which depends on the current PRF value.

**6.3.5 CFM Gain**



Properly adjust the CFM gain (or Doppler gain) to ensure that the color flow is continuous but no color speckle is present.

Turn the **D GAIN** knob clockwise / counterclockwise to increase / decrease the CFM gain.

**Remarks:**

- The CFM gain value is displayed on the screen at the Color Image Info area (GN).
- It is possible to change the CFM Gain only when the CFM mode is active.

### 6.3.6 Persistence

**PERSIST**

Similar to the persistence in the B mode, adjust the persistence value to enhance the smoothness of the color image.

- select PERSIST from the context menu.
- turn the **MENU** knob to adjust the PERSIST setting.

**Remark:**

- The persistence value is displayed on the screen at the Color Image Info area (the P in C/P).

### 6.3.7 Color Map

**C MAP**

Use this function to select the method for the color coding of blood flows.

- press **F1** to select C MAP.
- turn the function knob to adjust the CHROMA setting.

**Remark:**

- The Color Map method is displayed on the screen at the Color Image Info area (the C in C/P).

### 6.3.8 CFM Power

**POWER %**

Similar to the acoustic output power in the B mode, the value of the output power in the CFM mode should be kept as low as reasonably achievable.

- press **F1** to select POWER %.
- turn the function knob to change the output power.



 **Remark:**

- The acoustic output power in the CFM mode is displayed on the screen at the Color Image Info area (PWR).

### 6.3.9 Baseline

#### BASELINE

Shifting the baseline increases the velocity range in one direction, the zero position also moves as a result. The maximum velocities in both directions are displayed at the ends of the Spectral Wedge (15, **Figure 2.2**).

- Flip the **BASELINE** button to shift the baseline up or down to shift the baseline; or
- Select BASELINE from the context menu, turn the **MENU** knob to shift the baseline.

### 6.3.10 Sector Width and Position

#### SEC.WIDTH

- press **F2** to select SEC.WIDTH.
- turn the function knob to change the sector width.

#### SEC.POS

- press **F3** to select SEC.POS.
- turn the function knob to change the sector position.

Sector width and position are the same as those in the B mode, refer to **Section 5.3.11** for explanations.

### 6.3.11 B Reject

#### B REJECT

Sets the display priorities of the color and 2D grayscale pixels. Larger B Reject value suppresses more grayscale pixels.

- press **F3** to select B REJECT.
- turn the function knob to change the B REJECT value.

### 6.3.12 CFM Frequency

#### FREQUENCY

The CFM mode frequency controls the transmit frequency.

Higher frequency delivers better display of low flow velocities, but the penetration depth is reduced.

Lower frequency delivers better display of high flow velocities, but the penetration depth is increased.

- press **F5** to select FREQUENCY.
- turn the function knob to change the frequency.

 **Remark:**

- The CFM frequency value is displayed on the screen at the Color Image Info area (FRQ).

### 6.3.13 Image Orientation (Left/Right)

#### LT↔RT

Refer to **Section 5.3.15**.

### 6.3.14 Flow Invert

#### FLOW INVERT

Similar to the Video Invert function in the M mode which inverts the grayscale display, the Flow Invert in CFM mode inverts the color display in relation to the direction of flow. The Spectral Wedge also inverts around the baseline.

The Flow Invert setting is adjustable in the real time mode as well as the freeze mode.

- press the Flow Invert (**Finv**) key to turn On/Off the Flow Invert function.
  - when Off: RED for flow to the transducer; BLUE for flow away from the transducer.
  - when On: BLUE for flow to the transducer; RED for flow away from the transducer.

### 6.3.15 Line Density

#### LINE DENSITY

This function determines the line density within the CFM sample box. Lower line density makes the color pixels larger. Line density in CFM mode can be set to Low or High.

- press **F4** to select LINE DENSITY.
- turn the function knob to change the LINE DENSITY setting.

### 6.3.16 2D Refresh

#### 2D REFRESH

If this option is left on, the 2D color Doppler image will be active during the Color Doppler+PW/CW and the Color Doppler+M modes.

- press **F4** to select 2D REFRESH.
- turn the function knob to turn on or off 2D REFRESH.

## 6.4 CFM Cine Mode



Press the **FREEZE** key during the real time CFM scan to freeze the image and start the cine mode. Recent image frames are cached and ready for review.

## △ Attention!

All measurements performed in the real time mode will be cleared upon pressing the **FREEZE** key.

The cine mode operation is independent of the display format (single, dual, quad).

C MAP/DIRECT. D	LOOP SPEED	PLAY/STOP	B REJECT	CINE REVIEW
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Figure 6.4: Function menu in CFM cine mode

Move the trackball fast forward to start playing the cine loop. Touch the trackball to stop the playback. Press the **MENU** knob and the cine mode menu (right) will appear at the context menu area (refer to Figure 2.2).

C MAP	3
B REJECT	254
LOOP SPEED	↔
START	←
END	→
FRAME BY FRAME	....

Figure 6.5: CFM cine mode context menu

More cine mode operations are introduced in the following subsections.

### 6.4.1 C Map

#### C MAP

Refer to **Section 6.3.7** for explanations of this function. To change the C MAP setting,

- press **F1** to select C MAP, turn the function knob to change the C MAP setting; or
- select C MAP from the context menu, turn the **MENU** knob to change the C MAP setting.

### 6.4.2 B Reject

#### B REJECT

Refer to **Section 6.3.11** for explanations of this function.

- press **F4** to select B REJECT, turn the function knob to change the B REJECT setting; or
- select B REJECT from the context menu, turn the **MENU** knob to change the B REJECT setting.

### 6.4.3 Flow Invert

#### FLOW INVERT

Refer to **Section 6.3.14** for explanations and usage of this function.

## 6.4.4 Cine Review

### CINE REVIEW

If the same patient has gone through the same diagnosis before, the saved images can be accessed conveniently from the cine mode menu.

- Press **F5** to select CINE REVIEW
- turn the function knob to select the cine image for review from a list of cine images.
- press the **SET** key to start reviewing the selected image.

### Remarks:

Press the **FREEZE** key to return to the real time scan immediately.

## 6.4.5 Cine Playback

LOOP SPEED

START

END

FRAME BY FRAME

Refer to **Section 5.4.7**.

## Chapter 7

# DPI Mode (Doppler Power Imaging)

Doppler Power Imaging (DPI) mode is especially useful in displaying very low flow velocities.

DPI can also work with other imaging modes to form duplex and triplex modes.

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### 7.1 Starting DPI Mode



Press the **[DPI]** key to activate the DPI mode. The DPI sample box appears in the active 2D image.

Press the **[B]** key to deactivate the DPI mode, the system enters the B mode.

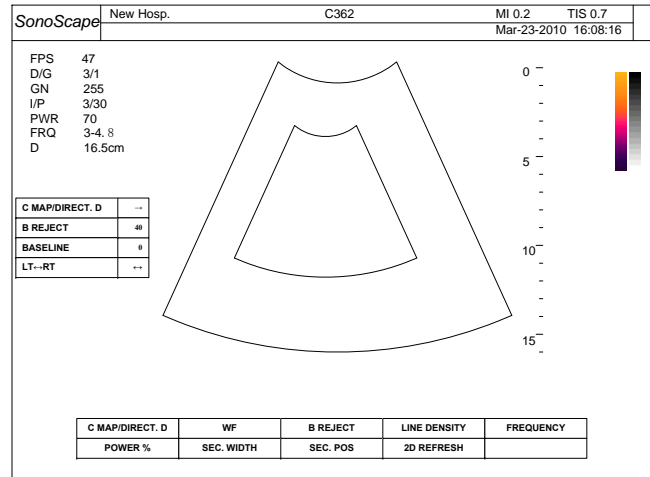


Figure 7.1: DPI mode

## 7.2 DPI Image Information

The DPI image information is displayed at the Color Image Info area (10, in **Figure 2.2**).

The meaning for the items shown in the info area are explained in the table below.

PRF	pulse repetition frequency
WF	wall filter value
GN	Doppler gain, D gain
C/P	Color Map setting / persistence value
PWR	acoustic output power (%)
FRQ	transmitted frequency (MHz)

<b>PRF</b>	<b>1.0</b>
<b>WF</b>	<b>75</b>
<b>GN</b>	<b>20</b>
<b>C/P</b>	<b>1/60</b>
<b>PWR</b>	<b>70</b>
<b>FRQ</b>	<b>6.0</b>

## 7.3 Real Time DPI Mode Operation

The DPI mode operation for the current ultrasound image is independent of the display format (single, dual or quad). Review **Section 3.3** for the general operation instructions.

### 7.3.1 DPI Menus

#### Function Menu

The following function menu appears on the screen with the real time DPI mode.

C MAP/DIRECT. D	WF	B REJECT	LINE DENSITY	FREQUENCY
POWER %	SEC. WIDTH	SEC. POS	2D REFRESH	

Figure 7.2: Function menu in real time DPI mode

#### Real Time DPI Mode Context Menu



Press the **MENU** key during the real time DPI scan to activate the DPI mode menu which will appear at the Context Menu area (refer to **Figure 2.2**).

Press the **MENU** knob again to dismiss the DPI mode context menu.

ECG	→
PERSIST	60
LT↔RT	↔

**Figure 7.3:** Real time DPI mode menu

### 7.3.2 Adjust DPI Sample Box

Follow the instructions below to adjust the sample box.

- Use the trackball to change the position of the sample box.
- Press the **SET** key. Use the trackball to change size of the sample box.
- Press the **SET** key again to re-adjust the position of the sample box.

### 7.3.3 Pulse Repetition Frequency



The Pulse Repetition Frequency sets the velocity range of the color flow display. The range of the PRF depends on the probe and the application mode. Increasing the PRF range also changes the velocity scale shown on color wedge.

Flip the **PRF** switch up/down to increase/decrease the PRF range.

**Remarks:**

- The current PRF value is display at the Color Image Info area (PRF).
- The system automatically adjusts the Wall Filter setting upon changing the PRF value.

### 7.3.4 Wall Filter

Wall Filter intends to eliminate the low frequency noise generated by movements of blood vessel walls.

- press **F2** to select WF.
- turn the function knob to change the value of the filter.

**Remarks:**

- The current Wall Filter value is displayed at the Color Image Info area (WF).
- The Wall Filter is adjustable within a range which depends on the current PRF value.

### 7.3.5 DPI Gain



Properly adjust the DPI gain to ensure that the color flow is continuous but no color speckle is present.

Turn the **D GAIN** knob clockwise / counterclockwise to increase / decrease the CFM gain.

**Remarks:**

- The DPI gain value is displayed on the screen at the Color Image Info area (GN).
- It is possible to change the DPI Gain only when the DPI mode is active.

### 7.3.6 Persistence

#### PERSIST

Similar to the persistence in the B mode, adjust the persistence value to enhance the smoothness of the DPI image.

- Select PERSIST from the context menu.
- Turn the **MENU** knob to decrease/increase persistence value.

**Remark:**

- The persistence value is displayed on the screen at the Color Image Info area (the P in C/P).

### 7.3.7 Color Map & Directional DPI

#### C MAP/DIRECT.D

- press **F1** to select C MAP/DIRECT.D.
- turn the function knob to change the value.

Set this value to 1, 2, or 4 to adjust the Color Map setting. Similar to the Color Map in the CFM mode, this function select the method for the color-coding of the display of blood flow.

#### Directional DPI

Set this value to 3 to enable Directional DPI (only possible during the real time scan). When Directional DPI is enabled, the above indicator is displayed on the screen.

**Remark:**

- Note that enabling Directional DPI is only possible during the real time DPI scan.
- Adjusting Color Map setting is also possible in the freeze mode.

Directional DPI displays the direction of flow while in Doppler Power Imaging. This function is very useful when there is requirements in applications where sensitivity and directional information are both required. Red represents flow toward the transducer; Blue represents flow away from the transducer.



### 7.3.8 DPI Power

#### POWER %

Similar to the acoustic output power in the B mode, the value of the output power in the DPI mode should be kept as low as reasonably achievable.

- press **[F1]** to select POWER %.
- turn the function knob to change the value.

#### Remark:

- The acoustic output power in the DPI mode is displayed on the screen at the Color Image Info area (PWR).

### 7.3.9 Sector Width and Position

#### SEC.WIDTH

- press **[F2]** to select SEC.WIDTH.
- turn the function knob to change the sector width.

#### SEC.POS

- press **[F3]** to select SEC.POS.
- turn the function knob to change the sector position.

Sector width and position are the same as those in the B mode, refer to **Section 5.3.11** for explanations.

### 7.3.10 B Reject

#### B REJECT

Sets the display priorities of the color and 2D grayscale pixels. Larger B Reject value suppresses more grayscale pixels.

- press **[F3]** to select B REJECT.
- turn the function knob to change the B REJECT value.

### 7.3.11 DPI Frequency

#### FREQUENCY

Similar to the CFM frequency, higher DPI frequency delivers better display of low flow velocities, but the penetration depth is reduced. Lower DPI frequency delivers better display of high flow velocities, but the penetration depth is increased.

- press **[F5]** to select FREQUENCY.

- turn the function knob to change the frequency.

 **Remark:**

- The DPI frequency value is displayed on the screen at the Color Image Info area (FRQ).

### 7.3.12 Image Orientation (Left/Right)

**LT↔RT**

Refer to **Section 5.3.15**.

### 7.3.13 Line Density

**LINE DENSITY**

This function, similar to the Line Density in CFM mode, adjusts the line density in displaying the flow in the DPI sample box. Line density can be set to Low or High.

- press **[F4]** to select LINE DENSITY.
- turn the function knob to change the LINE DENSITY setting.

### 7.3.14 2D Refresh

**2D REFRESH**

If this option is left on, the 2D color Doppler image will be active during the Color Doppler+PW/CW and the Color Doppler+M modes.

- press **[F4]** to select 2D REFRESH.
- turn the function knob to turn on or off 2D REFRESH.

## 7.4 DPI Cine Mode Operation



Press the **[FREEZE]** key during the real time DPI scan to freeze the image and start the cine mode. Recent image frames are cached and ready for review.

### **Attention!**

All measurements performed in the real time mode will be cleared upon pressing the **[FREEZE]** key.

The cine mode operation is independent of the display format (single, dual, quad).

C MAP/DIRECT.D	LOOP SPEED	PLAY/STOP	B REJECT	CINE REVIEW
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**Figure 7.4:** Function menu in DPI cine mode

Move the trackball fast forward to start playing the cine loop. Touch the trackball to stop the playback. Press the **MENU** knob and the cine mode menu (right) will appear at the context menu area (refer to **Figure 2.2**).

C MAP/DIRECT.D	1
B REJECT	255
LOOP SPEED	↔
START	←
END	→
FRAME BY FRAME	....

**Figure 7.5:** DPI cine mode menu

More cine mode operations are introduced in the following subsections.

### 7.4.1 Color Map

#### C MAP/DIRECT.D

Also refer to **Section 7.3.7**.

- Press **F1** to select C MAP/DIRECT.D, turn the function knob to change the color map setting; or
- select C MAP/DIRECT.D from the context menu, turn the **MENU** knob to change the color map setting.

### 7.4.2 B Reject

#### B REJECT

Also refer to **Section 7.3.10**.

- Press **F4** to select B REJECT.
- Turn the function knob to change the B REJECT value.

### 7.4.3 Cine Playback

#### LOOP SPEED

#### START

#### END

#### FRAME BY FRAME

Refer to **Section 5.4.7**.



## Chapter 8

# TDI Mode (Tissue Doppler Imaging)

Tissue Doppler Imaging (TDI) captures the wall motion of vessels and creates a color image displaying the tissue motion. TDI is a cardiology technique, so it can only be used in cardiology application modes.

Like conventional Doppler mode, TDI also uses Doppler principle. However, in TDI mode high amplitude (high intensity), low frequency tissue motion is quantified. In contrast, in the conventional Doppler mode low amplitude (low intensity), high frequency blood motion is quantified.

TDI can also work with other imaging modes to form duplex and triplex modes.

### **Attention!**

Only phased array probes (2P1) are TDI capable.

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## 8.1 Starting TDI Mode



To activate the TDI mode, press the **TDI** key or the **T** key on the alphanumeric keyboard. The TDI sample box appears in the active 2D image.

Press the **B** key to deactivate the TDI mode, the system enters the B mode.

## 8.2 TDI Image Information

The color image information for the TDI mode ultrasound is displayed at the Color Image Info area (refer to **Figure 2.2** for the location).

The meaning for the items shown in the info area are explained in the table below.

PRF	pulse repetition frequency
WF	wall filter value
GN	Doppler gain, D gain
C/P	Color Map setting / persistence value
PWR	acoustic output power (%)
FRQ	transmitted frequency (MHz)

<b>PRF</b>	<b>1.0</b>
<b>WF</b>	<b>75</b>
<b>GN</b>	<b>20</b>
<b>C/P</b>	<b>1/60</b>
<b>PWR</b>	<b>70</b>
<b>FRQ</b>	<b>2.6</b>

## 8.3 TDI Mode Operation

The TDI mode operation for the current ultrasound image is independent of the display format (single, dual or quad). TDI mode parameters and settings can be adjusted through the TDI mode menu or directly using the knobs / flip switches.

### 8.3.1 Real Time TDI Mode Menus

#### Real Time CFM Mode Function Menu

The following function menu appears on the screen with the real time TDI mode.

<b>C MAP/DIRECT. D</b>	<b>WF</b>	<b>B REJECT</b>	<b>LINE DENSITY</b>	<b>FREQUENCY</b>
<b>POWER %</b>	<b>SEC. WIDTH</b>	<b>SEC. POS</b>	<b>2D REFRESH</b>	

**Figure 8.1:** Function menu in real time TDI mode

#### Real Time TDI Mode Context Menu



Press the **MENU** key to activate the TDI mode menu which will appear at the Context Menu area (refer to **Figure 2.2**).  
Press the **MENU** knob again to dismiss the TDI mode context menu.

ECG	→
PERSIST	40
BASELINE	0
LT↔RT	↔

**Figure 8.2:** TDI mode menu

### 8.3.2 Adjust TDI Sample Box

Follow the instructions below to adjust the sample box.

- Use the trackball to change the position of the sample box.
- Press the **SET** key. Use the trackball to change size of the sample box.
- Press the **SET** key again to re-adjust the position of the sample box.

### 8.3.3 Pulse Repetition Frequency



The Pulse Repetition Frequency sets the velocity range of the display.  
The range of the PRF depends on the probe and the application mode. Increasing the PRF range also changes the velocity scale shown on color wedge.

Flip the **PRF** switch up/down to increase/decrease the PRF range.

 **Remarks:**

- The current PRF value is display at the Color Image Info area (PRF).
- The system automatically adjusts the Wall Filter setting upon changing the PRF value.

### 8.3.4 Wall Filter



Wall Filter should be adjusted to remove the random color speckle but also keep the enough amount of color display.

**FILTER** press **F2** to select WF.

- turn the function knob to change the value of the filter.

 **Remarks:**

- The current Wall Filter value is display at the Color Image Info area (WF).
- The Wall Filter is adjustable within a range which depends on the current PRF value.

### 8.3.5 TDI Gain



Properly adjust the TDI gain to ensure that the color flow is continuous but no color speckle is present.

Turn the **D GAIN** knob clockwise / counterclockwise to increase / decrease the TDI gain.

#### **Remarks:**

- The TDI gain value is displayed on the screen at the Color Image Info area (GN).
- It is possible to change the TDI Gain only when the TDI mode is active.

### 8.3.6 Persistence

#### **PERSIST**

Similar to the persistence in the B mode, adjust the persistence value to enhance the smoothness of the color image.

- select PERSIST from the context menu.
- turn the **MENU** knob to adjust the PERSIST setting.

#### **Remark:**

- The persistence value is displayed on the screen at the Color Image Info area (the P in C/P).

### 8.3.7 Color Map

#### **C MAP**

Similar to the Color Map in the CFM mode, this function select the method for the color-coding of the display of color flow.

- press **F1** to select C MAP.
- turn the function knob to adjust the CHROMA setting.

#### **Remark:**

- The Color Map method is displayed on the screen at the Color Image Info area (the C in C/P).

### 8.3.8 TDI Power

#### **POWER %**

Similar to the acoustic output power in the B mode, the value of the output power in the TDI mode should be kept as low as reasonably achievable.



- press **[F1]** to select POWER %.
- turn the function knob to change the output power.

 **Remark:**

- The acoustic output power in the TDI mode is displayed on the screen at the Color Image Info area (PWR).

### 8.3.9 Baseline

#### BASELINE

Shifting the baseline increases the velocity range in one direction, the zero position also moves as a result. The maximum velocities in both directions are displayed at the ends of the Spectral Wedge (15, **Figure 2.2**).

- Flip the **BASELINE** button to shift the baseline up or down to shift the baseline; or
- Select BASELINE from the context menu, turn the **[MENU]** knob to shift the baseline.

### 8.3.10 Sector Width and Position

#### SEC.WIDTH

- press **[F2]** to select SEC.WIDTH.
- turn the function knob to change the sector width.

#### SEC.POS

- press **[F3]** to select SEC.POS.
- turn the function knob to change the sector position.

Sector width and position are the same as those in the B mode, refer to **Section 5.3.11** for explanations.

### 8.3.11 B Reject

#### B REJECT

Sets the display priorities of the color and 2D grayscale pixels. Larger B Reject value suppresses more grayscale pixels.

The B Reject value is adjustable in the real time mode as well as the freeze mode.

- go to the context menu, highlight B REJECT.
- use the **LEFT/RIGHT** keys to adjust the B Reject value.

### 8.3.12 TDI Frequency

#### FREQUENCY

The TDI mode frequency controls the transmit frequency.

Higher frequency delivers better display of low flow velocities, but the penetration depth is reduced.

Lower frequency delivers better display of high flow velocities, but the penetration depth is increased.

- Press **F5** to select FREQUENCY.
- Turn the function knob to change the frequency.

#### Remark:

- The TDI frequency value is displayed on the screen at the Color Image Info area (FRQ).

### 8.3.13 Image Orientation (Left/Right)

#### LT↔RT

Refer to **Section 5.3.15**.

### 8.3.14 Flow Invert

#### FLOW INVERT

The Flow Invert in TDI mode inverts the color display in relation to the direction of flow. The Spectral Wedge also inverts around the baseline.

- press the Flow Invert (**Finv**) key to turn On/Off the Flow Invert function.
  - when Off: RED for flow to the transducer; BLUE for flow away from the transducer.
  - when On: BLUE for flow to the transducer; RED for flow away from the transducer.

### 8.3.15 Line Density

#### LINE DENSITY

This function determines the line density within the TDI sample box. Lower line density makes the color pixels larger. Line density in TDI mode can be set to Low or High.

- press **F4** to select LINE DENSITY.
- turn the function knob to change the LINE DENSITY setting.

### 8.3.16 2D Refresh

#### 2D REFRESH

If this option is left on, the 2D color Doppler image will be active during the Color Doppler+PW/CW and the Color Doppler+M modes.

- press **[F4]** to select 2D REFRESH.
- turn the function knob to turn on or off 2D REFRESH.

## 8.4 Cine Mode Operation



Press the **[FREEZE]** key during the real time TDI scan to freeze the image and start the cine mode. Recent image frames are cached and ready for review.

The cine mode operation is independent of the display format (single, dual, quad).

C MAP/DIRECT. D	LOOP SPEED	PLAY/STOP	B REJECT	CINE REVIEW
-----------------	------------	-----------	----------	-------------

Figure 8.3: Function menu in TDI cine mode

#### Cine Mode Operation

Move the trackball fast forward to start playing the cine loop. Touch the trackball to stop the playback.

Press the **[MENU]** knob and the cine mode context menu (right) appears.

More cine mode operations are introduced in the following subsections.

C MAP	3
B REJECT	254
LOOP SPEED	↔
START	←
END	→
FRAME BY FRAME	....

Figure 8.4: TDI cine mode context menu

### 8.4.1 C Map

#### C MAP

Refer to **Section 6.3.7** for explanations of this function. To change the C MAP setting,

- press **[F1]** to select C MAP, turn the function knob to change the C MAP setting; or
- select C MAP from the context menu, turn the **[MENU]** knob to change the C MAP setting.

### 8.4.2 B Reject

#### B REJECT

Refer to **Section 6.3.11** for explanations of this function.

- press **[F4]** to select B REJECT, turn the function knob to change the B REJECT setting; or
- select B REJECT from the context menu, turn the **[MENU]** knob to change the B REJECT setting.

### 8.4.3 Flow Invert

#### FLOW INVERT

Refer to **Section 6.3.14** for explanations and usage of this function.

### 8.4.4 Cine Review

#### CINE REVIEW

If the same patient has gone through the same diagnosis before, the saved images can be accessed conveniently from the cine mode menu.

- Press **[F5]** to select CINE REVIEW
- turn the function knob to select the cine image for review from a list of cine images.
- press the **[SET]** key to start reviewing the selected image.

#### **Remarks:**

Press the **[FREEZE]** key to return to the real time scan immediately.

### 8.4.5 Cine Playback

#### LOOP SPEED

#### START

#### END

#### FRAME BY FRAME

Refer to **Section 5.4.7**.

# Chapter 9

## M Mode

M mode can only be used with the B, CFM, or TDI mode to form the B+M, CFM+M, TDI+M duplex mode.

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### 9.1 Starting M Mode



Press the **M** mode key during the real time scan with B/CFM/TDI mode to activate the B+M/CFM+M/TDI+M duplex mode.

Only phased array probes (2P1) support CFM+M and TDI+M modes.

Press the **M** mode key again to deactivate the M mode.

Initially the M mode cursor line (a straight line across the ultrasound image) is inserted at the center of the 2D ultrasound image. The M mode trace (**Figure 9.1**) will not be active until the **UPDATE** key is pressed.

Real time M-duplex mode operations are explained in **Section 9.2** and **Section 9.3**.

M-duplex cine mode operations are explained in **Section 9.4**.

### 9.2 M Mode Operation, M Trace Inactive

**Before the M mode trace is active**, the system virtually works at B/CFM/TDI/... mode. The items in the function menu and the context menu are identical (except for B+M mode) to those with the single B/CFM/TDI/... mode.

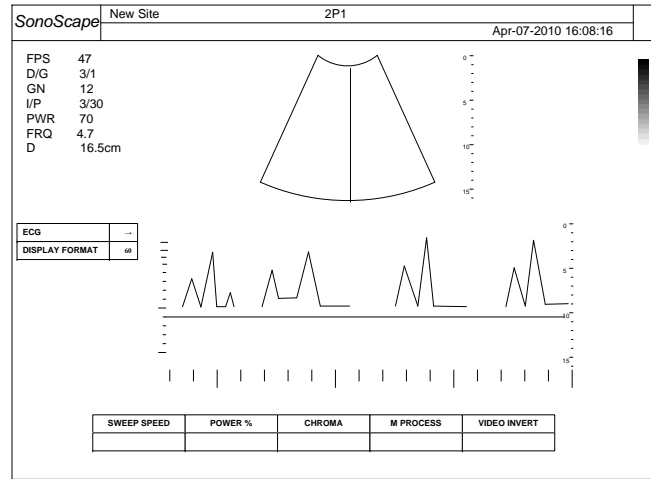


Figure 9.1: B+M duplex mode with the M trace updating

In B+M duplex mode, before the M trace is active, the function menu is shown as in **Figure 9.2**.

FOCAL NUMBER	FOCAL SPAN	DYN	GSC	PERSIST
LINE DENSITY	FREQUENCY	SEC.WIDTH	SEC.POS	2D REFRESH

Figure 9.2: B mode function menu in B+M duplex mode (with M trace inactive)



Press the **MENU** knob to activate the context menu (right).

The B menus in the B+M duplex mode is shown above and on the right.

Except for the item STEER M and DISPLAY FORMAT, which are specific for the M-duplex mode, all other items has the same meaning as in single B/CFM/TDI mode. Refer to the respective chapters for explanations and usage of these items.

ECG	→
CHROMA	1
UP↓DOWN	Off
LT↔RT	↔
POWER %	60
STEER M	Off
DISPLAY FORMAT	V1/2

Figure 9.3: B menu in B+M duplex mode

### 9.2.1 Adjust M Mode Cursor Line

Move the trackball to change the M mode cursor position.

#### STEER M

This function is only available in B+M duplex mode.

With this function, multiple M mode cursor lines can be inserted into the 2D image. Follow instructions below to add additional M cursor lines.

- Press the **MENU** knob to activate the context menu shown on page 9-2.
- Use the trackball to select STEER M, turn the **MENU** knob to change the number of M mode cursor lines.
- Turn off the display of the context menu by pressing the **MENU** knob again.
- Use the trackball to change the M cursor position.

- Press the **LEFT/RIGHT** keys or use the **ANGLE** knob to change the angle of the M mode cursor.
- If multiple M cursors are present, press the **SET** key to select the next M cursor. The currently selected M cursor is highlighted in cyan.

 **Remarks:**

- The STEER M function is primarily for cardiology application and may be disabled in other application modes.
- If multiple M cursors are present, only the last selected M cursor (in cyan) will be active upon activating the CFM+M/TDI+M duplex mode.

### 9.3 M Mode Operation, M Trace Active



Press the **UPDATE** key to let the M mode trace update. Some M mode parameters (right) are displayed at the M Mode Info area.  
Press the **UPDATE** key again to stop updating the M mode trace.

<b>MPR</b>	<b>PEK</b>
<b>SR</b>	<b>4</b>
<b>GN</b>	<b>200</b>
<b>PWR</b>	<b>85</b>

When the M trace is active, the function menu is shown as in **Figure 9.4**.

<b>SWEEP SPEED</b>	<b>POWER %</b>	<b>CHROMA</b>	<b>M PROCESS</b>	<b>VIDEO INVERT</b>

**Figure 9.4:** Function menu in M-duplex mode (with M trace active)



Press the **MENU** knob to activate the M mode menu (right).  
The following subsections provide instructions for the M mode operation while the M trace is active.

<b>ECG</b>	<b>→</b>
<b>DISPLAY FORMAT</b>	<b>60</b>

#### 9.3.1 M Gain

Only when the M trace is updating can the M mode gain be changed. Note that the M gain is different from the B mode (2D) gain.

The M gain controls the overall brightness of the M trace, it determines how much the amplification of the echoes is.

Turn the **GAIN** knob to adjust the M gain.

 **Remark:**

- The M gain value is shown at the M Mode Image Info area (the **GN**).

### 9.3.2 Sweep Speed

#### SWEEP SPEED

Use this function to adjust the speed of sweeping in the M mode. The larger the sweep speed is set, the faster the M trace is updating.

- Press **F1** to select SWEEP SPEED.
- Turn the function knob to change the sweep speed.

#### Remark:

- The current sweep speed value is shown at the M Mode Image Info area (the **SR**).

### 9.3.3 Power

#### POWER %

The POWER represents the acoustic output power, it is identical to that in the B mode.

- Press **F2** to select POWER %.
- Turn the function knob to change the acoustic output.

#### Remarks:

- The current acoustic output power is shown at the M Mode Image Info area (the **PWR**).
- Note that the **PWR** shown at the 2D Image Info area will not be updated until the **UPDATE** key is pressed again.

### 9.3.4 Chroma

#### CHROMA

Similar to the chroma setting in the B mode, this function gives the effect of changing the M trace color.

- Press **F3** to select CHROMA.
- Turn the function knob to change the chroma setting.

### 9.3.5 M Process

#### M PROCESS

This function changes the methods for detection processing for the M trace display.

- Press **F4** to select M PROCESS.
- Turn the function knob to change the method for the M process to **AVE** (average) or **PEK** (peak).

#### Remarks:

The current M PROCESS setting is shown at the M Mode Image Info area (the **MPR**).



### 9.3.6 Video Invert

#### VIDEO INVERT

This function inverts the M trace display in relation to brightness. In the black/white M trace display, black and white will be swapped upon setting Video Invert to On.

- Press **[F5]** to select VIDEO INVERT.
- Turn the function knob to turn on or off this function.

### 9.3.7 Display Format

#### DISPLAY FORMAT

Use this function to change the layout of the B+M mode ultrasound image.

Select DISPLAY FORMAT from the context menu, and use the **[MENU]** knob to change the display format for M-duplex mode. Six display formats are possible, refer to **Figure 9.5** on page 9-5 for the illustrations of different display formats.

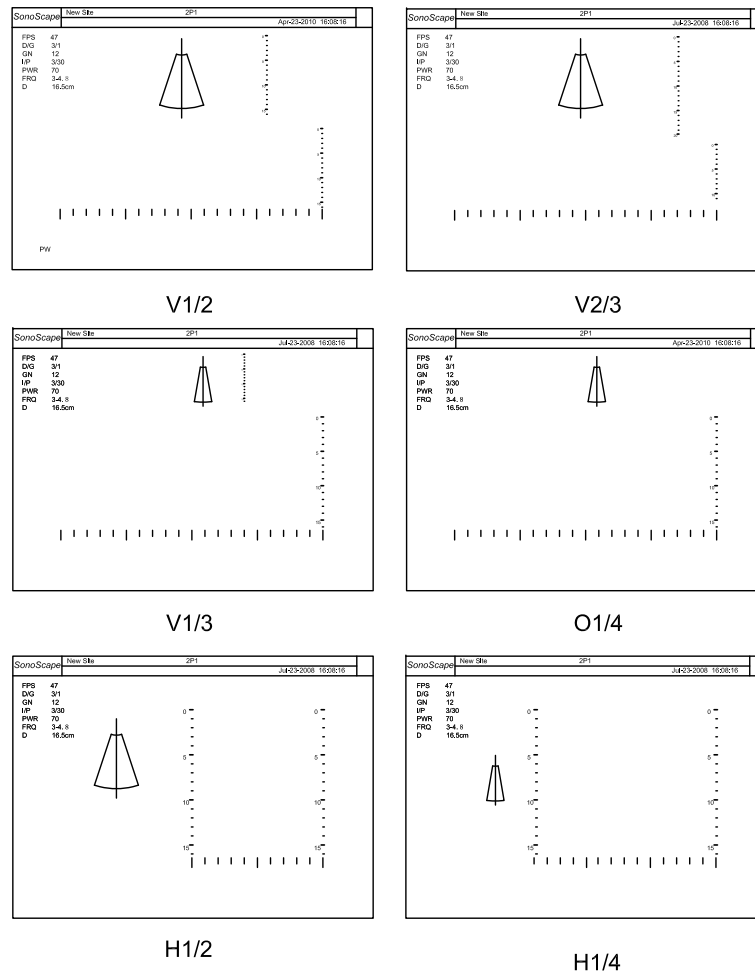


Figure 9.5: Display formats in the M/PW/CW mode

## 9.4 Cine Mode Operation



Press the **FREEZE** key during the real time scan with the M-duplex mode to start the M cine mode.

**Remark:**

- When the M trace is inactive, pressing the **FREEZE** key activates the cine mode. Refer to the respective chapters for the single cine mode operations.

The following figure shows the function menu in the M-duplex cine mode with M trace active.

CHROMA	VIDEO INVERT	START	END	CINE REVIEW
--------	--------------	-------	-----	-------------

**Figure 9.6:** M-duplex cine mode (with M trace active) function menu



When the M trace is active, press the **MENU** knob to activate the M cine mode context menu (right). Refer to the respective sections listed below for the M cine mode operation.

CHROMA	1
VIDEO INVERT	Off
DISPLAY FORMAT	V1/2
START	←
END	→
FRAME BY FRAME	....

**CHROMA** Refer to **Section 9.3.4** for explanations.

- Press **F1** to select CHROMA, turn the function knob to change the chroma setting; or
- Select CHROMA from the context menu, turn the **MENU** knob to change the chroma setting.

**VIDEO INVERT** Refer to **Section 9.3.6** for explanations.

- Press **F2** to select VIDEO INVERT, turn the function knob to turn on or off this function; or
- Select VIDEO INVERT from the context menu, turn the **MENU** knob to turn on or off this function.

**DISPLAY FORMAT** Refer to **Section 9.3.7** for explanations and usage.

**Cine Playback Operations**

- START**
- END**
- FRAME BY FRAME**

Refer to **Section 5.4.7** for explanations and usage.

# Chapter 10

## Spectral Doppler Mode

Pulsed Wave Doppler (PW) and Continuous Wave Doppler (CW) are collectively called Spectral Doppler mode.

PW Doppler lets you examine blood flow data selectively from a small region called the *sample volume*. The sample volume is covered by the *sample volume gate* which is located on the *Spectral Doppler cursor*. A short line across the sample volume is called the *flow direction cursor*. This cursor line should be aligned to the blood flow direction when measuring the flow velocity.

CW Doppler examines the flow data all along the Doppler cursor rather than a small region.

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## 10.1 Activation of Spectral Doppler Mode

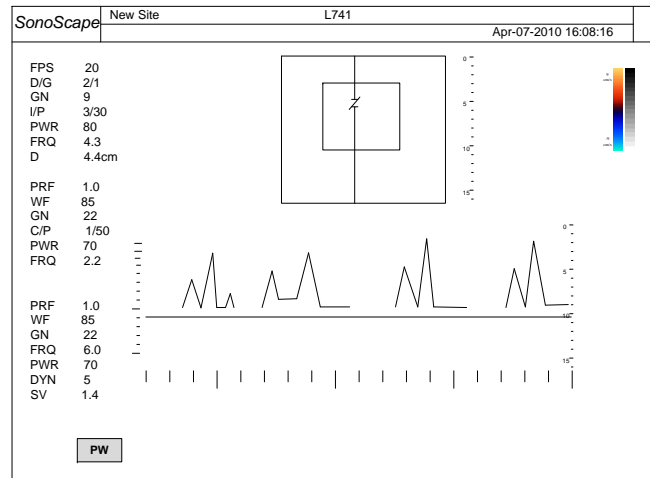


Figure 10.1: CFM+PW duplex mode

Spectral Doppler Imaging (PW/CW) is normally used with the B/CFM/DPI/TDI mode.



Press the **PW** key during the real time with the single B/CFM/DPI/TDI mode to activate the PW-duplex mode.



Press the **CW** key during the real time scan with the single B/CFM/DPI/TDI mode to activate the CW-duplex mode.

The Spectral Doppler cursor line is inserted at the center of the 2D image.

At the lower left corner of the screen,

**PW** the PW status icon appears when PW mode is activated; or

**CW** the CW status icon appears when CW mode is activated.

<b>PRF</b>	<b>8.0</b>
<b>WF</b>	<b>400</b>
<b>GN</b>	<b>8</b>
<b>FRQ</b>	<b>2.0</b>
<b>PWR</b>	<b>50</b>
<b>DYN</b>	<b>2</b>
<b>SV</b>	<b>4.1</b>

Figure 10.2: Spectral Doppler Image Information

The ultrasound image area is divided into two asymmetrical parts: the PW/CW spectral (which is inactive by default) is displayed along with the 2D image. Six display formats are possible, review **Section 10.1.3** on page 10-3.

Spectral Doppler image information appears on the screen (refer to **Figure 10.2**). The meaning of these items are shown in the table below. Note that the *sample volume size* (SV) only has meaning for PW image.

PRF	pulse repetition frequency
WF	wall filter value
GN	spectral Doppler gain, D gain
FRQ	transmitted frequency (MHz)
PWR	acoustic output power (%)
DYN	dynamic range
SV	sample volume size (for PW image)

### 10.1.1 B/CFM/DPI/TDI Operation in Spectral Doppler Mode

When the PW/CW spectral display is inactive, B/CFM/DPI/TDI operations in the PW/CW duplex mode are possible.

For B mode operation, refer to Chapter 5.

For CFM operation, refer to Chapter 6.

For DPI operation, refer to Chapter 7.

For TDI operation, refer to Chapter 8.

The following two items shown in the menus in **Figure 10.4** are specific to the spectral Doppler duplex mode. Refer to **Section 10.1.2** and **Section 10.1.3** for explanations.

#### 2D REFRESH

#### DISPLAY FORMAT

For PW operation, see **Section 10.2**.

For CW operation, see **Section 10.3**.

### 10.1.2 2D Refresh

#### 2D REFRESH

➤ Note that this function only has effect for PW-duplex mode.

Set this item to On to enable the real-time 2D image display when spectral display is active.

When 2D Refresh is set to Off, the 2D image is frozen once the spectral display is active.

Usage instructions:

- Press **F5** to select 2D REFRESH.
- Turn the function knob to turn on or off the 2D REFRESH function.

### 10.1.3 Display Format

#### DISPLAY FORMAT

Each PW-duplex or CW-duplex mode has six possible display formats. The screen layout in spectral Doppler duplex mode is similar to that in M-duplex mode. Refer to illustrations in **Figure 9.5**, page 9-5.

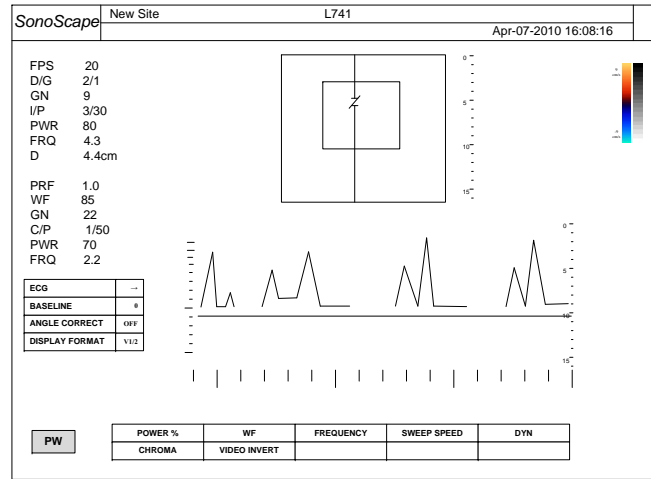


Figure 10.3: CFM+PW duplex mode

## 10.2 PW Mode Operation

### 10.2.1 Sample Volume Gate Adjustment

Adjustment of the sample volume gate is possible during the real time PW mode scan.

Follow instructions below to adjust the sample volume gate.

- Move the trackball to change the location of the gate; the spectral Doppler cursor will be moved together. For phased array probes, the angle of the spectral Doppler cursor is changed; for linear array probes, the spectral Doppler cursor shifts horizontally.
- Press the **SET** key, the gate position is fixed. Move the trackball to change the gate size.

 **Remark:**

- Adjusting the gate position and size temporarily pause the PW spectral display if it is active (updating).

### 10.2.2 Activation of PW Spectral Display



The PW spectral is not active until the **UPDATE** key is pressed. With the default setting, pressing the **UPDATE** key also freezes the 2D image.



The function menu in the PW mode is shown in **Figure 10.5**. Press the **MENU** knob to activate the PW mode context menu (right). The STEER ANGLE appears only with linear array probes.

STEER ANGLE	0
ECG	→
BASELINE	0
ANGLE CORRECT	OFF
DISPLAY FORMAT	V1/2

**Figure 10.4:** PW Mode Menu

POWER %	WF	FREQUENCY	SWEEP SPEED	DYN
CHROMA	VIDEO INVERT			

**Figure 10.5:** Function menu in CFM+PW mode (with PW spectral active)

### 10.2.3 Pulse Repetition Frequency (PRF)



The Pulse Repetition Frequency sets the velocity range of the spectral display. The range of the PRF depends on the probe and the application mode. Flip the **PRF** switch up/down to increase/decrease the PRF range.

**Remarks:**

- The current PRF value is display at the Spectral Doppler Image Info area (PRF).
- The system automatically adjusts the Wall Filter setting upon changing the PRF value.

### 10.2.4 Wall Filter (WF)

Wall Filter intends to eliminate the low frequency noise generated by movements of blood vessel walls.

- press **F2** to select WF.
- turn the function knob to change the value of the filter.

**Remarks:**

- The current Wall Filter value is displayed at the Color Image Info area (WF).
- The Wall Filter is adjustable within a range which depends on the current PRF value.

### 10.2.5 Spectral Doppler Gain



It is possible to change the PW/CW gain only when the PW/CW spectral display is active.

The Doppler gain controls the overall brightness of the spectral display.

When the spectral Doppler display is active, turn the **D GAIN** knob to adjust the Doppler gain.

**Remark:**

- The spectral Doppler gain value is shown at the Spectral Doppler Image Info area (the GN).

## 10.2.6 Steer Angle

### STEER ANGLE

Use this function to adjust the spectral Doppler cursor for linear array probes<sup>1</sup>.

- Select STEER ANGLE from the context menu.
- Use the **MENU** knob to change the angle of the spectral Doppler cursor.

## 10.2.7 Flow Invert

In PW or CW mode, press the **Finv** key to invert the spectral display in relation to the flow direction. The displayed spectrum is inverted around the baseline.

When Flow Invert is turned on, *Invert* indicator appears on top right of the spectral display.

## 10.2.8 Spectral Doppler Frequency

### FREQUENCY

The spectral Doppler frequency controls the transmit frequency.

- press **F3** to select FREQUENCY.
- turn the function knob to change the frequency value.

**Remark:**

- The spectral Doppler frequency value is displayed on the screen at the Spectral Doppler Image Info area (FRQ).

## 10.2.9 Sweep Speed

### SWEEP SPEED

Similar to the sweep speed in the M mode, this speed determines how fast the spectral Doppler display is updating.

- Press **F4** to select SWEEP SPEED.
- Turn the function knob to change the sweep speed.

<sup>1</sup>This function is hidden for those other than linear array probes.



### 10.2.10 Baseline

#### BASELINE

Shifting the baseline increases the velocity range in one direction. The vertical axis represents the scale for flow velocity (in cm/s).

- Select BASELINE from the context menu.
- Turn the **MENU** knob to adjust the amount of the baseline shift.

### 10.2.11 PW Power

#### POWER %

The value of the output power in the PW mode should be kept as low as reasonably achievable.

- Press **F1** to select POWER %.
- Turn the function knob to adjust the acoustic output.

#### Remark:

- The acoustic output power in the PW mode is displayed on the screen at the Spectral Doppler Image Info area (PWR).

### 10.2.12 Angle Correction

#### ANGLE CORRECT

Angle correction enables the adjustment of the flow direction cursor, such that it aligns with the vessel axis.

It's only necessary to use the angle correction when make velocity-related measurements.

Usage instructions:

- Select ANGLE CORRECT from the context menu, turn the **MENU** knob to switch it on.
- Press the **MENU** knob to dismiss the context menu. Turn the **ANGLE** knob to adjust the angle of the flow direction cursor.

### 10.2.13 Dynamic Range (DYN)

#### DYN

- Press **F2** to select DYN.
- Turn the function knob to decrease/increase the value of Dynamic Range.

#### Remarks:

Dynamic Range is displayed at the Spectral Doppler Image Info Area on the screen (DYN).

### 10.2.14 Chroma

#### CHROMA

Similar to the chroma setting in the B mode, this function gives the effect of changing the spectral display color.

The chroma setting is adjustable in the real time mode as well as the freeze mode.

- Press **F1** to select CHROMA.
- Turn the function knob to the chroma setting.

### 10.2.15 Video Invert

#### VIDEO INVERT

This function has the effect of changing the background of the spectral display.

- Press **F2** to select VIDEO INVERT.
- Turn the function knob to turn on or off this function.

The background of the spectral display is

- dark, when Video Invert is Off;
- bright, when Video Invert is On.

## 10.3 CW Mode Operation

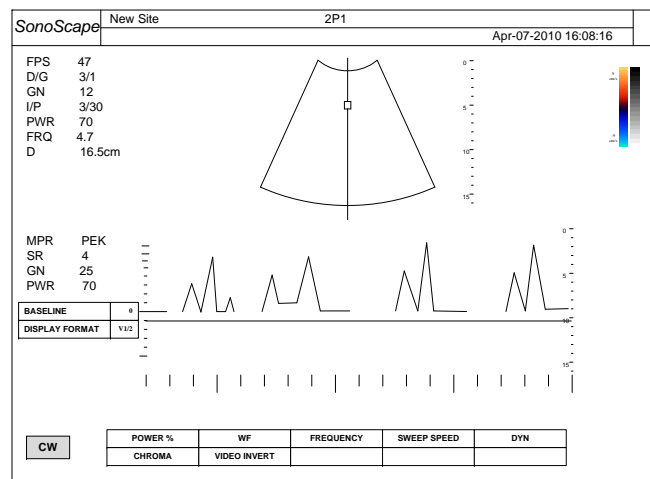


Figure 10.6: CFM+CW duplex mode

### 10.3.1 Activation of CW Mode (PW↔CW)

Only phased array probes support the CW imaging mode.



Use the **UPDATE** key to activate or stop the CW spectral display.

When the CW spectral display is active, the function menu is shown in **Figure 10.5**. Press the **MENU** knob to activate the context menu (right).

Most operations in PW and CW modes are identical. Refer to the respective sections for operation instructions.

BASELINE	0
DISPLAY FORMAT	V1/2

**Figure 10.7:** CW Mode Menu

### 10.3.2 CW Cursor Position

In CW imaging mode, an area on the spectral cursor line is sampled. This area is covered by a small rectangle called the CW cursor.

The CW cursor position is adjustable using the trackball.

### 10.3.3 Flow Invert

Refer to **Section 10.2.7**.

### 10.3.4 Sweep Speed

#### SWEEP SPEED

Refer to **Section 10.2.10**.

### 10.3.5 CW Power

#### POWER %

The value of the output power in the CW mode should be kept as low as reasonably achievable.

- highlight POWER % at the spectral Doppler mode menu.
- use the **LEFT/RIGHT** keys to adjust the output power of the transducer.

 **Remark:**

- The acoustic output power in the CW mode is displayed on the screen at the Spectral Doppler Image Info area (PWR).

### 10.3.6 Dynamic Range (DYN)

#### DYN

Refer to **Section 10.2.13**.

### 10.3.7 Chroma

**CHROMA**

Refer to **Section 10.2.14**.

### 10.3.8 Video Invert

**VIDEO INVERT**

Refer to **Section 10.2.15**.

### 10.3.9 Display Format

**DISPLAY FORMAT**

Refer to **Section 10.1.3**.

### 10.3.10 Pulse Repetition Frequency (PRF)

Refer to **Section 10.2.3**.

### 10.3.11 Wall Filter (WF)

**WF**

Refer to **Section 10.2.4**.

## 10.4 Spectral Doppler Cine Mode Operation



Either in PW or CW mode, if the spectral display is not active, press the **FREEZE** actually freezes the 2D image.

When the spectral display is active, press the **FREEZE** key to activate the spectral Doppler cine mode.

CHROMA	VIDEO INVERT	START	END	CINE REVIEW
--------	--------------	-------	-----	-------------

**Figure 10.8:** Function menu in spectral Doppler cine mode



Press the **MENU** knob to activate the context menu in the spectral Doppler cine mode. Refer to the respective sections listed below for the spectral Doppler cine mode operation.

- CHROMA** Refer to **Section 10.2.14**.
- VIDEO INVERT** Refer to **Section 10.2.15**.
- DISPLAY FORMAT** Refer to **Section 10.1.3**.

CHROMA	1
VIDEO INVERT	Off
DISPLAY FORMAT	V1/2
START	←
END	→
FRAME BY FRAME	....
PLAY/STOP	→
LOOP SPEED	↔

**Cine Playback Operations****START****END****FRAME BY FRAME****PLAY/STOP****LOOP SPEED**Refer to **Section 5.4.7**.



# Chapter 11

## 3D Mode\*



The 3D imaging is part of the 4D package which is optional and can be installed upon the user request.

3D ultrasound allows the user to see width, height and depth of the anatomical structure. In this case, the echoes are processed by a sophisticated computer program resulting in a reconstructed three dimensional volume image of internal organs or fetus.

Since this 3D image, or volume display, is generated after sufficient 2D image data are collected, it is not real time. For real time 3D, or 4D, refer to **Chapter 12**.

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### 11.1 Starting 3D Mode

Prior to the activation of 3D mode, sufficient 2D image information must be acquired. These 2D images can be collected with normal transducers working in the B mode.

The operator's experience and training are vital to satisfactory 3D images.

Once sufficient 2D image sequence is acquired, press the **FREEZE** key to start the B cine mode.

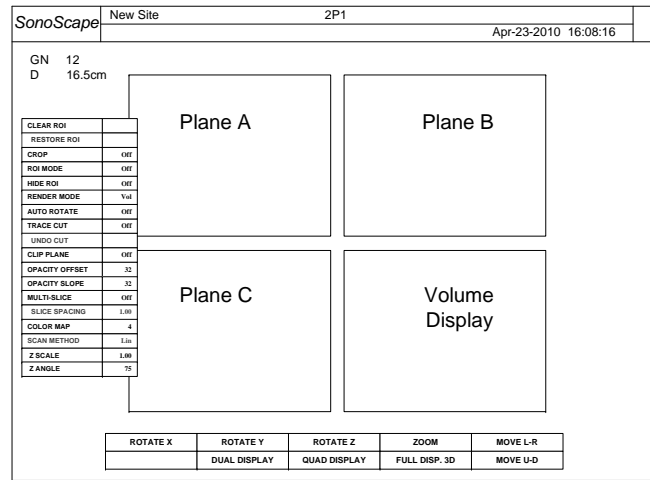
**To activate the 3D mode:**



Mark the start and end frames (**Section 5.4.5**, page 5-11); the frames enclosed will be sent for producing 3D image.

Press the **4D** key to start the 3D mode.

Press the **4D** key again to exit the 3D mode, and return to the B cine mode.



**Figure 11.1:** 3D Mode

The 3D mode display (**Figure 11.1**) is divided into four quadrants and includes cross-sectional views of the anatomical structure:

- Plane A shows the longitudinal image.
- Plane B shows the transversal image.
- Plane C shows the horizontal image.
- Volume display: the surface or partial-transparent view of the 3D structure is displayed at the last quadrant.

## 11.2 3D Mode Menus

Function menu in the 3D mode is shown in **Figure 11.2**.

ROTATE X	ROTATE Y	ROTATE Z	ZOOM	MOVE L-R
	DUAL DISPLAY	QUAD DISPLAY	FULL DISP. 3D	MOVE U-D

**Figure 11.2:** Function menu in 3D mode





Press the **MENU** knob during the 3D mode to activate the 3D mode menu. Instructions for 3D operation are explained in the following sections.

CLEAR ROI	
RESTORE ROI	
CROP	Off
ROI MODE	Off
HIDE ROI	Off
RENDER MODE	Vol
AUTO ROTATE	Off
TRACE CUT	Off
UNDO CUT	
CLIP PLANE	Off
OPACITY OFFSET	32
OPACITY SLOPE	32
MULTI-SLICE	Off
SLICE SPACING	1.00
COLOR MAP	4
CINE REVIEW	Off
RESCAN	Off
IMAGE QUALITY	Med
STABILIZATION	Off

Figure 11.3: 3D mode menu

## 11.3 3D Mode Operation

### 11.3.1 Display Format

- DUAL DISPLAY
- QUAD DISPLAY
- FULL DISP. 3D

By default, the 3D mode uses the quad display format, as shown in **Figure 11.1**.

Other display formats are possible: press **1**, **2** and **4** on the alphanumeric keyboard to activate the single, dual, and quad display formats respectively.

Alternatively, in the function menu (**Figure 11.2**), the items: DUAL DISPLAY ← **F2**, QUAD DISPLAY ← **F3**, and FULL DISP. 3D ← **F4** also change the 3D mode display formats.

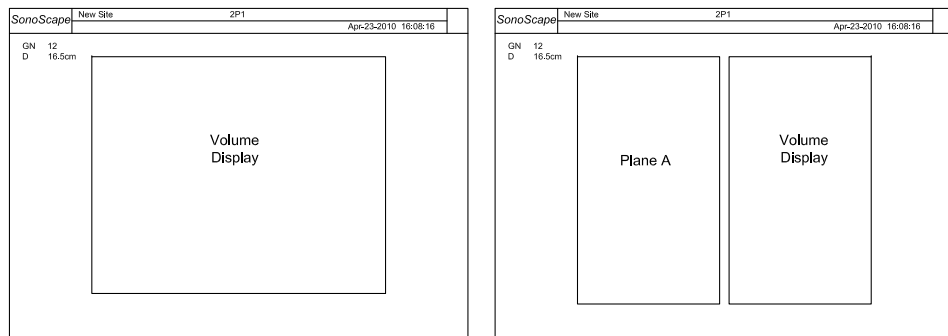


Figure 11.4: Single & dual display formats in the 3D mode

Single and dual display formats in the 3D mode are illustrated in **Figure 11.4**.

### 11.3.2 Rotate, Zoom and Move

Rotate and zoom the 3D structure.

**Method 1:**

Hide ROI box (refer to **Section 11.3.5**). Move the cursor over the volume display<sup>1</sup>,

- press the **UPDATE** key; and move the trackball to rotate the display of the 3D structure.
- press the **ZOOM** key; and move the trackball to zoom in/out the the display of the 3D structure.

**Method 2:****ROTATE X**

Press **F1** to select ROTATE X, turn the function knob to rotate the 3D structure display around the x axis.

**ROTATE Y**

Press **F2** to select ROTATE Y, turn the function knob to rotate the 3D structure display around the y axis.

**ROTATE Z**

Press **F3** to select ROTATE Z, turn the function knob to rotate the 3D structure display around the z axis.

**ZOOM**

Press **F4** to select ZOOM, turn the function knob to zoom in/out the display of the 3D structure.

**Move the 3D structure.**

The 3D structure display can be shifted horizontally or vertically.

**MOVE L-R**

Press **F5** to select MOVE L-R, turn the function knob to move the 3D structure display in the left/right direction.

**MOVE U-D**

Press **F5** to select MOVE U-D, turn the function knob to move the 3D structure display in the up/down direction.

### 11.3.3 Clear & Restore ROI

**CLEAR ROI**

Highlight this item and press the **SET** key over it to clear the ROI region. The result is, in 3D and 2D images, the regions inside the ROI boxes are removed.

**RESTORE ROI**

Press this item to restore the display of the region removed by CLEAR ROI previously.

Note: to adjust the ROI boxes, see **Section 11.3.5**.

### 11.3.4 Crop

**CROP**

Instead of removing the region inside the ROI box, as what CLEAR ROI does, this function crops the display to the ROI box.

Note: to adjust the ROI boxes, see **Section 11.3.5**.

<sup>1</sup>When CLIP PLANE is enabled, refer to **Section 11.3.9**.

### 11.3.5 ROI Box Adjustment

#### ROI MODE

This item should be set to On in order to adjust the ROI boxes.

#### HIDE ROI

Note that the HIDE ROI option is automatically turned off upon enabling ROI MODE.

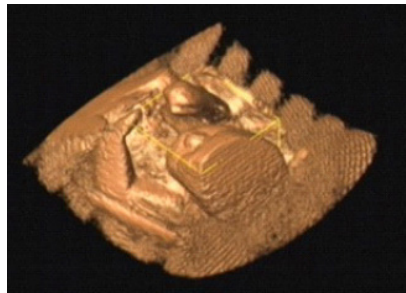
#### Instructions for adjusting the ROI boxes:

1. Press the **UPDATE** key over a 2D image to select the image. The frame box of the selected image will be highlighted upon the selection.
2. Move the trackball to move the ROI box position.
3. Press the **SET** key; move the trackball to resize the ROI box.
4. Press the **SET** key again to enable moving the ROI box position.
5. Press the **UPDATE** key to deselect the image. Move the cursor over another image and press the **SET** key to select it.

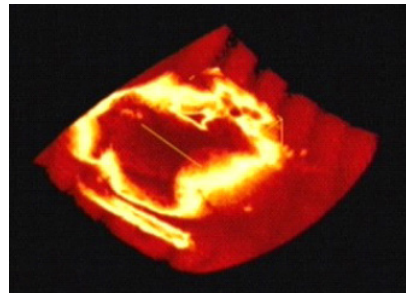
### 11.3.6 Render Mode

#### RENDER MODE

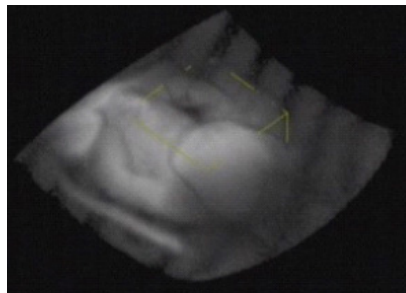
Three render modes are available: Volume Rendering (Vol), X-ray, Maximum Intensity Projection (MaxIP).



**Figure 11.5:** Vol Mode: displays the contour of the internal organs or fetus.



**Figure 11.6:** MaxIP Mode: displays the samples with the highest intensity along the ultrasound beam.



**Figure 11.7:** X-ray Mode: displays the average gray values of the echoes along the ultrasound beam.

### 11.3.7 Auto Rotate

#### AUTO ROTATE

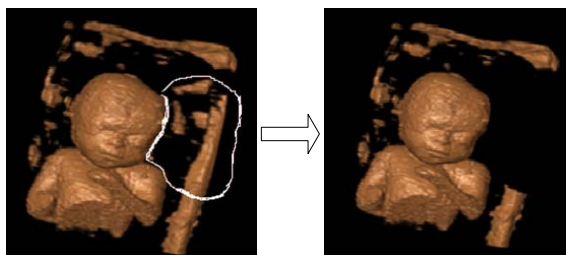
Turn on this function to activate the auto-rotation of the display of the 3D structure. This function is normally used for demonstration purpose.

The maximum angle of rotation can be set to 45°, 90°, 180°, 270°, or 360°. The display of the 3D structure rotates continuously (first clockwise and then counterclockwise) from 0° to this maximum angle.

### 11.3.8 Trace Cut

#### TRACE CUT

Turn this function on to remove any unwanted region from the volume display. Practically, it can be useful for clearing region obstructing the display of ROI.



**Figure 11.8:** Trace Cut

To use Trace Cut:

- Press the **SET** key over TRACE CUT. Turn the **MENU** knob to turn it On.
- Press the **MENU** knob to dismiss the menu.
- Use the trackball to plot a trace to enclose the unwanted region.
- Press the **SET** key to remove the region surrounded by the trace.

#### UNDO CUT

This function restores the display of the volume removed by TRACE CUT.

### 11.3.9 Clip Plane

#### CLIP PLANE

Turn this function on to enable the clip plane. Clipping facilitates the visualization of the structure covered by the surface.

To move the position of the clip plane:

1. Move the cursor over the volume display and press **UPDATE** or **ZOOM**.
2. Use the trackball to move the clip plane position.

#### Remark:

Note that in the step 1 above,

- press **UPDATE** and followed by the space bar to activate the rotation of the volume display; or
- press **ZOOM** and followed by the space bar. Use the trackball to zoom in/out the volume display.

### 11.3.10 Opacity Setting

#### OPACITY OFFSET

Use this function to adjust the opacity offset which enhances the display of the 3D structure.

**OPACITY SLOPE**

This function fine tunes the opacity setting.

**11.3.11 Multi-Slice**

This function shows the surfaces slicing the 3D structure.

**11.3.12 Color Map****COLOR MAP**

Similar to the C Map function in the B mode, this function chooses the method for mapping the amplitudes of echoes to the grayscale or color pixels.

**11.3.13 Scan Method****SCAN METHOD**

Adjust the Scan Method, which can be chosen from Linear Motion(Lin) and Sector Motion(Sec), to the actual method used for acquiring the volume data.

**11.3.14 Z Scale (For Scan Method = Lin)****Z SCALE**

This function increases or decreases the volume display in the z direction.

**11.3.15 Z Angle (For Scan Method = Sec)****Z Angle**

This function changes the Z-angle value used for obtaining the display of the 3D structure.



# Chapter 12

## 4D Mode\*



The 4D imaging is part of the 4D package which is optional and can be installed upon the user request.

4D imaging enables the display of the real time 3D anatomical structure.

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### 12.1 Starting 4D Mode

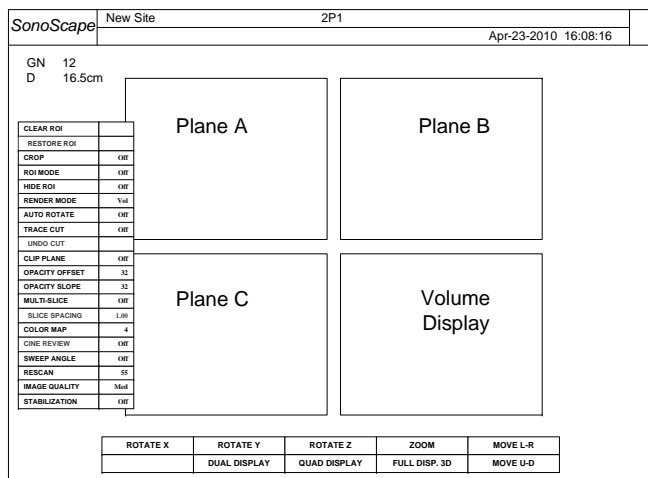
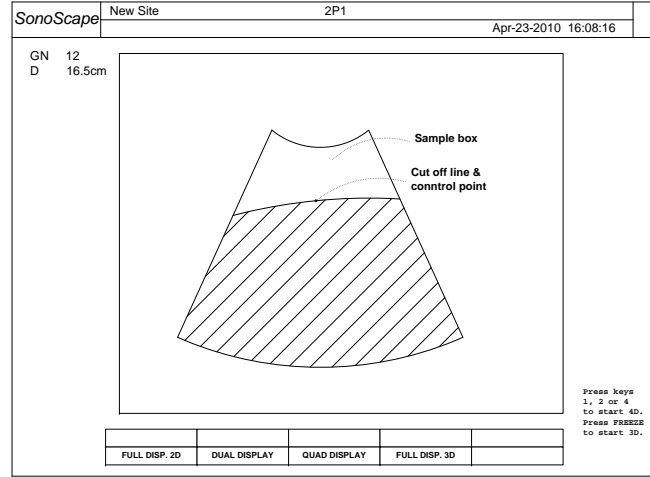


Figure 12.1: 4D Mode with the Quad Display format



Connect and select a volume probe, click an application mode icon to start with B mode imaging. Press **4D** to activate the 4D mode. The screen (i.e., the FULL DISP. 2D display) shows a 2D image with a large *sample box* and a yellow *cut off line*. See **Figure 12.2**.



**Figure 12.2:** 4D mode with the FULL DISP. 2D format)

The following messages are displayed on the lower right corner of the screen:

```
Press keys
1, 2 or 4
to start 4D.
Press FREEZE
to start 3D.
```

Pressing **FREEZE** activates the 3D mode which is introduced in **Chapter 11**.

Pressing 1, 2 or 4 activates the real time volume display in the single, dual or quad display format (refer to **Section 12.3.1**). Press **FREEZE** to stop the probe motor and also the 4D acquisition.

## 12.2 4D Mode Menus

The function menu in 4D mode is shown in **Figure 12.3**; the item, FULL DSIP. 2D, only appears when the transducer motor is not running.

ROTATE X	ROTATE Y	ROTATE Z	ZOOM	MOVE L-R
FULL DISP. 2D	DUAL DISPLAY	QUAD DISPLAY	FULL DISP. 3D	MOVE U-D

**Figure 12.3:** Function menu in 4D mode





Press the **MENU** knob during the 4D mode to activate the 4D mode menu.



Most functions shown in the 4D mode menus are the same as those in 3D mode menus. Refer to **Chapter 11** for the operation of these functions.

The following sections will focus on explaining the functions which are new in 4D mode.

The availabilities of some functions depend on the status of the motor.

CLEAR ROI	
RESTORE ROI	
CROP	Off
ROI MODE	Off
HIDE ROI	Off
RENDER MODE	Vol
AUTO ROTATE	Off
TRACE CUT	Off
UNDO CUT	
CLIP PLANE	Off
OPACITY OFFSET	32
OPACITY SLOPE	32
MULTI-SLICE	Off
SLICE SPACING	1.00
COLOR MAP	4
CINE REVIEW	Off
SWEEP ANGLE	Off
RESCAN	55
IMAGE QUALITY	Med
STABILIZATION	Off

Refer to Chapter 10.

## 12.3 4D Mode Operations

### 12.3.1 Display Format

Figure 12.4: 4D mode menu

**FULL DISP. 2D** displays the 2D real time image in full screen.

This option is available only when the transducer motor is not running. To turn it on, press **F1** to select and enable this option. To adjust the sample box and the cut off line, the system must be in FULL DISP. 2D display format.

The following options change the display format in 4D mode to dual, quad or single 3D display format. Refer to **Section 11.3.1** for more information.

**DUAL DISPLAY**

**QUAD DISPLAY**

**FULL DISP. 3D**

### 12.3.2 Adjustment of Sample Box & Cut Off Line

**Remarks:**

- The adjustment of the sample box and the cut off line is only possible with the FULL DISP. 2D display format.
- Only the data in the area enclosed by the sample box and the cut off line (the shaded area in **Figure 12.2**) will be collected for 3D rendering.

**To adjust the sample box,**

- move the trackball to change the position of the sample box;
- press **SET**; use the trackball to change the size of the sample box.
- use **SET** to toggle the function of the trackball between resizing and moving the sample box.

**To adjust the cut off line,**

- press **UPDATE** and use the trackball to shift the cut off line;

- press **UPDATE**; use the trackball to change the position of the control point and the shape of the cut off line.
- use **SET** to toggle the function of the trackball between moving the control point and moving the cut off line.

### 12.3.3 Sweep Angle

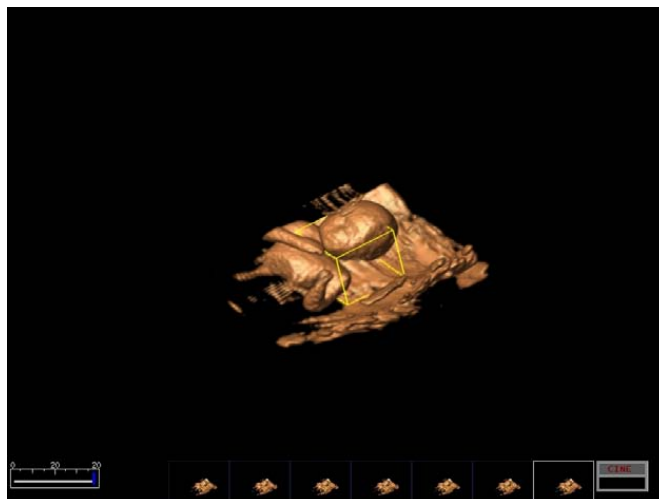
#### SWEEP ANGLE

Use this function to modify the sweep angle for displaying the volume structure. The modification is possible only when the transducer motor is not running; it takes effect with the next volume data acquisition.

### 12.3.4 Cine Review

#### CINE REVIEW

Use this function to review the image frames captured when the motor was running. The previews of the 3D structure are displayed at the bottom of the screen; see **Figure 12.5**.



**Figure 12.5:** Cine review in 4D mode

### 12.3.5 Rescan

#### RESCAN

This function attempts to obtain the volume display with a higher resolution by performing a rescan. By default it is set to off.

Press **FREEZE** when the motor is running, i.e., during the real time volume data acquisition,

- when RESCAN is set to off, the motor will stop immediately;
- when RESCAN is set to on, the motor continues running for a while, attempting to obtain the volume display with a higher resolution.

### 12.3.6 Image Quality

#### IMAGE QUALITY

This item sets the image quality for the volume display. It can be set to Low, Med, or High.

The higher the image quality, the lower the time response. A lower image quality setting is recommended for the display of the heart.

### **12.3.7 Stabilization**

#### **STABILIZATION**

Use this function to improve the stability of display of the 3D structure. It is recommended to turn off this function when imaging the heart.



# Chapter 13

## Transducers

SSI-8000 supports a wide range of probes which make the system remarkably versatile. This chapter provides the transducer information and the guidance for the use and maintenance of the transducers.



### Warning!

Review to **Chapter 1**, especially **Section 1.3** and **Section 1.4**, for safe use of the transducers.

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## 13.1 Transducer Information

### 13.1.1 Supported Transducers and Intended Applications

The transducers supported by SSI-8000 are listed non-exhaustively in **Table 13.1**.<sup>1</sup> Contact your SonoScape representative for the complete list of the supported transducers.

### 13.1.2 Acoustic Output

The acoustic output powers for the supported transducers are listed in the **Acoustic Output Tables** in the companion CD-ROM of this manual.

<sup>1</sup>For the usage and maintenance of the speciality probes, refer to the corresponding probe user manuals.

<b>Model</b>	<b>Description</b>	<b>Intended Applications</b>
L741	Linear Array, 5.0-10.0 MHz	Small Organ, Musculo-skeletal (Conventional & Superficial), Peripheral vessel
L742	Linear Array, 5.0-12.0 MHz	Small Organ, Musculo-skeletal (Conventional & Superficial), Peripheral vessel
L743	Linear Array, 5.0-10.0 MHz	Small Organ, Musculo-skeletal (Conventional & Superficial), Peripheral vessel
C344	Curved Array, 2.0-5.0 MHz	Fetal , Abdominal, Ob/GYN
VC6-2	Curved Array, 2.0-6.0 MHz	Fetal , Abdominal, Ob/GYN
2P1	Phased Array, 2.0-4.0 MHz	Abdominal, Neonatal Cephalic, Adult Cephalic, Cardiac Adult, Cardiac Pediatric
5P1	Phased Array, 3.0-7.0 MHz	Pediatric, Neonatal Cephalic, Cardiac Pediatric
6V1	Micro-curved Array, 4.0-8.0 MHz	Transrectal, Transvaginal
6V3	Micro-curved Array, 5.0-9.0 MHz	Transrectal, Transvaginal
EC9-5	Micro-curved Array, 5.0-9.0 MHz	Transrectal, Transvaginal
C611	Micro-curved Array, 4.0-8.0 MHz	Abdominal, Pediatric, Neonatal Cephalic, Cardiac Pediatric

**Table 13.1:** Transducer list

## 13.2 Environmental Requirements

The transducers should be used with that the following environmental requirements has been satisfied.

	<b>Operation</b>	<b>Storage and transport</b>
<b>Relative humidity</b>	30%~75%, no condensation	20%~90%, no condensation
<b>Ambient temperature</b>	10°C~40°C	-20°C~55°C
<b>Barometric pressure</b>	700hPa~1060hPa	700hPa~1060hPa

## 13.3 Preparation and Usage of the Probe

### 13.3.1 Inspection

After each use, or before first use or after long-time storage of the probe, the probe must be examined for any damages listed in the table below. Stop using the probe if any damage is found. Contact your representative for servicing asap.

#### **Possible damage types**

Cracks on the probe handle (user section).
Cracks on the probe head (applied section).
Scratches on the probe head (acoustic window surface).
Swell of the acoustic window material.
Cracks or wear on the probe cable.
Cracks on the probe connector or any other kinds of visible damage.
Deformed pins or broken pins exist inside the probe connectors.

### 13.3.2 Probe Connection

Refer to **Section 3.1** for detailed information on probe connection.

### 13.3.3 Preparation for Scanning

#### **Attention!**

- An effective acoustic coupling does not require inordinate pressure, but it does require coupling gel and patient contact.
- Check the expiration date of the probe sheath and the coupling gel. Never use expired probe sheath and coupling gel.
- Latex or natural rubber contained inside medical equipments or accessories can cause severe allergic reactions in some individuals. It's suggested by FDA that the user should identify the latex-sensitive patients and be prepared to treat allergic reactions promptly.
- Only water-soluble coupling gel should be applied to the probe head surface. Avoid contact with the mineral oil.

#### 13.3.3.1 For Surface Probes

Put an adequate amount of coupling gel either on the probe head (acoustic window) or the patient skin.

If disease transmission is a concern, use of the sterile probe sheath is highly recommended. Refer to instructions below to use the probe sheath as a barrier between the patient and the transducer surface.

#### 13.3.3.2 For intracavitary probes

*Note: The probes are provided in non-sterile condition from the manufacturer.*



Intracavitary probes should be cleaned and disinfected both before and after usage.

1. To prevent disease transmission, wear sterile gloves.
2. Put an adequate amount of coupling gel on the probe head or into the probe sheath.
3. Insert the transducer into the probe sheath.



Use of legally marketed sterile probe sheath is required for intracavitary operations. If lubricant is used, it must be water-soluble. Do not apply coupling gel directly on the patient skin.

4. Cover the probe with the probe sheath up to the user section (probe handle).

5. Examine the integrity of the probe sheath. If breakage occurs, repeat from step 1 to replace the sheath with another new one.

### 13.3.4 Scanning

Refer to **Chapter 3** to turn on the system and start an ultrasound diagnosis.

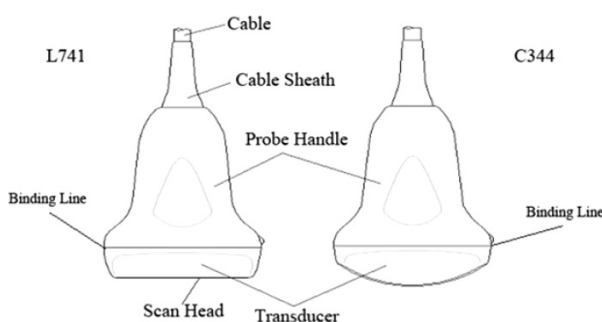
## 13.4 Probe Maintenance: Cleaning and Disinfection

Clean the transducer and the probe handle after each use.

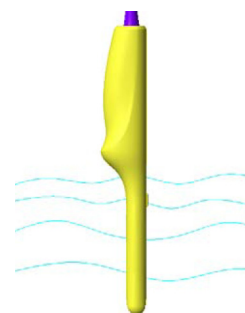
For surface probes, disinfect the transducer periodically. For intracavitary probes, disinfecting the transducer after each use is required.

*Keep a log of maintenance (inspection, cleaning and disinfection) and malfunction.*

### 13.4.1 Probe immersion level



**Figure 13.1:** Surface probes



**Figure 13.2:** Intracavitary probe

For surface probes, do not immerse the probe beyond its binding line (refer to **Figure 13.1**).

For intracavitary probes, the allowed immersion level is shown in **Figure 13.2**.

### Warning!

- DO NOT use solutions containing alcohol, mineral oil for cleaning or disinfecting probes.
- Wear medical sterile gloves to prevent potential disease transmission. Wear protective goggle if necessary.
- DO NOT apply solutions containing ethyl oxides on the probe.

### 13.4.2 Cleaning Instructions

1. Disconnect the probe from the ultrasound system. Remove the biopsy guide if it is attached to the probe.
2. Remove all the coupling gel and clean the probe with soft cloth and flowing potable water.



3. If the probe surface carries too much residue, remove all visible residue with wet cloth soaked in mild soap water. Use wet soft cloth to scrub the surface if dried residue exists. Remove all soap water residue with damp cloth soaked in potable water.
4. Air dry or dry with a soft cloth.

### 13.4.3 Disinfection Instructions

The level of disinfection is directly related to the duration of contact with the germicide. High level of disinfection<sup>2</sup> is recommended for surface probes and required for intracavitary probes. Liquid chemical germicides (e.g. Cidex) that are legally marketed are highly recommended. Prepare and use the germicides following the manufacturer's instructions.

#### **Warning!**

- DO NOT use high pressure steam to disinfect the probe.
  - DO NOT use thermal disinfection! Temperatures higher than 66°C or 150°F will damage the probe.
1. Ensure that all visible residues have been removed.
  2. Prepare the germicide solutions according to the manufacturer's instructions. Please also follow the manufacturer's instructions for storage and disposal of the germicide.
  3. Immerse the probe head into the germicide for a time interval specified by the germicide manufacturer. The immersion level should be kept below the binding line. High level disinfection is recommended for surface probes and required for intracavitary probes. Note that you may need to rotate and shake the transducer in order to remove the air bubbles between the transducer surface and the germicide solution.
  4. After removing the probe from the germicide solution, rinse it thoroughly with clean, potable water to remove all visible germicide. Dry the probe with a soft cloth.

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<sup>2</sup>Refer to the germicide manufacturer's instruction to perform high level disinfection.



# Chapter 14

## System Maintenance

We recommend the user to perform the following maintenance operations:

- Clean the probes and probe holders daily to remove coupling gel, dust, and etc.
- Clean the system (keyboard, monitor, and etc.) regularly.

### **Attention!**

- Switch the system off before cleaning.
- Damp cloth soaked in mild soap water is allowed.
- Protect the system, especially the electric parts, from drip water.
- Do not apply acetone/alcohol or use abrasives on the system or the transducer surfaces.

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### **14.1 Guidance for Service**

In case of any malfunctions, turn off the system and disconnect the power supply. Contact your SonoScape representative for service. Mention the detailed phenomena of the malfunction to the service personnel to help the identification of cause.

### **Warning!**

There are no user replaceable parts inside the system. Any kind of do-it-yourself repairs invalidate the warranty. Contact your representative for service instead.

## 14.2 Manufacturer Responsibility

The manufacturer assumes the responsibility with regard to safety, reliability and performance of this product only under the following conditions,

- all installation, hardware and software upgrades, modifications and repairs of this product are performed or instructed by authorized personnel;
- operation, transport and storage of this product are under the required environmental conditions;
- the product is operated in accordance with this operator's manual.

## 14.3 Contact Information














Any feedbacks or inquires concerning our product or service should be directed to the following address.

**☎ Contact Information:****Address:** 4/F., Yizhe Building, Yuquan Road, Shenzhen, P.R. China**Zip Code:** 518051**Tel:** 86-400-678-8019**Fax:** 86-755-26722850**Website:** <http://www.sonoscape.com>**E-mail:** [service@sonoscape.net](mailto:service@sonoscape.net)

## Appendix A

# Description of Symbols

The following symbols are utilized either in the operator's manual or on the product.

Symbol	Description
	Dangerous electric voltage
	Warning! Follow these instructions to avoid personal injury or system damage.
	Attention! Follow these instructions to avoid system damage.
	Off (Mains power switch OFF)
	On (Mains power switch ON)
	Protective earth/ground connection.
	Potential equilibrium connection
	AC
	CF: Isolation from ground; max. Patient leakage current: normal situation $\leq 10\mu\text{A}$ , with one defect $\leq 50\mu\text{A}$
	BF: Isolation from ground; max. Patient leakage current: normal situation $\leq 100\mu\text{A}$ , with one defect $\leq 500\mu\text{A}$
	BF: Tremble-free protection
	B: Max. Patient leakage current: normal situation $\leq 100\mu\text{A}$ , with one defect $\leq 500\mu\text{A}$
<b>IP</b>	To protect against dust and immersion as per requirements in IEC529.
	Non-ionization radiation: Ultrasound scanner transmits acoustic waves.

**Table A.1:** Table of Symbols



## Appendix B

# Information of EU Representative

**SONOMED**

Via Luigino Tandura, 74-00128 Rome, Italy

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