2

Basic measurements

2.1 Basic measurement menu
2.2 Measurement Methods

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2.1 Basic measurement menu

The following measurement menus and parameters are available under basic measurements.

Table1: B Mode

Menu	Measurement Methods	Measurement Results Display Parameters				
Distance measurements						
Distance		Dist				
Dist-trace		Dist-trace				
Area and Circumference Measurements						
Area-Trace		Area	Circ			
Area-Circle		Area	Circ	Diam		
Area-Ellipse		Area	Circ	x-axis	y-axis	
Volume measurements						
Volume 1 Volume 2	Area-Length	VOL	Area	Dist	Circ	
	Ellipse+Caliper	VOL	Area	Circ	x-axis	y-axis
		z-axis				
	3 Caliper	VOL	x-axis	y-axis	z-axis	
	Ellipse	VOL	Area	Circ	x-axis	y-axis
Index measurements						
B.Index	Caliper, Ellipse, Trace, Circle	A	B	A/B	B/A	|A-B|/A
Histogram measurements						
Histogram	Square, Rectangle, Circle, Trace	T	L	M	MN	SD
Bone angle measurements						
Rt. Hip J Angle Lt. Hip J Angle		A	B	type		
Angle measurements						
Angle	2 Caliper, Point	Angle 1	Angle 2	D1	D2	

Table2: M Mode

Menu	Measurement Methods	Measurement Results Display Parameters				
Distance measurements (amplitude)						
M. Length		d				
Time measurements						

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Menu	Measurement Methods	Measurement Results Display Parameters				
Time		dt				
Heart rate measurements						
HR		HR	dt	beats		
Velocity measurements						
Velocity	Caliper Horizontal L	v	dt	dD		
Index measurements						
M. Index	Time Length Velocity	A	B	A/B	B/A	|A-B|/A

Table3: D Mode

Menu	Measurement Methods	Measurement Results Display Parameters				
Time measurements						
Time		dt				
Heart rate measurements						
HR		HR	dt	beats		
Blood flow velocity measurements						
Velocity1	Horizontal L, Vertical L, Cross Line, Cross Point	pV	PG			
Velocity2	Horizontal L, Vertical L, Cross Line, Cross Point	v1	v2	dv	dt	v1/v2
		PG1	PG2	dPG	dPG/dt	ACC
Acceleration (deceleration) measurements						
ACCEL	Horizontal L, Vertical L, Cross Line, Cross Point	v1	v2	dv	dt	v1/v2
		PG1	PG2	dPG	dPG/dt	ACC
RI measurements						
RI		RI	PSV	EDV	S/D	D/S
Pressure half-time measurements						
P1/2T		pV	PG	P1/2T	VA	
D. Caliper measurements						
D.Caliper1 D.Caliper2	Horizontal L, Vertical L, Cross Line, Cross Point	v1	v2	dv	dt	v1/v2
		v2/v1	PG1	PG2	dPG	dPG/dt
		ACC	P1/2T	VA		
Mean flow velocity measurements						

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Menu	Measurement Methods	Measurement Results Display Parameters				
Mean VEL		MnV	MPG	PV	PG	VTI
		FlowT	AccT	ACC	AccT/FT	
PI measurements						
PI		MnV	MnPG	PSV	EDV	dV
		dT	PG1	PG2	dPG	VTI
		PI	RI	FT	AccT	ACC
		AccT/FT	S/D	D/S	Vm	
Stenosis flow measurement						
STENO Flow		MnV	MnPG	PVel	PG	VTI
		FT	AccT	ACC	AccT/FT	P1/2T
		VA				
Regurgitant flow measurement						
Regurg Flow		MnV	MnPG	PVel	PG	VTI
		FT	P1/2T			
D. Trace measurements						
D.Trace1 D.Trace2		MnV	MnPG	PSV	EDV	dV
		dT	PG1	PG2	dPG	VTI
		PI	RI	FT	AccT	ACC
		AccT/FT	S/D	D/S		
D. Index measurements						
D.Index (Caliper)	Velocity, PG, Time	A	B	A/B	B/A	|A-B|/A
D.Index (Caliper)	Mn Vel, MnPG, VTI	A	B	A/B	B/A	|A-B|/A

Table4: B/D Mode

Menu	Measurement Methods	Measurement Results Display Parameters				
Blood flow Volume Measurements (for peripheral blood vessels)						
FV(Artery)MnV		MnV	PSV	EDV	dv	dt
		VTI	PI	RI	FlowT	ACCT
		ACC	AccT/FT	S/D	Vm	FV(MnV)
		FVm(MnV)	CSD	CSA		
Blood flow Volume Measurements (for peripheral blood vessels)						
FV(Artery)VTI		MnV	PSV	EDV	dv	dt
		VTI	PI	RI	FT	ACCT
		ACC	AccT/FT	S/D	Vm	FV(beat)
		FV(min)	CSD	CSA	HR	
Blood flow Volume Measurements						

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Menu	Measurement Methods	Measurement Results Display Parameters				
F.Volume (Vein)		MnV	pV	VTI	AccT	ACC
		FV	CSD	CSA		
Blood flow Volume Measurements (for cardiovascular use)						
SV/CO		MnV	pV	VTI	AccT	ACC
		SV	CO	CSD	CSA	HR

2.2 Measurement Methods

2.2.1 B mode measurement

(1) Distance measurements

Caliper and Trace methods are available for measuring the distance between two points.

Distance measurement: Caliper method

The distance between 2 points can be measured via the caliper method.

Procedure

1. Press [Measurement] button on the touch panel.
2. Select [Dist.] from the Measurement menu.
   The + mark is displayed.
3. Set the start and end point positions with the Caliper method.
   The distance is displayed.

Example of Measurement Results Display

Dist: cm	Distance measurement value

Dist-trace measurement: Trace method

The distance of two points can be measured using the Trace method.

Procedure

1. Press [Measurement] button on the touch panel.
2. Select [Dist-trace] from the Measurement menu.
3. Trace along the boundary of the measurement target with the B Trace method.
   The distance is displayed.

Example of Measurement Results Display

Dist-trace:	
cm	Distance measurement value

(2) Area and Circumference Measurements

The Trace, Ellipse and Circle methods are available for measuring area and circumference.

Area-T measurement: Trace methods

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This function calculates the length of the line traced with the +mark and the area enclosed by the trace line.

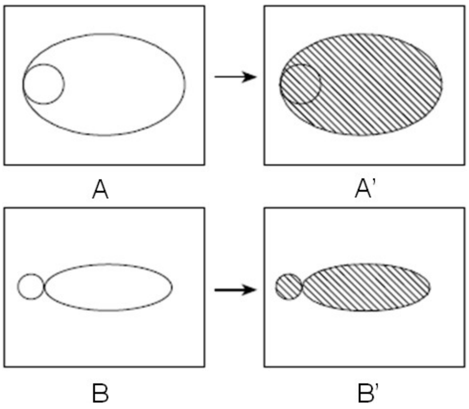
Procedure

1. Press [Measurement] button on the touch panel.
2. Select [Area-T] from the Measurement menu.
   The + mark is displayed.
3. Trace along the boundary of the measurement target with the B Trace method.
   The length of the circumference is displayed.
4. Select [Enter]] to close the trace line.
   The area and length of the circumference are displayed.

Example of Measurement Results Display

`Area-T`	
`Area:` `cm`^{2}	: Area
`Circ:` `cm`	: Circumference

If there are several parts enclosed by trace lines, the total area enclosed by the outermost line is calculated (see figure below). The circumference is displayed as the total length of the trace line.



Area-E measurement: Ellipse methods

This measurement approximates the measurement subject to an ellipse, and measures the area and circumference.

Procedure

1. Press [Measurement] button on the touch panel.
2. Select [Area-E] from the Measurement menu.
   The + mark is displayed.
3. Use the Elipse method so the ellipse encloses the area to be measured.
   The area and length of the circumference are displayed.

Example of Measurement Results Display

`Area-E`	

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Area: cm^2	: Area
Circ: cm	:Circumference
x-ax: cm	:Long axis length of the ellipse (x-ax > y-ax)
y-ax: cm	:Short axis length of the ellipse

Area-C measurement: Circle methods

This measurement approximates the measurement subject to circle, and measures the area, diameter and circumference.

Procedure

1. Press [Measurement] button on the touch panel.
2. Select [Area-C] from the Measurement menu.
   The + mark is displayed.
3. Use the Circle method so the circle encloses the area to be measured.
   The area and length of the circumference are displayed.

Example of Measurement Results Display

Area-C	
Area: cm^2	: Area
Circ: cm	: Circumference
Diam: cm	: Circle diameter

(3) Volume Measurement: Volume1/Volume2

The following calculation methods are used for volume measurements.

- Spheroidal
  Three diameters (long axis, short axis and the maximum cross-sectional diameter in the direction perpendicular to the long axis (= intermediate axis diameter) measured from the image of two orthogonally intersecting cross-sectional planes, and the volume of the rotating ellipsoid is calculated.
- Prolate
  The volume is calculated by finding the long and short axes of the ellipse in the same way as measuring the area of an ellipse and measuring the hypothetical circle on the cross-sectional plane perpendicular to the short axis.
- Method of calculating volume from the traced area:
  There are two trace methods; (1) automatic trace of three indicated points, and (2) manual trace.
  - Area-Length
    Trace the long axis cross-section and calculate volume from this area and long axis diameter.

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    - BP Simpson
      The volume is computed using the basic principles of the Disk method (measurement with two cross sections).
    - SP Simpson
      The volume is computed using the basic principles of the Disk method (measurement with one cross section).

There are four types of measurement method. The following are the combinations of calculation methods.

	Spheroidal	Prolate	Area-Length	BP Simpson	SP Simpson
Ellipse+Caliper	yes	-	-	-	-
Area-Length	-	-	yes	yes	yes
3 Caliper	yes	-	-	-	-
Ellipse	-	yes	-	-	-

The volume measurements on the Measurement menu are Volume1 and Volume2. Use the measurement preset ([Create Measurement Tools > Basic Measurement > Measured Method & Display Items > B.Mode]) to select measurement and calculation methods for Basic Measurement > Measured Method & Display Items > B.Mode />Volume1 and Volume2.

Volume1/Volume2 measurement: Area-Length method

Trace the boundary region and calculate volume from this area. There are 2 types of traces.

- Manual Trace
  Trace the boundary with the B.Trace method.
  Set the Area-Length to [Manual] with Volume 1 or Volume 2 under the measurement presets ([Create Measurement Tools > Basic Measurement > Measured Method & Display Items > B.Mode]).
- Auto Trace
  Specify 3 points in the boundary region. It automatically traces the boundary region based on those 3 points.
  Set the Area-Length to [Auto] with Volume 1 or Volume 2 under the measurement presets ([Create Measurement Tools > Basic Measurement > Measured Method & Display Items > B.Mode]).

Procedure

1. Display the orthogonal intersecting long axis cross-sectional image and the short axis cross-sectional image with the B/B mode.
2. Press [Measurement] button on the touch panel.
3. Select the [Volume1]or [Volume2] from the measurement menu.
   The + mark is displayed.
4. Trace the boundary region.
   Manual trace
   Trace along the contours of the measurement target using the B Trace method.
   Auto trace

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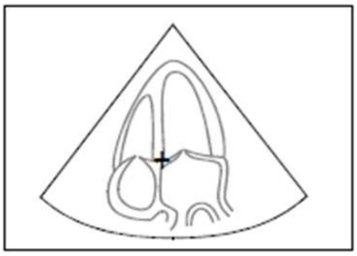
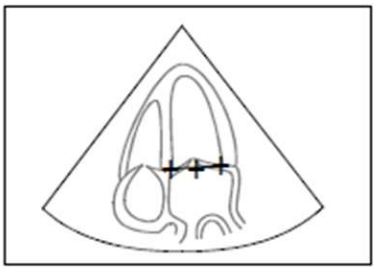
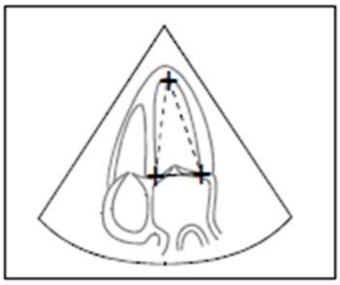
a. Use the trackball to move the + mark to the 1st point in the boundary region and press [Enter] key.



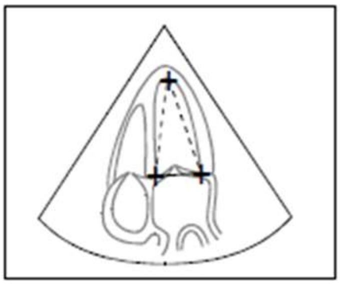
b. Use the trackball to move the + mark to the 2nd point in the boundary region and press [Enter] key.



c. Use the trackball to move the + mark to the 3rd point in the boundary region (top of long axis).



d. Press the [Enter]key.



Example of Measurement Results Display

Volume 1:	
Vol: cm^3	: Volume
Area: cm^2	: Area
Dist: cm	: Long axis of the long axis view

Volume1/Volume2 measurement: 3 Caliper method

Measures the two orthogonal cross-sectional images. Measure the long axis, short axis and the maximum cross-sectional diameter in the direction perpendicular to the long axis

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(intermediate axis diameter) with the Caliper method. It calculates the volume from the 3 measured axes as a spheroid.

Procedure

1. Display the orthogonal intersecting long axis cross-sectional image and the short axis cross-sectional image with the B/B mode.
2. Press [Measurement] button on the touch panel.
3. Select the [Volume1]or [Volume2] from the measurement menu.
   The + mark is displayed.
4. Set the long axis with the long axis view.
5. Use the Caliper method to set the short axis on the long axis cross-sectional image or the short axis cross-sectional image.
6. Measure the cross-sectional diameter in the direction perpendicular to the long axis (= intermediate axis diameter) on the short axis cross-sectional image with the Caliper method.
   The volume value is displayed.

Example of Measurement Results Display

Volume 1:	
Vol: cm^3	: Volume
x-ax: cm	:Long axis of the long axis view
y-ax: cm	:Short axis of the long axis view
z-ax: cm	:Intermediate axis of the short axis view

Volume1/Volume2 measurement: Ellipse method

Approximates the image of the part to be measured as an ellipsoid, and computes the volume. The short axis cross-section is assumed to be a circle.

Procedure

1. Press [Measurement] button on the touch panel.
2. Select the [Volume1]or [Volume2] from the measurement menu.
   The + mark is displayed.
3. Set the long axis with the long axis view.
4. Set the measurement target with the Ellipse method.
   The volume is displayed. To redo, press [Cancel] key.

Example of Measurement Results Display

Volume 1:	
Vol: cm^3	: Volume
Area: cm^2	: Area
x-ax: cm	: Long axis
y-ax: cm	: Short axis

Volume1/Volume2 measurement: Ellipse + Caliper method

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Measures the two orthogonal cross-sectional images. Measure the long axis and short axes using the Ellipse method. On the other image, measure the cross-sectional diameter in the direction perpendicular to the long axis (= intermediate axis diameter) with the Caliper method. It calculates the volume from the 3 measured axes as a spheroid.

Procedure

1. Display the orthogonal intersecting long axis cross-sectional image and the short axis cross-sectional image with the B/B mode.
2. Press [Measurement] button on the touch panel.
3. Select the [Volume1]or [Volume2] from the measurement menu.
   The + mark is displayed.
4. Set the ellipse on the long axis view with the Ellipse method.
   The area is displayed.
   To redo, press [Cancel] key.
5. Measure the cross-sectional diameter in the direction perpendicular to the long axis (= intermediate axis diameter) on the short axis cross-sectional image with the Caliper method.
   The volume value is displayed.

Example of Measurement Results Display

`Volume 1:`	
`Vol:` cm^3	: Volume
`Area:` cm^2	: Area
`x-ax:` `cm`	: Long axis of the long axis view
`y-ax:` `cm`	: Short axis of the long axis view
`z-ax:` `cm`	: Intermediate axis of the short axis view

(4) Angle Measurement: Angle

Measures the angle at which 2 straight lines intersect.
The 2 Caliper method and Point method can be used for taking this measurement.
Using the 2 Caliper Method for Measurement

Procedure

1. Press [Measurement] button on the touch panel.
2. Select [Angle] from the Measurement menu.
   The + mark is displayed.
3. Use the Caliper method to draw a straight line along one side of the angle to be measured.

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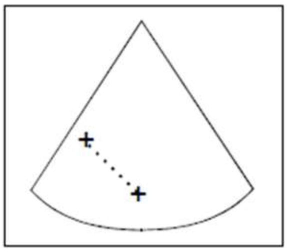
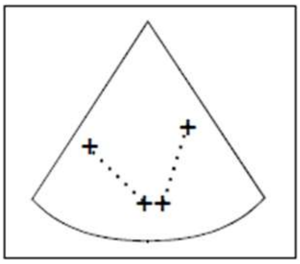


4. Draw a straight line along the other side of the angle using the Caliper method.



The angle of the 2 intersecting straight lines is displayed.

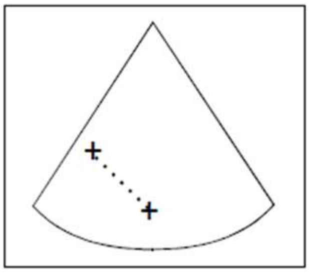
Example of Measurement Results Display

Angle:	
Angle1: °	:Angle
D1: cm	:Length of 1st side
D2: cm	:Length of 2nd side

Measuring Angles with the **Point Method**

Procedure

1. Press [Measurement] button on the touch panel.
2. Select [Angle] from the Measurement menu.
   The + mark is displayed.
3. Move the + mark to the one side of the angle to measure and press [Enter] key.
4. Move the + mark to the vertex of the angle to measure and press [Enter] key.



5. Move the + mark to the one side of the angle to measure and press [Enter] key.

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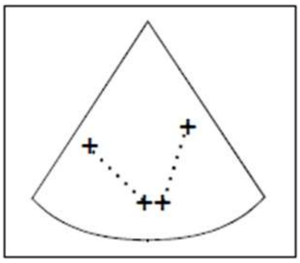

The angle is displayed.

Example of Measurement Results Display

`Angle:`	
`Angle1:      °`	:Angle
`D1:         cm`	:Length of 1st side
`D2:         cm`	:Length of 2nd side

(5) General Purpose Index Measurement: B.Index

The general purpose index (A/B, B/A, |A-B|/A) is obtained from two measurement values A and B.

The following measurement methods are available.

Use B.Index in the measurement preset ([Create Measurement Tools > Basic Measurement > Measured Method & Display Items > B.Mode]) to set the measurement method.

Measurements Methods	Measurements	Unit	Measurements results display	Remarks
Caliper	Distance	cm	B.Index(Calp)	Measures the target distance.
Ellipse	Area	cm^2	B.Index(Ellp)	This measurement approximates the target range to an ellipse.
Circle	Area	cm^2	B.Index(Circ)	This measurement approximates the target range to a circle.
Trace	Area	cm^2	B.Index(Trac)	This measurement approximates the target range to a trace.

Procedure

1. Press [Measurement] button on the touch panel.
2. Select [B.Index] from the Measurement menu.
   The + mark is displayed.
   The method is displayed as "B. Index(Calp)" in the measurement results display.
3. Measure measurement target A.
4. Measure measurement target B.
   The general purpose index is displayed.

Example of Measurement Results Display

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`B.Index(Calp)`	Measurement method in parentheses.
`A/B:`	Indices
`1A:     cm`	Measurement of A (when the Ellipse, Circle or Trace method is used, cm^2)
`2B:     cm`	Measurement of B (when the Ellipse, Circle or Trace method is used, cm^2)

(6) Histogram Measurement: Histogram

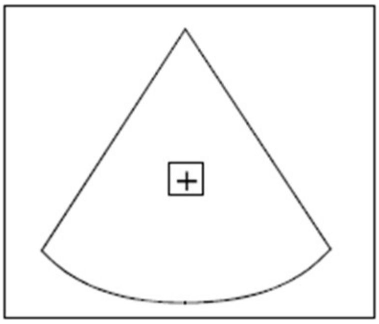
Displays the echo intensity data and the intensity distribution of echoes in the ROI of the ultrasound tomographic image as a histogram.
The ROI shape and size can be set with Histogram under the measurement preset ([Create Measurement Tools > Basic Measurement > Measured Method & Display item > B.Mode]).

ROI Shape	ROI Size	Measurement Results Display	Description
Square	Free Fixed: 5, 7, 10, 15	Hist-Box ##	Displays the size (mm) in ##.
Circle	Free Fixed: 5, 7, 10, 15	Hist-Cir ##	Displays the size (mm) in ##.
Rectangle	Any rectangle	Hist-Rect	Set the target range on the cross-sectional image.
Trace	Trace range	Hist-Trace	Trace the target region on the cross-sectional image.

The factory default setting of ROI Shape is "Square", and ROI Size is 10 mm.
When images are saved in the system, histogram measurements can be made if the images are saved in the Line or Palette formats.
NOTE: This measurement is affected by setting conditions, such as TGC or Gain. When making comparisons using multiple images, it is necessary to bear in mind any differences in their setting conditions.

Procedure

1. Display a cross-sectional image of the part to be measured in the B mode, and freeze it.
2. Press [Measurement] button on the touch panel.
3. Select [Histogram] from the Measurement menu.
   ROI is displayed.If the shape of the ROI is Square, the display will appear like the following.



4. Set the ROI size (when the ROI Size is "Free", or ROI Shape is "Rectangle" or "Trace").

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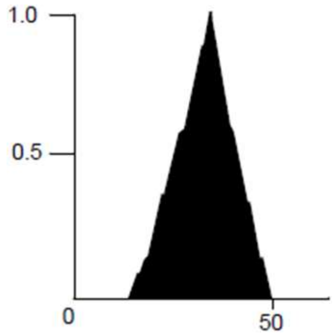
5. Move the ROI to the region of interest, and press [Enter] key.
   Brightness data and a histogram are displayed in the measurement results (see the figure below).



Frequency distribution of the brightness gradation level
X-axis:
Brightness level of pixels in the ROI (0 to 63).
Y-axis:
Shows the frequency of appearance of the brightness level gradation level of the total number of pixels as 100%.

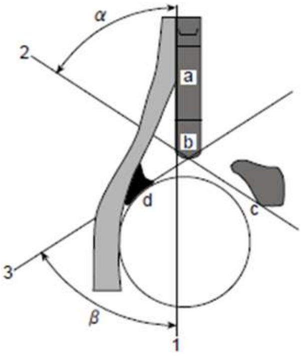
To continue measurements, press [Enter]. Continue and set up to 3 ROIs.

Example of Measurement Results Display

`Hist-Box 10`	:ROI Shape and Size (mm)
`T:`	:Number of echo brightness pixels sampled from within the ROI
`L:`	:Most frequent (echo brightness) gradient value inside the ROI
`M:`	:Number of pixels at the most frequent gradient value in the ROI
`MN:`	:Average gradient value (echo brightness) in the ROI
`SD:`	:Standard deviation of gradient value inside the ROI

(7) Measurement of Congenital Dislocation of the Hip Joint: Hip J Angle

Measurement is based on Graf's ultrasound classification using the echo of the hip joint for neonate or infant by means of a lateral approach. This measurement is an aid for diagnosing the degree of congenital dislocation of the hip joint in a patient.
NOTE: The patient's age may be used when classifying the degree of dislocation. Normally the age data calculated from the DOB in the patient data is used. If the age is input directly, 12 weeks or 84 days or more is treated as 3 months.
Angles α and β are measured from three auxiliary lines (1 - 3).



1. Base Line
2. Bony roof line
3. Cartilage roof line
α. Bony roof angle
β. Cartilage roof angle
a. The point where the acetabular perichondrium and the iliac wall meet
b. Bony acetabular rostrum
c. Lower iliac margin
d. The main echo of the acetabular labrum

Procedure

1. Display the hip joint image in the 1B mode and freeze.
   <u>Drawing pattern:</u>

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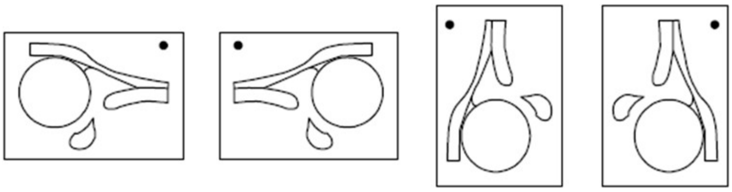
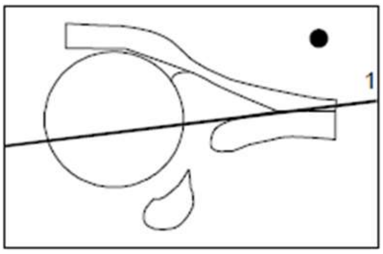
Congenital dislocation of the hip joint can be measured using the pattern below. In either case, it is assumed that the direction in which the active mark (●) is displayed is the head, and the direction in which there is no active mark is the foot.

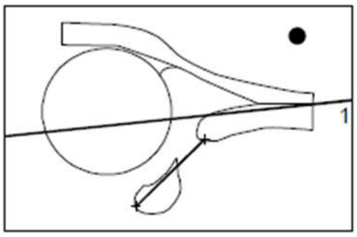


NOTE: Measurements cannot be made in the B/B mode. Displayed in 1B mode.
NOTE: Invert U/L, Invert L/R, Image Rotation and Depth/Range are changed at this stage. The changes cannot be made once the measurement has started.

2. Press [Measurement] button on the touch panel.
3. Select the [Rt.Hip J Angle]or [Lt.Hip J Angle] from the measurement menu.
   The + mark is displayed.
4. Set up the Baseline.
   a. Use the trackball to move the + mark to one end of the Baseline, and press [Enter] key.
   b. Move the + mark to the other end and press [Enter] key.
      The Baseline is confirmed.



5. Set up the Bony roof line.
   a. Use the trackball to move the + mark to one end of the Bony roof line, and press [Enter] key.
   b. Move the + mark to the other end and press [Enter] key.
      The Bony roof line and angle α are confirmed.



6. Set up the cartilage roof line.
   a. Use the trackball to move the + mark to one end of the Cartilage roof line, and press [Enter] key.
   b. Move the + mark to the other end and press [Enter] key.
      Three auxiliary lines are drawn in enlarged form.

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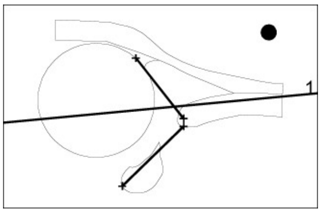

Example of Measurement Results Display

Rt Hip Angle	
1Baseline	
2A(1-2): °	:Bony roof angle (angle formed by auxiliary lines 1 & 2: α)
3B(1-3): °	:Cartilage roof angle (angle formed by auxiliary lines 1 & 3: β)

Graf's Ultrasound Classification

The Hip type as estimated based on the angles, α, β and patient age is classified based on the following. Set the dislocation type display with Hip J Angle under the preset ([Create Measurement Tools > Basic Measurement > Measured Method & Display Items > B.Mode]).

Table5: Hip Type based on Graf's classification

Sub Classification TYPE	Hip Type Assessment Standard			Dislocation Type Displayed
	α	β	Patient age	
I	α ≥ 60		every	I
II a	50 ≤ α ≤ 59		Age < 3 months	II a
II b	50 ≤ α ≤ 59		Age ≥ 3 months	II b
II c	43 ≤ α ≤ 49	β ≤ 77	every	II c
D	43 ≤ α ≤ 49	β > 77	every	D
III	α < 43		every	III, IV
IV	α < 43		every	III, IV
	50 ≤ α ≤ 59		Age unknown	II a, II b
	43 ≤ α ≤ 49		every	II c, D
	other cases	other cases		??

2.2.2 M mode

(1) Distance (amplitude) Measurement: M.Length

Measures the distance between two points on the same time phase on an M mode image.

Procedure

1. Press the [Measurement] button on the touch panel.
2. Select [M. Length] from the Measurement menu.
   + mark appears on the line cursor.
3. Measure the distance (amplitude) using the Caliper method.
   The distance is displayed.
4. To continue the measurement, move the + mark to the next point and press [Enter] key.

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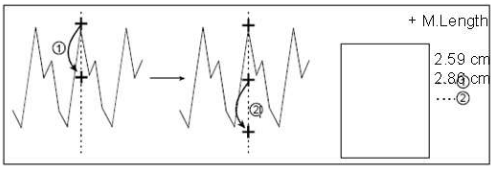


Multiple distance measurements can be made in succession. Five segments made up of 6 points in the same phase can be measured.

Example of Measurement Results Display

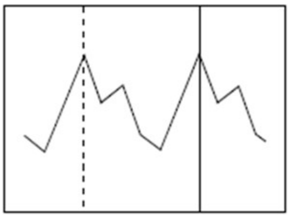
M.Length	
d1: cm	: Distance between marks 1 - 2
d2: cm	: Distance between marks 2 - 3
d3: cm	: Distance between marks 3 - 4

(2) Time Measurement: Time

Use the steps below to measure the time between two points on an M mode image.

Procedure

1. Press the [Measurement] button on the touch panel.
2. Select [Time] from the Measurement menu.
   The line cursor is displayed.
3. Set the starting time and ending time with the Caliper method.



The time between the two points is displayed.

Example of Measurement Results Display

dt: ms	:Time between two points

(3) Heart Rate Measurement: Heart Rate

Measures the heart rate during the time between two points on the M mode image.

- Heart rate during the time between two points
  Select HR under the measurement preset ([Create Measurement Tools > Basic Measurement > Measured Method & Display Items > M.Mode]).

Procedure

1. Press the [Measurement] button on the touch panel.
2. Select [Heart Rate] from the Measurement menu.
   The line cursor is displayed.

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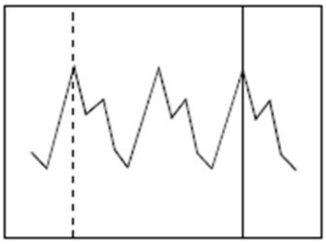
3. Measure the heart rate in the results display using the Caliper method.



The heart rate and the time between the two points are displayed.

Example of Measurement Results Display

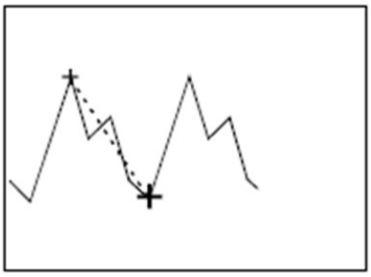
`HR:          BPM`	: Heart rate
`dt:           ms`	:Time between two points (corresponding to HR below)
`every 2 beats`	: Number of heart beats between two points

(4) Velocity Measurement: M.VEL

Use the following steps to measure the time, amplitude and velocity from the inclination between two points on an M mode image.

Procedure

1. Press the [Measurement] button on the touch panel.
2. Select [M. VEL.] from the Measurement menu.
   The + mark is displayed.
3. Set the start and end point positions with the Caliper method.



The velocity, amplitude and time between the two points are displayed.

Example of Measurement Results Display

`M.VEL`	
`  v:      cm/s`	:Velocity
`  dD:     cm`	:Amplitude (distance)
`  dt:      ms`	:Time

(5) General Purpose Index Measurement: M.Index

The general purpose index (A/B, B/A, |A-B|/A) is obtained from two measurement values A and B. The following measurement methods are available.

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Use M.Index in the measurement preset ([Create Measurement Tools > Basic Measurement> Measured Method & Display Items > M.Mode]) to set the measurement method.

Measurement Methods	Measurement Target	Measurements Target	Unit	Measurement Results Display
Line	Length	Distance (amplitude)	cm	M.Index(Leng)
Line	Time	Time	ms	M.Index(Time)
Caliper	Velocity	Velocity	cm/s	M.Index(Vel.)

Procedure

1. Press the [Measurement] button on the touch panel.
2. Select [M.Index] from the Measurement menu.
   The + mark is displayed.
   The measurement target is displayed as "M. Index(Leng)" under the measurement results display screen.
3. Measure measurement target A.
4. Measure measurement target B.
   The general purpose index is displayed.

Example of Measurement Results Display

	: Measurement method in parentheses.
`A/B:`	: Indices
`1A:        cm`	: Measured value of A
`2B:        cm`	: Measured value of B

2.2.3 D mode

NOTE: When performing multiple measurements of blood flow on a blood flow waveform drawn using the color Doppler method as a guide, use identical recording conditions (forward and reverse flow directions) for all of the blood flow waveforms.
The measured blood flow values obtained using this system are displayed in absolute values on the observation monitor. They are managed as positive and negative values for the purpose of calculating the arithmetic index.
If the display of each measured value in a report is set to "Average" in the preset, the positive and negative values are added together and displayed as a mean value. If the blood flow directions are different, correct results will not be displayed.

(1) Time Measurement: Time

Use the steps below to measure the time between two points on an D mode image.

Procedure

1. Press the [Measurement] button on the touch panel.
2. Select [Time] from the Measurement menu.

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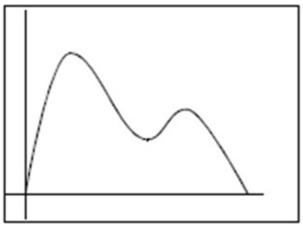
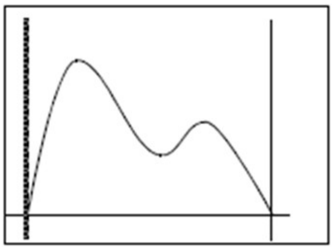
The line cursor is displayed.



3. Set the start and end point positions with the Caliper method.



The time between the two points is displayed.

Example of Measurement Results Display

`dt:        ms`	:Time between two points

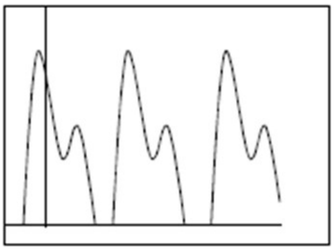
(2) Heart Rate Measurement: Heart Rate

You can measure the heart rate from the time between two points on an D mode image

- Heart rate during the time between two points
  Use HR in the measurement preset ([Create Measurement Tools > Basic Measurement> Measured Method & Display Items > D.Mode])).

Procedure

1. Display the D mode image.
2. Press the [Measurement] button on the touch panel.
3. Select [Heart Rate] from the Measurement menu.
   The line cursor is displayed.



4. Set the start and end point positions with the Caliper method (position of the heart rate part in the results display).

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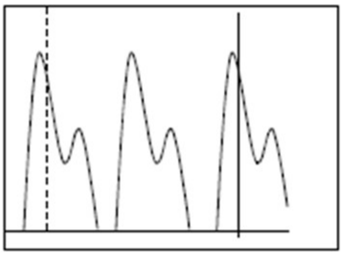


Set the start and end point positions with the Caliper method (position of the heart rate part in the results display).

Example of Measurement Results Display

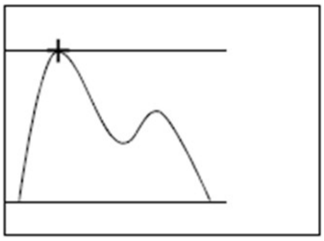
`HR:          BPM`	: Heart rate
`dt:          ms`	:Time between two points (corresponding to HR below)
`every 2 beats`	: Number of heart beats between two points

(3) Blood Flow Velocity Measurement: D.Velocity1

Use the steps below to measure the peak blood flow velocity and the peak pressure gradient.

Procedure

1. Press the [Measurement] button on the touch panel.
2. Select [D.VEL1] from the Measurement menu.
   The + mark is displayed.



3. Use the trackball to move the + mark to the measurement point, and press [Enter].
   It displays the peak velocity and the peak pressure gradient.

Example of Measurement Results Display

`D.VEL1`	
`pV:         cm/s`	: Peak blood flow velocity
`PG:         mmHg`	: Peak pressure gradient

(4) Blood Flow Velocity Measurement: D.Velocity2

Use the steps below to measure the blood velocity at the two points and the flow velocity ratio on a D mode image.

Procedure

1. Display the D mode image and freeze it.

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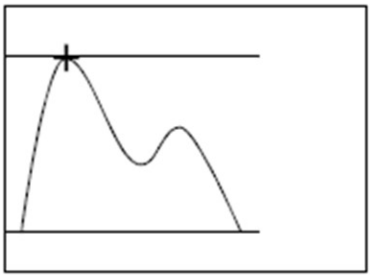
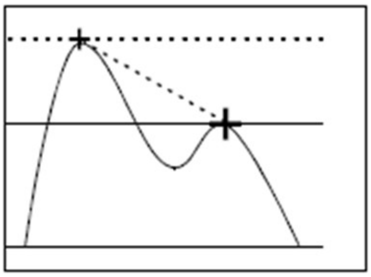
2. Press the [Measurement] button on the touch panel.
3. Select [D.VEL2] from the Measurement menu.
   The + mark is displayed.



4. Use the trackball to move the + mark to the first measurement point, and press [Enter].
5. Use the trackball to move the + mark to another measurement point, and press [Enter].



The flow velocities at the two points and the ratio of those blood flow velocities are displayed.

Example of Measurement Results Display

D.VEL2	
v1: cm/s	:Blood flow velocity of measurement point 1
v2: cm/s	:Blood flow velocity of measurement point 2
dV: cm/s	:Blood velocity difference
v1/v2:	:Blood flow velocity ratio

(5) Acceleration (deceleration) Measurement: ACCEL

Use the steps below to measure the acceleration (deceleration) between two points on an D mode image.

Procedure

1. Display the D mode image and freeze it.
2. Press the [Measurement] button on the touch panel.
3. Select [ACCEL] from the Measurement menu.
   The + mark is displayed.
4. Set the start and end point positions with the Caliper method.

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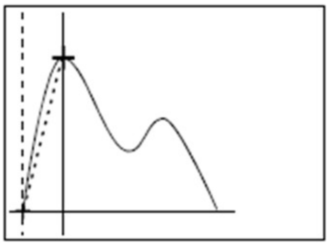


The acceleration between the two points is displayed.

Example of Measurement Results Display

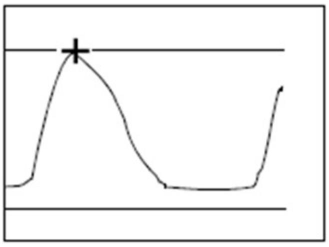
ACCEL	
ACC: cm/s^2	:Acceleration (DEC: is displayed if deceleration)
v1: cm/s	:Blood flow velocity at the start point
v2: cm/s	:Blood flow velocity at the end point
dt: m/s	:Time between two points
dV: cm/s	:Blood flow velocity deviation between two points

(6) Resistance Index Measurement: RI

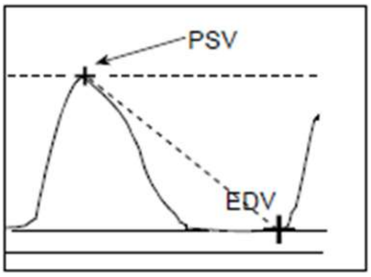
You can measure the RI (Resistance Index) from the two flow velocity values (PSV and EDV) on the blood flow waveform pattern.

Procedure

1. Display the D mode image and freeze it.
2. Press the [Measurement] button on the touch panel.
3. Select [RI] from the Measurement menu.
   The + mark is displayed.
4. Use the trackball to move the + mark to the peak-systolic velocity (PSV), and press [Enter].



5. Use the trackball to move the + mark to the end diastolic velocity (EDV), and press [Enter].



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"RI" and "S/D" are displayed.

Example of Measurement Results Display

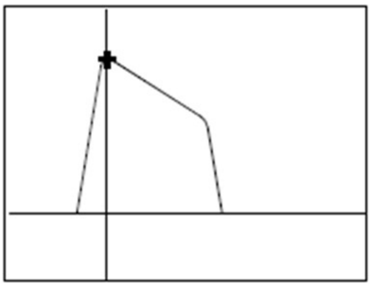
RI	
RI:	: Resistance Index
S/D:	: Systolic/Diastolic Velocity Ratio
PSV: cm/s	:Peak Systolic Velocity
EDV: cm/s	: End Diastolic Velocity

(7) Pressure Half-Time Measurements: P1/2T

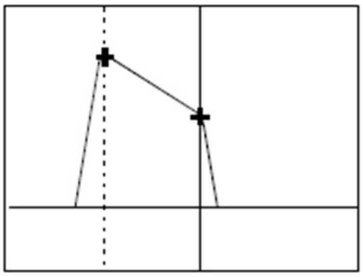
Measures the pressure half-time. The valve area can also be calculated from the pressure half time.

Procedure

1. Display the D mode image and freeze it.
2. Press the [Measurement] button on the touch panel.
3. Select [P1/2T] from the Measurement menu.
   The + mark is displayed.
4. Use the trackball to move the + mark to the peak velocity point, and press [Enter].



5. Use the trackball to move the + mark so the auxiliary line follows the deceleration waveform, and press [Enter].



"P1/2T" and "VA" are displayed.

Example of Measurement Results Display

P1/2T	
P1/2T: ms	: Pressure half-time
VA: cm^2	: Stenosis valve area estimated from the stenosis blood flow
pV: cm/s	: Peak velocity at stenosis

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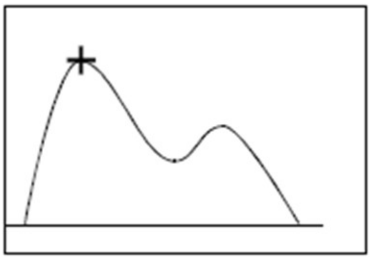
PG: mmHg	: Pressure gradient corresponding to pV

(8) Dop Caliper Measurement: D.Caliper1, D.Caliper2

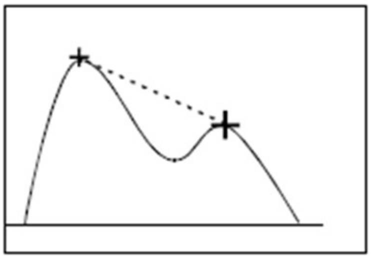
Use the steps below to measure the blood flow velocity, blood flow velocity difference, time difference, blood flow velocity ratio, and so on, between two points on the D mode image.

Procedure

1. Display the D mode image and freeze it.
2. Press the [Measurement] button on the touch panel.
3. Select the [D.Caliper1] or [D.Caliper2] from the measurement menu.
   The + mark is displayed.
4. Use the trackball to move the + mark to the measurement point, and press [Enter].



5. Use the trackball to move the + mark to another measurement point, and press [Enter].



The time between two points, acceleration or deceleration is displayed.

Example of Measurement Results Display

D.Caliper1	
v1: cm/s	:Blood flow velocity at the start point
v2: cm/s	:Blood flow velocity at the end point
dv: cm/s	:Blood flow velocity deviation between two points
dt: ms	:Time between two points
PG1: mmHg	:v1 pressure gradient
PG2: mmHg	:v2 pressure gradient
DEC: cm/s^2	: Deceleration between v1 - v2 (acceleration is indicated as ACC).

(9) General Purpose Index Measurement: D.Index

The general purpose index (A/B, B/A, |A-B|/A) is obtained from two measurement values A and B. The following measurement methods are available.

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The measurement method can be set with D.Index under the preset ([Create Measurement Tools > Basic Measurement > Measured Method & Display Items > D.Mode]).

Measurement Methods	Measurement Target	Measurement Target	Unit	Measurement Results Display
D.Index(Caliper)	Velocity	Velocity	cm/s	D.Index(Vel.)
	PG	Pressure gradient	mmHg	D.Index(PG)
	Time	Time	ms	D.Index(Time)
D.Index(Trace)	MnVel	Mean velocity	cm/s	D.Index(MnV)
	MPG	Mean pressure gradient	mmHg	D.Index(MPG)
	VTI	Velocity time integral	cm	D.Index(VTI)

Procedure

1. Press the [Measurement] button on the touch panel.
2. Select [D.Index] from the Measurement menu.
   The + mark is displayed.
   The method is displayed as "D. Index (Vel.)" on the measurement results display screen.
3. Measure measurement target A.
4. Measure measurement target B.
   The general purpose index is displayed.

Example of Measurement Results Display

D.Index(Vel.)	: Measurement method in parentheses. Display example is velocity.
B/A:	:Indices
1A: cm/s	:Measured value of A
2B: cm/s	:Measured value of B

(10) Measurement of Mean Velocity and Mean Pressure Gradient: Mean VEL

You can trace the blood flow waveform and measure blood flow data such as the mean velocity and the mean pressure gradient.

Procedure

1. Display the D mode image and freeze it.
2. Press the [Measurement] button on the touch panel.
3. Select [Mean VEL] from the Measurement menu.
   The + mark is displayed.
4. Use the Doppler Trace method to trace the blood flow waveform.

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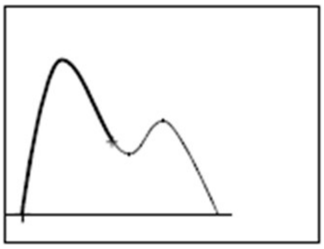


The trace line and the measurement results are displayed.

Example of Measurement Results Display

Mean VEL	
MnV: cm/s	: Mean velocity
MPG: mmHg	: Mean pressure gradient
VTI: cm	: Velocity time integral
FlowT: ms	: Flow time

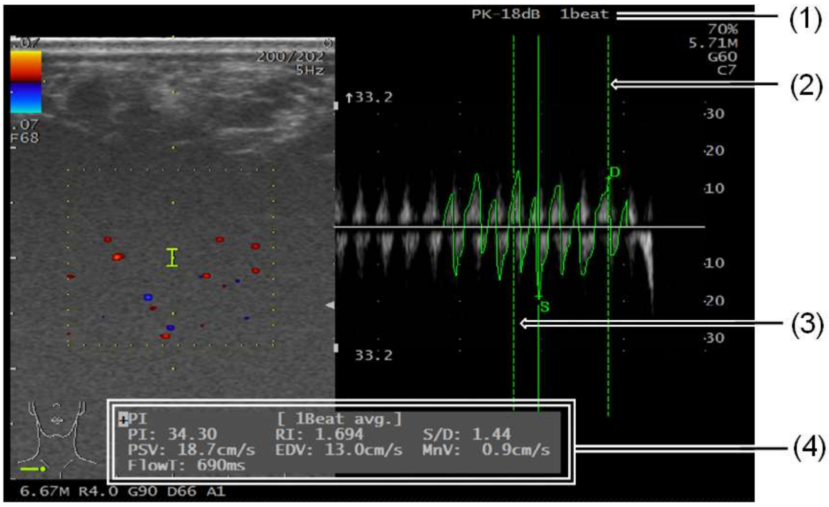
(11) Pulsatility Index Measurement: PI

You can trace the blood flow waveform and measure data on hemodynamics, such as PI, RI, and S/D.

NOTE: It has been reported that minimum diastolic velocity is also used to calculate this index. End-diastolic blood velocity (EDV) and the minimum diastolic velocity are not necessarily identical. If required, adjust the EDV phase to the end-diastolic or minimum diastolic velocity point.

Procedure

1. Display the D mode image and freeze it.
2. Press the [Measurement] button on the touch panel.
3. Select [PI] from the Measurement menu.
4. Use the Manual Trace method or Auto Trace method to trace the blood flow waveform. A line cursor accompanied by "S", "D" is displayed.



```
PI                  [ 1Beat avg.]
 PI: 34.30          RI: 1.694       S/D: 1.44
 PSV: 18.7cm/s      EDV: 13.0cm/s   MnV:  0.9cm/s
 FlowT: 690ms
```

Example of PI measurement display.

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(1) detected heart rate, (2) active heartbeat (dashed line), (3) start point of detected heartbeat waveform, (4) measurement results.

5. Select a heartbeat (when multiple heartbeats are traced).
    a. Select [Beat Select] from the [Meas] tab in the function menu.
    b. Use [Pointer] rotary encoder to select a heartbeat.
    The selected heartbeat is displayed with a broken line connecting its start point and the start point of the next heartbeat.
6. Adjust the "S" (Peak Systolic Velocity point) position, and press [Enter] key.
7. Align "D" (End Diastolic Velocity point) position to the end-diastolic or minimum blood flow velocity point and press [Enter] key.
8. Adjust the start point (rising point in the waveform), and press [Enter] key.

Example of Measurement Results Display

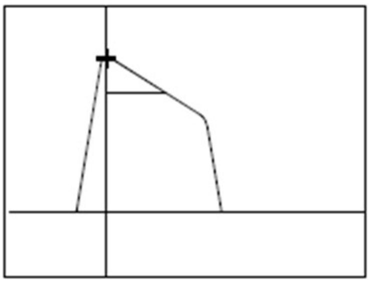
PI	
PI:	: Pulsatility Index
RI:	: Resistance Index
PSV: cm/s	:Peak Systolic Velocity
EDV: cm/s	: End Diastolic Velocity
MnV: cm/s	: Mean Velocity
FlowT: ms	: Flow Time
[1 Beat avg.]	: Detected Heartbeats

(12) Stenosis Flow Measurement: Steno Flow

You can trace the stenosis blood flow waveform and measure the stenosis valve passage peak blood flow velocity (pV), maximum pressure gradient between valves (PG), the mean pressure gradient (MnPG) and pressure half-time (P1/2T).

Procedure

1. Display the D mode image and freeze it.
2. Press the [Measurement] button on the touch panel.
3. Select [Steno Flow] from the Measurement menu.
4. Use the Doppler Trace method to trace the blood flow waveform.
    The PV line cursor is displayed.



5. Adjust the PV point position with the trackball, and press [Enter] key.

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Example of Measurement Results Display

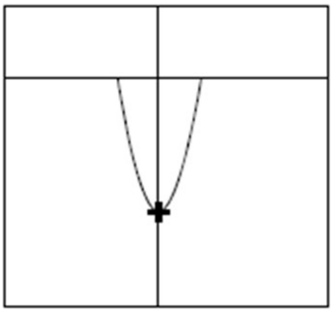
Steno Flow	
MnV: cm/s	: Mean Velocity
MPG: mmHg	: Mean pressure gradient
pV: cm/s	: Peak blood flow velocity
VTI: cm	: Velocity time integral
FlowT: ms	: Flow time
P1/2T: ms	: Pressure half-time
VA: cm^2	: Valve area

(13) Regurgitant Flow Measurement: Regurg Flow

Use the steps below to trace the regurgitant flow waveform and measure the peak valve regurgitation blood flow velocity (pV) and the peak pressure gradient between valves (PG).

Procedure

1. Display the D mode image and freeze it.
2. Press the [Measurement] button on the touch panel.
3. Select [Regurg Flow] from the Measurement menu.
4. Use the Doppler Trace method to trace the blood flow waveform.
   The PV line cursor is displayed.



5. Adjust the PV point position with the trackball, and press [Enter] key.

Example of Measurement Results Display

Regurg Flow	
MnV: cm/s	: Mean velocity
MPG: mmHg	: Mean pressure gradient
pV: cm/s	: Peak blood flow velocity
PG: mmHg	: Pressure gradient
FlowT: ms	: Flow time

(14) D. Trace Measurement: D.Trace1, D.Trace2

Measures the Doppler information from the traced waveform.

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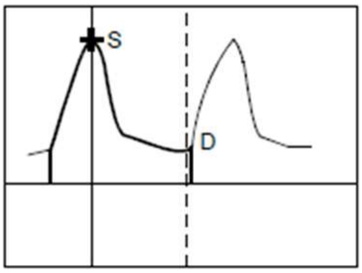
The names of "D.Trace1" and "D.Trace2" can be set by the user. Use Name Assignment in the measurement preset ([Create Measurement Tools > Basic Measurement > Measured Method & Display Items > D.Mode]) to select a method.

Procedure

1. Display the D mode image and freeze it.
2. Press the [Measurement] button on the touch panel.
3. Select the [D.Trace1] or [D.Trace2] from the measurement menu.
4. Use the Doppler Trace method to trace the blood flow waveform.
   A line cursor accompanied by "S", "D" is displayed.



5. Adjust the "S" (PSV) position with the trackball, and press [Enter] key.
6. Adjust the "D" (EDV) position, and press [Enter] key.

Example of Measurement Results Display

D Trace1:	
PSV: cm/s	: Peak systolic velocity
EDV: cm/s	: End diastolic velocity
MnV: cm/s	: Mean velocity
dv: cm/s	:Deviation between the velocities of PSV and EDV
PG1: mmHg	:PSV pressure gradient
PG2: mmHg	:EDV pressure gradient
MPG: mmHg	:Mean pressure gradient
dPG: mmHg	:Deviation in the pressure gradient (PG1-PG2)
VTI: cm	:Velocity time integral
FlowT: ms	:Flow time

(15) Real Time Doppler Auto Trace

This function automatically traces the Doppler waveform in real-time D mode and displays the Doppler information for the most recent single heartbeat. You can also perform tracing immediately after the image is frozen without tracing in real time. The calculated Doppler information can be transferred to an application measurement.
This is suitable for use with the pulsatile waveform of peripheral arteries, such as the carotid artery.

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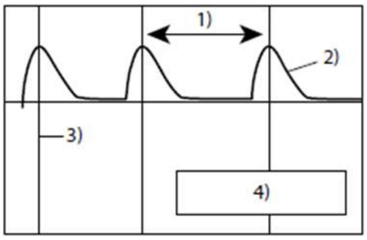

1) Most recent single heartbeat
The most recent single heartbeat is displayed.
2) Trace Line
The line traced by the Peak method is displayed.
3) R-wave search line cursor
While the ECG signals are being displayed, it is displayed at the timing of when an R-wave is detected. It is also displayed when the image is frozen.
4) Measurement results display
Measurement values such as PI, RI, S/D, PSV and EDV are displayed for the most recent single heartbeat.

When PI and RI are calculated using Real Time Doppler Auto Trace measurement, the minimum blood flow velocity point during a single heartbeat is the EDV. In the case of a waveform in which the polarity of the blood flow changes during the interval between the systole and the diastole, as is the case with the arteries of the lower extremities, the peak of the waveform that has undergone a polarity change is detected as EDV.
The following settings are required before Real Time Doppler Auto Trace measurement begins.

- Navigate the preset to [Preset Set-Up Menu > Doppler2] and set the items to be displayed to Doppler2/>[On] under D. Trace Display Items.
- Assign the following to the function menu using Preset ([Preset Set-Up Menu> Menu-Function]).
  [Doppler Auto Trace]
  [Trace Threshold]
  [Freeze Trigger]
  [Trace Direction]
  [Trace Smooth]
  [Trace Locate]
- Set up the menu for transferring applied measurements after measurement.
  - Make function menu settings.
    Use the preset ([Preset Set-Up Menu > Menu-Function])to assign Menu-Function />[Transfer Menu Auto Display] to the function menu.
    Once selected, the menu display can be switched during measurement.
  - Set to display after freezing.
    This appears only when all the following conditions are met.
    - Set Measurement Transfer List under the preset [Preset Set-Up Menu > Doppler2]) to Doppler2/>"Auto".
    - Set trackball Priority (Freeze On) in the preset [Preset Set-Up Menu > Display2]) to Display2/>"Measurement".
    - Set Basic measurements are displayed together. in the measurement preset ([Create Measurement Tools >Application Measurement > Display Form]) to Application Measurement > Display Form />"No"

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- Set the [Freeze Trigger] to "On" during measurement.

Tracing the Doppler Waveform in Real-time

This function traces a Doppler waveform in real-time display.

Procedure

1. Display a satisfactory D mode image in real-time.
    - Velocity range settings
      Set to avoid aliasing.
    - Wall filter settings
      Navigate the preset to [Preset Set-Up Menu > Doppler1] and make settings under Wall Filter. The mean flow velocity is calculated in the PI/RI measurement. The mean value of the flow velocity is calculated based on all velocity components that are displayed relative to the most recent single heartbeat. If the low velocity components are removed from the Doppler waveform by excessive application of the wall filter, etc., the mean velocity will be underestimated and could affect the PI value.
    - Dop Gain settings
      Adjust D mode gain so that the sonogram is free of noise.
    - Angle correction settings
      Correct the angle difference between the angle of incidence of the Doppler waveform ultrasound and the blood vessel.
2. Select [Doppler Auto Trace] from the function menu.
   The trace line and the measurement results for the most recent single heartbeat are displayed on a Doppler waveform of a D mode image.
   The result is displayed as "***" if a Doppler waveform required for the measurement cannot be captured.
   Measurement results are updated when a new R-wave is detected (as the most recent heartbeat is updated).
3. Select [Trace Direction] from the function menu and set the trace range.
4. Select and adjust the trace range.
   Adjusting the detection level of the trace line
   Select [Trace Threshold] from the function menu and make adjustments.
   Smoothing trace line
   Select [Trace Smooth] from the function menu and make adjustments.
5. Press [Freeze] key and freeze the image.
   This also freezes the Doppler waveform and the measurement results.
   When the image conditions change as a result of the search function, a change in the sweep velocity, or a request, the trace line and the measurement results are updated accordingly. If there is no valid heartbeat on the screen, no measurement values are displayed.
   When the menu for transferring to applied measurement is displayed, the measurement results can be transferred to the applied measurement items. Select [Transfer Menu Auto Display] from the function menu when the transfer menu is not displayed.
6. Select [Doppler Auto Trace] to finish tracing.

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Example of Measurement Results Display

RT Doppler Auto Trace:	
PI: .	: Pulsatility Index
RI: .	: Resistance Index
S/D: .	:Ratio of Velocity between Systole and Diastole
D/S: . .	:Ratio of Velocity between Diastole and Systole
PSV: . cm/s	: Peak Systolic Velocity
EDV: . cm/s	: End Diastolic Velocity
MnV: . cm/s	: Mean Velocity
FlowT: ms	: Flow Time

After measurement results are confirmed, they can be measured again using the Doppler Trace method (Auto Trace or Manual Trace).

Reference information

2.2.6(3) Transferring Basic Measurement Results to Applied Measurements on page 76

Tracing the Doppler Waveform after Freezing

You can perform automatic tracing immediately after an image is frozen, without tracing it in real time, and then display the Doppler information.

Prior confirmation

Set the [Preset Set-Up Menu > Doppler2] Freeze Trigger to "On".

Procedure

1. Display a satisfactory D mode image in real-time.
    - Velocity range settings
      Set to avoid aliasing.
    - Wall filter settings
      Navigate the preset to [Preset Set-Up Menu > Doppler1] and make settings under Doppler1/> Wall Filter. The mean flow velocity is calculated in the PI/RI measurement. The mean value of the flow velocity is calculated based on all velocity components that are displayed relative to the most recent single heartbeat. If the low velocity components are removed from the Doppler waveform by excessive application of the wall filter, etc., the mean velocity will be underestimated and could affect the PI value.
    - Dop Gain settings
      Adjust D mode gain so that the sonogram is free of noise.
    - Angle correction settings
      Correct the angle difference between the angle of incidence of the Doppler waveform ultrasound and the blood vessel.
2. Press [Freeze] key and freeze the image.
   The D mode image is traced and the trace line and the calculation results are displayed. When the image conditions change as a result of the search function, a change in the

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sweep velocity, or a request, the trace line and the measurement results are updated accordingly. If there is no valid heartbeat on the screen, no measurement values are displayed.

  - To transfer the measurement results to the applied measurement items, select [Transfer Menu Auto Display] from the function menu.

Reference information

2.2.6(3) Transferring Basic Measurement Results to Applied Measurements on page 76

2.2.4 B/D Mode

Basic measurements that can be made in the B/D mode include any volume of blood flow measurement. Select a measurement appropriate for blood flow. Use FV (Vein) for steady flow, FV (Artery) MnV or FV (Artery) VTI for artery (pulsatile blood flow).
This section describes the methods used for [Enter & +].

Reference information

1.2 Measurement Methods on page 26

(1) FV (Artery) MnV

Calculates the blood flow volume in the pulsatile blood flow waveform from the time-averaged maximum blood flow velocity (MnV) and flow path cross-sectional area (CSA).

- Coefficient setting
  Correction using a coefficient may be required with peripheral arteries or portal veins. Set coefficients using COEF under the measurement preset ([Create Measurement Tools > Basic Measurement > Measured Methods & Display Items > D.Mode]).
  The factory default coefficient (COEF) setting is 1.00..
- Setting for the method for measuring the cross-sectional diameter (CSD) or cross-sectional area (CSA)
  The measuring method can be set in CSA Method in the measurement preset ([Create Measurement Tools> Basic Measurement > Measured Methods & Display Items > D.Mode]).
  - "Caliper": Measure the CSD with the caliper method and then calculate the CSA based on the CSD being the diameter of a circle.
  - "Trace": Measure CSA using the B Trace method.
  - "Ellipse": Measure CSA using the Ellipse method.
  - "Circle": Measure CSA using the Circle method.

Procedure

1. Display the B/D mode image and freeze it.
   To improve measurement accuracy
   Expand the cross-section image in the B mode. Accuracy will improve, especially when measuring the cross-sectional area CSA with the caliper method.

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2. Press the [Measurement] button on the touch panel.
3. Select [FV (Artery) MnV] from the measurement menu.
4. Measure the interval of single heartbeat with the Doppler Trace method
5. Press the [Caliper]key.
6. Measure the cross sectional diameter (CSD) or cross sectional area (CSA).
   The flow path cross-sectional area (CSA) and blood flow volume are displayed.

Example of Measurement Results Display

FV(Artery)MnV	
1MnV: cm/s	: Mean Velocity
2CSA: cm^2	: Cross-sectional area
CSD: cm	:Cross-sectional diameter
FV(MnV):	
ml/m	:Blood flow volume for one minute
COEF: 1.00	: Coefficient
[1Beat avg.]	: Detected heartbeats

(2) FV (Artery) VTI

Calculates the blood flow volume from the velocity time integral value of one heartbeat (VTI), flow path cross-sectional area (CSA) and heart rate.

- Setting for the method for measuring the cross-sectional diameter (CSD) or cross-sectional area (CSA)

Procedure

1. Display the B/D mode image and freeze it.
   To improve measurement accuracy
   Expand the cross-section image in the B mode. Accuracy will improve, especially when measuring the cross-sectional area (CSA) with the Caliper method.
2. Press the [Measurement] button on the touch panel.
3. Select [FV (Artery) VTI] from the measurement menu.
4. Measure the interval of single heartbeat with the Doppler Trace method
   The velocity-time integration value (VTI) and HR are calculated.
5. Press the [Caliper]key.
6. Measure the cross sectional diameter (CSD) or cross sectional area (CSA).
   The flow path cross-sectional area (CSA) and blood flow volume are displayed.

Example of Measurement Results Display

FV(Artery)VTI	
1VTI: cm	: Velocity-time integral value

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2HR: BPM	: Heart rate
3CSA: cm^2	: Cross-sectional area
CSD: cm	:Cross-sectional diameter
FV: ml/b	:Blood flow volume corresponding to 1 beat
FV: ml/m	: Blood flow volume per minute
[1Beat avg.]	: Detected heartbeats

Reference information

2.2.4(1) FV (Artery) MnV on page 69

(3) FV (Vein)

Calculates the flow blood volume in a steady blood flow waveform from the time-averaged flow velocity (MnV) and the cross-sectional area (CSA).

- Coefficient setting
  Correction using a coefficient may be required with peripheral arteries or portal veins. Set coefficients using COEF under the measurement preset ([Create Measurement Tools > Basic Measurement > Measured Methods & Display Items > D.Mode]).
  The factory default coefficient (COEF) setting is 1.00. Settings using animals or phantoms are on the scale of 0.5 to 0.7. There are reports of portal vein blood flow volume of 0.57.
- Setting for the method for measuring the cross-sectional diameter (CSD) or cross-sectional area (CSA)

Procedure

1. Display the B/D mode image and freeze it.
   To improve measurement accuracy
   Expand the cross-section image in the B mode. Accuracy will improve, especially when measuring the cross-sectional area (CSA) with the Caliper method.
2. Press the [Measurement] button on the touch panel.
3. Select [FV (Vein)] from the measurement menu.
4. Measure for an appropriate interval with the Doppler Trace method.
5. Press the [Caliper] key.
6. Measure the cross sectional diameter (CSD) or cross sectional area (CSA).
   The flow path cross-sectional area (CSA) and blood flow volume are displayed.

Example of Measurement Results Display

FV(Vein)	
1MnV:	
. cm/s	Mean velocity

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`2CSA: .` `cm`^{2}	Cross-sectional area
`CSD: .` `cm`	Cross-sectional diameter
`FV: .` `ml/m`	Blood flow volume per minute
`COEF:` `1.00`	Coefficient

Reference information

2.2.4(1) FV (Artery) MnV on page 69

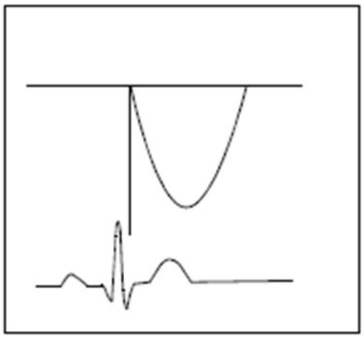
(4) Blood Flow Volume Measurement: SV/CO

Calculates the blood flow volume (SV, CO) in the pulsatile blood flow waveform from the velocity time integral value of one heartbeat (VTI), flow path cross-sectional area (CSA) and the heart rate.

- Setting for the method for measuring the cross-sectional diameter (CSD) or cross-sectional area (CSA)

Procedure

1. Display the B/D mode image and freeze it.
   <u>To improve measurement accuracy</u>
   Expand the cross-section image in the B mode. Accuracy will improve, especially when measuring the cross-sectional area (CSA) with the Caliper method.
2. Press the [Measurement] button on the touch panel.
3. Select [SV/CO] from the measurement menu.
4. Use the Auto Trace or Manual Trace to trace the blood flow waveform for an interval of one heartbeat.
   The trace line and the line cursor for heartbeat measurement are displayed.



5. Press the [Enter]key.
   <u>When no ECG is displayed</u>
   Measure the heartbeat.

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6. Measure the cross sectional diameter (CSD) or cross sectional area (CSA).
   The blood flow volume (SV, CO) is displayed.

Example of Measurement Results Display

`SV/CO`	
`1VTI: cm`	:Velocity time integral
`2HR: BPM`	:Heart rate (1 beat)
`3CSA:` cm^2	: Cross-sectional area
`CSD: cm`	:Cross-sectional diameter
`SV: ml`	: 1 stroke volume
`CO: l/m`	: Cardiac output

Reference information

2.2.4(1) FV (Artery) MnV on page 69

2.2.5 B/Flow Mode

The measurements that can be made in B/Flow mode include measurement of the blood flow volume.

(1) Blood Flow Volume Measurement: Flow Profile

This function makes it easy to measure the blood flow volume of the tubular peripheral vascular system (including the carotid artery) with good reproducibility. These measurements can be applied to the peripheral vascular system throughout the body. It is not applicable to non-circular vessels such as veins or for measuring blood flow in the heart cavities.
The one-dimensional flow rate profile detected by the Color Doppler method is expanded to a two-dimensional profile. The individual flow values from the two-dimensional profile are multiplied by the areas of the respective micro-area elements to obtain the individual flow volumes, which are totaled in order to quantify the instantaneous blood flow. The blood flow volume which flows for any given time in a region of interest can be calculated with the integration processes of instantaneous blood flow in a longitudinal direction.
The target of this measurement is successive multiple B/Flow images.
If you pay attention to the following points during image acquisition, an improvement in measurement accuracy can be expected.

1. Image and blood vessel to be measured
   - A tomographic image of the maximum diameter of the blood vessel and a long axis view with a flow direction that is as uniform as possible
   - The image must be saved in the system in the RGB+Line format.
2. Color image display settings

Related items	Description
[Velocity range]	There must be no aliasing caused by the range being too low. Nor must there be any end-diastole frames without color caused by being set too high.

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Related items	Description
Wall Filter (Color Flow)	Should be set at the lowest value that ensures unwanted signals are not displayed.
Rejection (Color Flow)	Do not use.
Gain (Color Flow)	Adjust so that the blood vessel lumen is well integrated within the color signal and the interference is not distracting.
[Persistence]	Set at the lowest value
[Line Density (Color Flow)]	Set as high as possible. There is greater error when the frame rate lowers and there are fewer frames for one heartbeat.
[Smoothing]	Set to Off.
[Wall Motion Reduction]	Set as low as possible.

3. Position of the physiological signal waveform display
   Set to the bottom of the screen, the same as the factory default.

Procedure

1. Depict a good long axis cross-section image continuing and passing through the center of blood vessel using the normal Color Doppler method, then press [Freeze] key.
2. Set the interval for flow volume measurement.
   a. If the trackball function display is not on "Playback", press [T.B.F] key.
   b. Use the trackball to display the start frame and press [Enter] key.
   c. Use the trackball to display the end frame and press [Enter] key.
3. Press the [Measurement] button on the touch panel.
4. Select [Flow Profile] from the measurement menu.
   The mark "A" for the blood flow measurement is displayed on the screen.
5. Set the flow volume profile line.
   a. Move mark "A" close to the anterior vessel wall.
   b. Press the [Enter]key.
      The profile line A-B is displayed. The position where you initially set A is displayed as B.
   c. Move mark "A", for measuring the blood flow, close to the back of the posterior vessel wall so that the profile line passes through the center of the blood vessel and is perpendicular to the vascular wall.
      A blood flow volume profile graph is displayed on the left side of screen.

   Precautions when setting profile lines
   Pay attention to the following points when setting profile lines to increase measurement accuracy.

   - Align the profile line A-B bar with the anterior and posterior vessel wall. Refer to the diagram below.
   - Do not include other vessels on the profile line (color information)
6. Press the [Enter]key.

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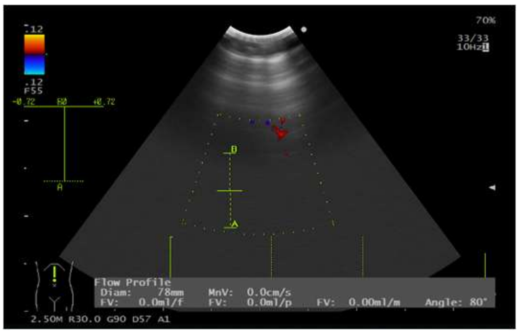
The blood flow volume "FV" (ml/p) and the minute blood flow (ml/m) volume corresponding to the target are displayed. The flow volume change curve is displayed at the bottom of the screen.



Flow Profile
Diam: 78mm
FV: 0.0ml/f
MnV: 0.0cm/s
FV: 0.0ml/p
FV: 0.00ml/m
Angle: 80°

(1) Profile line A-B
(2) Flow volume profile graph
(3) Flow volume change curve
(4) Search mark

7. If necessary, reset the arbitrary section flow volume.
    a. Use the trackball to move the search mark to the initial frame of the flow volume change curve.
    b. Press the [Enter]key.
    c. Move the search mark to the end frame position of the flow volume change curve. The blood flow volume corresponding to the set sector is displayed.

Example of Measurement Results Display

`Flow Profile`	
`Diam:        mm`	:Internal vessel diameter on the profile line
`MnV:         cm/s`	:Mean blood flow velocity on the profile line between A-B
`FV:          ml/f`	:Blood flow volume corresponding to 1 frame
`FV:          ml/p`	:Blood flow velocity of the specified segment
`FV:          ml/m`	: Blood flow volume per minute
`Angle:       °`	:Angle between the ultrasound beam and flow direction at the center of the blood vessel

If the flow volume being measured is low, the volume tends to be slightly overestimated due to the impact of the flow filter.
Where low speed components are suppressed by the filter, the average flow rate value tends to be higher than the real value. When an average flow rate value is high, there is little effect, even if low speed components are suppressed, but the effect becomes evident when an average flow rate is low. For this reason, the tendency to overestimate the flow rate becomes apparent in low flow rate conditions.

2.2.6 Editing Basic Measurement Results

Up to 10 measurements results can be displayed with basic measurements. These measurements results can be corrected and sent to applied measurements.

(1) Modifying and Remeasuring Basic Measurement Results

The following presets have to be made:

- Assign [Sel Ch] to the [Meas] tab in the function menu.

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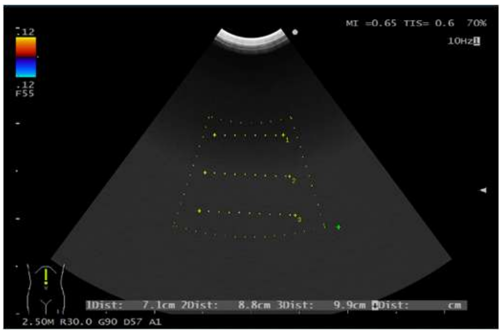
Use the measurement preset ([SW Assignment > Touch Panel SW Assignment]) to set this function.

Procedure

1. Select [Cancel] if the caliper mark is displayed.
2. Select [Sel Ch] from the [Meas] tab in the function menu.
   The measurement results are highlighted.



3. Select measurement results you wish to correct or delete.
   The selected measurement results are deleted.
   The caliper mark for taking new measurements is displayed. If you continue and remeasure as is, that number is displayed with the measurement results.

(2) Deleting Caliper Marks

The caliper mark and the measurement results are erased from the screen.

Procedure

1. Select [Clear] from the [Meas] tab.
2. Press the [Measurement] button on the touch panel.
3. Unfreeze the image.
   If Caliper Auto Off is set to [ON] for a given measurement, the caliper mark and the measurement results are erased.
   Basic measurements can be configured with the measurement preset ([Create Measurement Tools > Basic Measurement > Caliper Auto Off]). Applied measurements can be configured with the measurement preset ([Create Measurement Tools > Application Measurement> Caliper Auto Off]).

(3) Transferring Basic Measurement Results to Applied Measurements

This is for using the results from basic measurements as the parameters for applied measurements.

Prior confirmation

The following presets have to be made:

- Assign [Transfer] to the [Meas] tab in the function menu. Use the measurement preset ([SW Assignment > Touch Panel SW Assignment]) to set this function.

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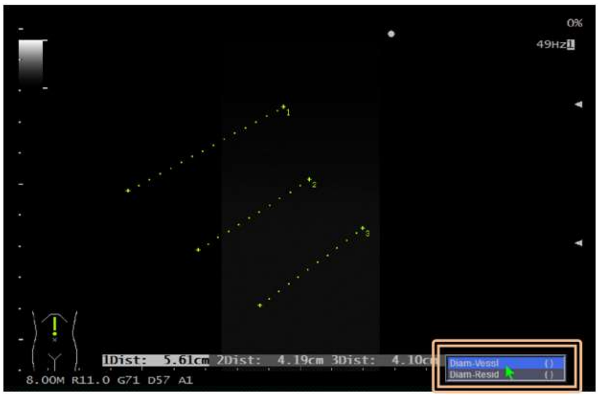
- Set the measurements that can be transferred.
  Use the measurement preset ([Study Assignment > (Study Name) > Tranfer List Assign]) to set this measurement.
- Assign [Transfer Menu Auto Display] to the function menu using preset ([Preset Set-Up Menu > Menu-Function]) for transferring Menu-Function/>Real Time Doppler Auto Trace to applied measurements.

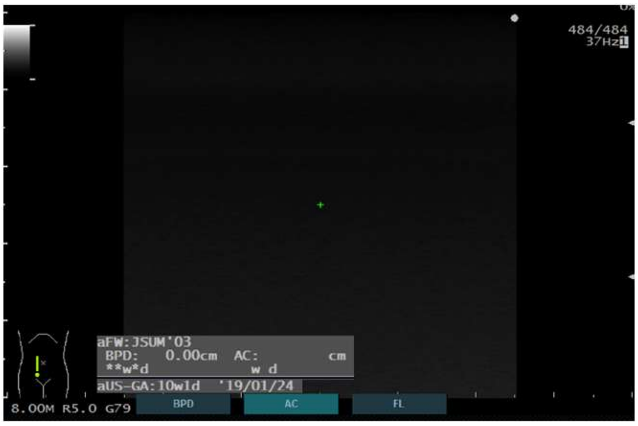
Procedure

1. Press the [Caliper] key to start basic measurement.
2. Select [Transfer] from the [Meas] tab in the function menu.
3. Select the basic measurement results you wish to transfer.



```
1Dist:  5.61cm 2Dist:  4.19cm 3Dist:  4.10c
8.00M R11.0 G71 D57 A1
```

4. Select applied measurement items for the transfer destination from the transfer destination list, and then transfer the measurement results.



```
aFW:JSUM'03
 BPD:   0.00cm  AC:        cm
 **w*d             w d
aUS-GA:10w1d  '19/01/24
8.00M R5.0 G79
```

To transfer Real Time Doppler Auto Trace
Select [Transfer Menu Auto Display] from the function menu and then select the applied measurement parameters for the transfer destination.

5. Repeat steps 2 to 4 as needed, to transfer other basic measurement results.

Retaking Applied Measurements

When measurements have been completed, or when basic measurement results have been transferred to applied measurements, the measurements can be redone using these measurement results.

1. Select the applied measurement you wish to remeasure.

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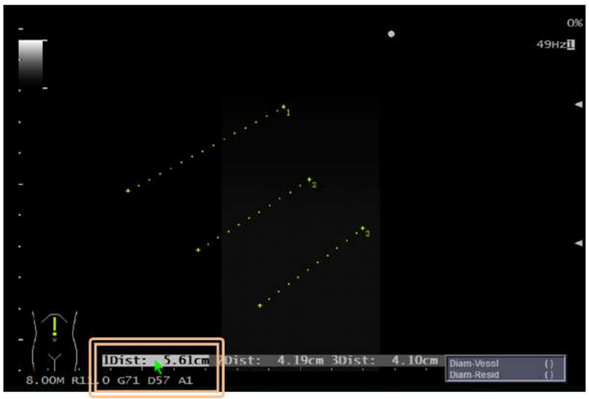
The measurement results are displayed in the parameters that have been measured. If there are any unmeasured parameters remaining, the parameter selection menu opens.



If all parameters have been measured, then just the measurement results are displayed.

2. Retake the measurements.

    a. If all the parameters have been measured, Press [Measurement] key.
    The measurement parameters selection menu opens.

    b. Operate [Pointer] rotary encoder to move the highlight and press the [Enter] key.
    To remeasure Real Time Doppler Auto Trace
    Select ([Trace]) from the Measurement menu. When [Trace] is selected, the Real Time Doppler Auto Trace and trace line are erased.

    c. Measure those items.

2.2.7 Presets

Preset configuration is common across all applications (clinical fields). For the sake of explanation, the abdomen is used here.
The measurement presets consist broadly of the following 3 elements:

- Create Measurement Tools
  Makes settings related to measurement method, mark size, report display, and so on, for basic measurements and for applied measurements.

Basic Measurement	Sets the basic measurement method, mark style and result display items.
Measured Method & Display Items	Sets the measurement method, mark style, and result display items, for each measurement type.
B.Mode	B mode measurement settings.
M.Mode	M mode measurement settings.
D.Mode	D mode measurement settings.
F.Mode	F mode measurement settings.
Caliper Mark Control	Measurement mark size and dot line settings.
Unit Selection	Display unit settings for taking measurements.
Caliper Auto Off	Settings for automatically erasing measurement marks and results when the image is unfrozen.

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Display Form	Settings for the basic measurement result display style.
Mark Display	Settings for caliper mark display.
Application Measurement	Sets the application measurement method, mark style, and result display.
Measured Method & Display Items	Sets the measurement method, mark style, and result display items, for application measurements.
Caliper Mark Control	Settings for application measurement mark sizes and dot lines.[*1]
Unit Selection	Settings for application measurement mark sizes and dot lines.[*1]
Caliper Auto Off	Settings for automatically erasing measurement marks and results when the image is unfrozen.
Report Data	Selects the method of displaying measurement values in reports.
Display Form	Settings for the applied measurement result display style.
Mark Display	Settings for caliper mark display.
Users' Calculation	Settings for the applied measurement result display style.
Reserved Word	Settings for index names (reserved words) registered by the user.

*1.

Application (clinical field) is not displayed under Other.

- Study Assignment

  Settings for configuring the display of reports, transfer lists and menus, at the study level.

Defined Study Name	
Menu Assign	Function for creating and editing measurement menus.
Combined Report Display[*1]	Settings for the information presented in reports.
Transfer List Assign[*1]	Sets the basic measurement results that can be transferred to applied measurement items
Other	Settings for the display of measurement operational guide messages.

*1.

Application (clinical field) is not displayed under Other.

- SW Assignment

  Assigns measurement functions to menu items.

SW Assignment	Sets the measurement function to start when a specific menu item is selected.
Touch Panel SW Assignment	Sets the functions to be assigned to [Meas] tab on the function menu.
+Mark Key Assignment	Sets the measurement function to start when [Caliper] is selected.

NOTE: The HOME button is not available when the Preset screen is displayed.

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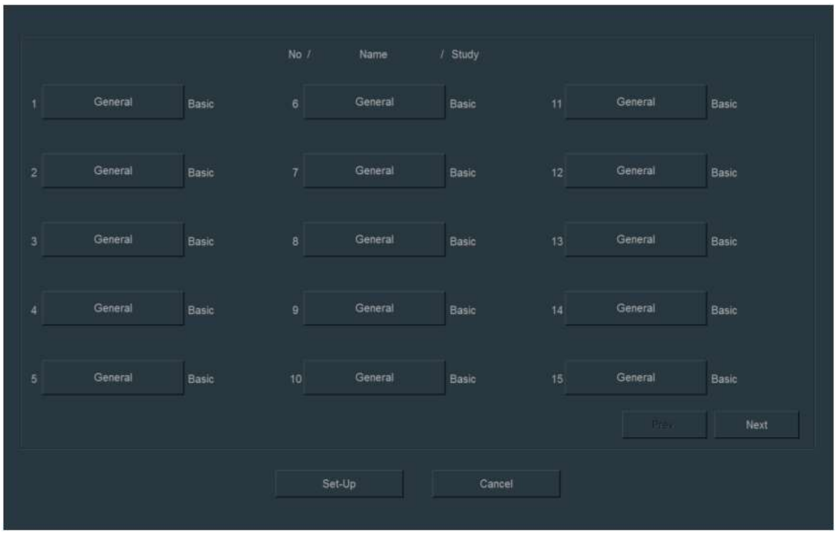
(1) Displaying Presets

There are two methods for displaying presets.

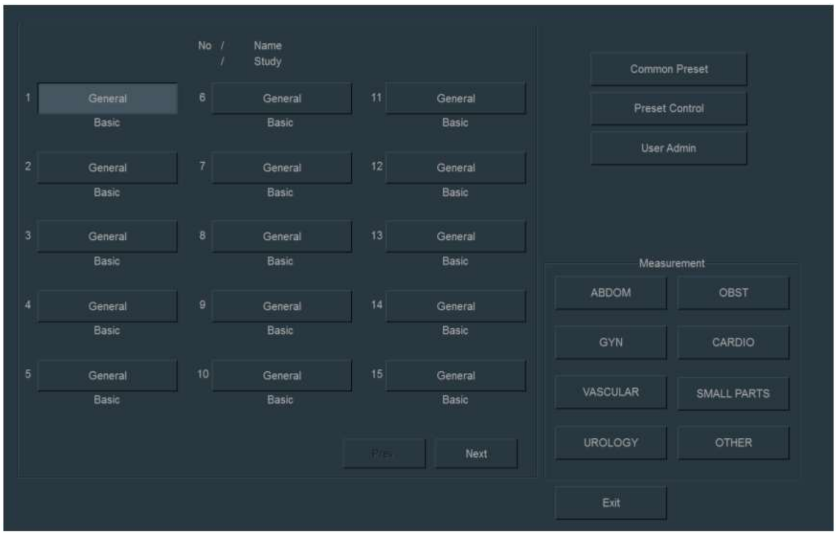
(a) Displaying Presets from the Function Menu.

Procedure

1. Select [Preset] from the [Accessories]]tab in the function menu.
   The Preset screen opens.


No / Name / Study
1 General Basic
2 General Basic
3 General Basic
4 General Basic
5 General Basic
6 General Basic
7 General Basic
8 General Basic
9 General Basic
10 General Basic
11 General Basic
12 General Basic
13 General Basic
14 General Basic
15 General Basic
Prev
Next
Set-Up
Cancel

2. Select [Set-Up].


No / Name
/ Study
1 General Basic
2 General Basic
3 General Basic
4 General Basic
5 General Basic
6 General Basic
7 General Basic
8 General Basic
9 General Basic
10 General Basic
11 General Basic
12 General Basic
13 General Basic
14 General Basic
15 General Basic
Prev
Next
Common Preset
Preset Control
User Admin
Measurement
ABDOM
OBST
GYN
CARDIO
VASCULAR
SMALL PARTS
UROLOGY
OTHER
Exit

3. Select an application from the Measurement list.
   The top page is displayed.
   If you select [ABDOM], the top page of the Abdom Preset opens:

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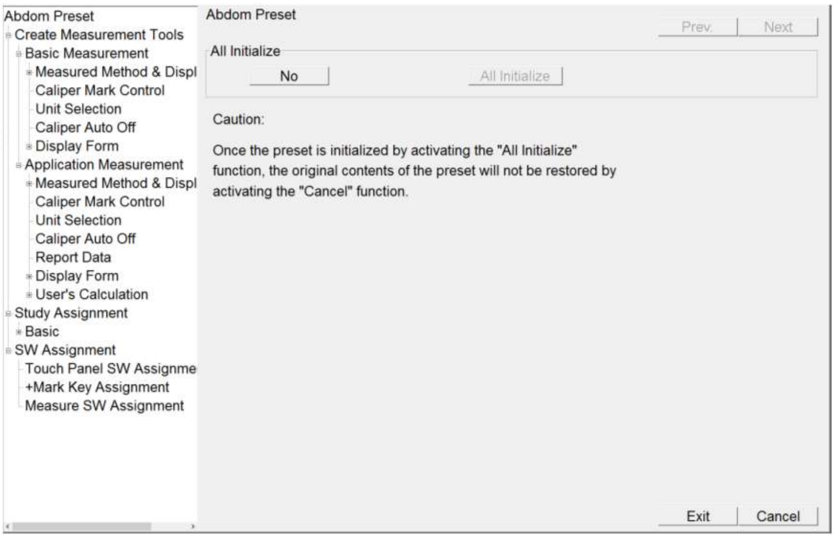

Abdom Preset
Create Measurement Tools
Basic Measurement
Measured Method & Displ
Caliper Mark Control
Unit Selection
Caliper Auto Off
Display Form
Application Measurement
Measured Method & Displ
Caliper Mark Control
Unit Selection
Caliper Auto Off
Report Data
Display Form
User's Calculation
Study Assignment
Basic
SW Assignment
Touch Panel SW Assignme
+Mark Key Assignment
Measure SW Assignment
Abdom Preset
Prev.
Next
All Initialize
No
All Initialize
Exit
Cancel

Caution:

Once the preset is initialized by activating the "All Initialize" function, the original contents of the preset will not be restored by activating the "Cancel" function.

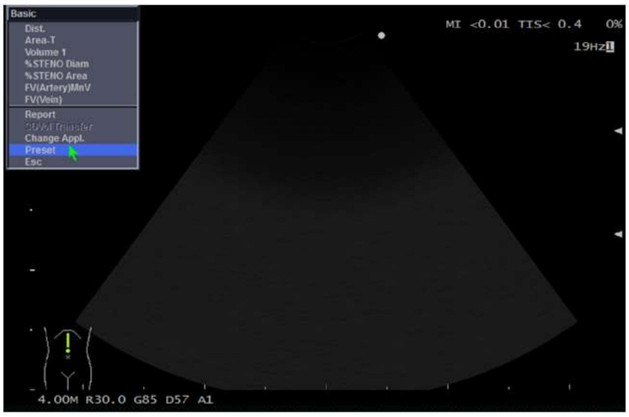
Buttons that are common to all Preset screens:

[Cancel]	Discards changes and closes the Preset screen.
[Exit]	Saves changes and closes the Preset screen.
[Next]	Goes to the next page.
[Prev.]	Goes to the previous page.

(b) Selecting Presets from the Measurement Menu.

Procedure

1. Press the [Measurement] button on the touch panel.

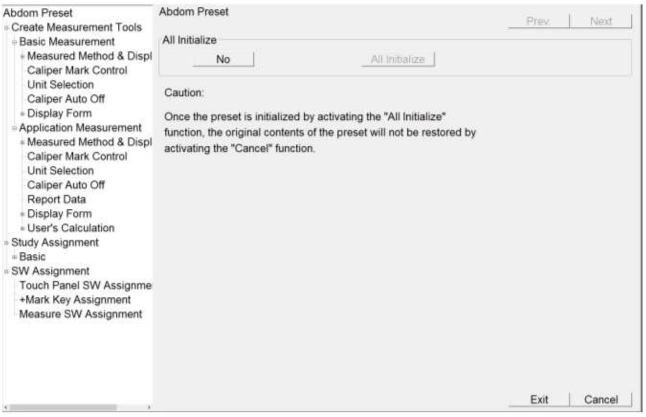

Basic
Dist.
Area-T
Volume 1
%STENO Diam
%STENO Area
FV(Artery)MnV
FV(Vein)
Report
3D Vol Transfer
Change Appl.
Preset
Esc
MI <0.01 TIS< 0.4 0%
19Hz
4.00M R30.0 G85 D57 A1

2. Select [Preset] from the measurement menu.

(2) Initializing presets

Returns the measurement application presets to their factory settings.

共通設計部


Abdom Preset
Create Measurement Tools
Basic Measurement
Measured Method & Displ
Caliper Mark Control
Unit Selection
Caliper Auto Off
Display Form
Application Measurement
Measured Method & Displ
Caliper Mark Control
Unit Selection
Caliper Auto Off
Report Data
Display Form
User's Calculation
Study Assignment
Basic
SW Assignment
Touch Panel SW Assignme
+Mark Key Assignment
Measure SW Assignment
Abdom Preset
Prev.
Next
All Initialize
No
All Initialize
Exit
Cancel

Caution:

Once the preset is initialized by activating the "All Initialize" function, the original contents of the preset will not be restored by activating the "Cancel" function.

Top Page (Abdom Preset)

Procedure

1. Select the name of an application from the tree view on the left side of the presets screen.
   The top page of the measurement preset is displayed.
2. Select [No] from the All Initialize field.
3. Select [All Initialize] when the "No" changes to "Yes".
   All the presets of that measurement application are initialized.
   Once presets are initialized, it is not possible to restore to the previous state, even by selecting [Cancel].

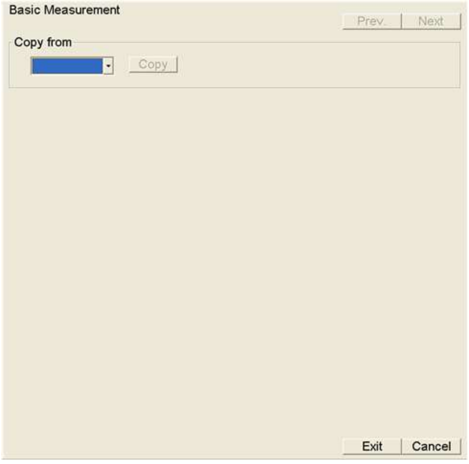
(3) Measurement-related Settings: Create Measurement Tools

Settings related to measurement methods, mark size, report display, and so on.
Create Measurement Tools are divided between basic measurements (basic measurement settings) and application measurements (applied measurement settings). Each type of measurement contains the following items.

Preset Items	Preset content
Measured Method & Display Items	Measurement methods and result display settings
Caliper Mark Control	Caliper mark display settings
Unit Selection	Result display unit settings
Caliper Auto Off	Display setting for measurement results and caliper marks after freeze is canceled
Report Data	Report display settings (Application Measurement only)
Display Form	Display settings for measurement results, and for caliper marks during measurement
Users Calculation	User index calculation formula settings (Application Measurement only)

The Basic Measurement top page has the following settings.

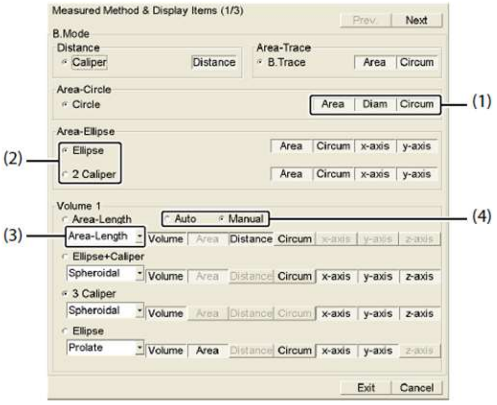
共通設計部


Basic Measurement
Prev.
Next
Copy from
Copy
Exit
Cancel

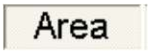
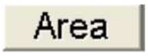
Copy From	Copy to Application list
Copy	Batch copies the basic measurement settings for the application selected with Copy From.

(a) Measurement Method and Results Display Settings: Measured Method & Display Items

Settings for measurement methods, caliper mark auxiliary line display, and report display. There are settings pages for each mode, as well as for both basic measurements and applied measurements.


Measured Method & Display Items (1/3)
Prev.
Next
B.Mode
Distance
Caliper
Distance
Area-Trace
B.Trace
Area
Circum
Area-Circle
Circle
Area
Diam
Circum
(1)
Area-Ellipse
(2)
Ellipse
2 Caliper
Area
Circum
x-axis
y-axis
Area
Circum
x-axis
y-axis
Volume 1
Area-Length
Auto
Manual
(4)
(3)
Area-Length
Volume
Area
Distance
Circum
x-axis
y-axis
z-axis
Ellipse+Caliper
Spheroidal
Volume
Area
Distance
Circum
x-axis
y-axis
z-axis
3 Caliper
Spheroidal
Volume
Area
Distance
Circum
x-axis
y-axis
z-axis
Ellipse
Prolate
Volume
Area
Distance
Circum
x-axis
y-axis
z-axis
Exit
Cancel

(1) Measurement results display settings

Options	Display example	Description
ON		Displays data as measurement results
ON		Does not display as measurement results.

(2) Measurement method settings

(3) Equation settings

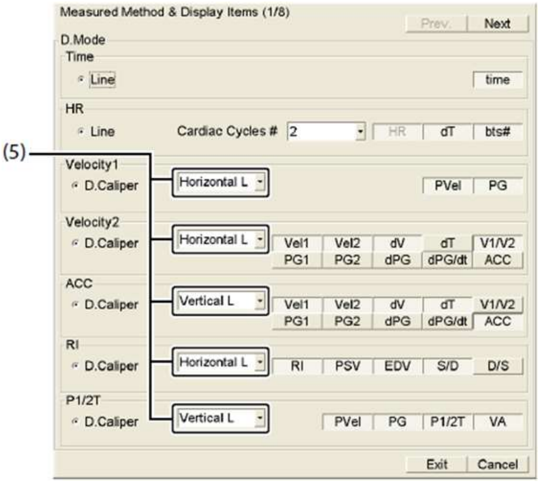
(4) Measurement method auto/manual setting

Measurement parameters	Options	Description
Area-Length	Auto	Once 3 points are specified for the boundary region, it automatically traces it.
	Manual	Trace the boundary from the start point.

共通設計部

Measurement parameters	Options	Description
D mode measurement	Auto	Once the trace range is specified, it automatically traces along the Doppler waveform.
	Manual	Trace along the Doppler waveform from the start point.
Flow Profile Measurement Specify Wall Position	Auto	Automatically recognizes the interior wall of a blood vessel for the specified segment.
	Manual	Manually set the wall of the blood vessel.

(5) Caliper mark auxiliary line settings



Measured Method & Display Items (1/8)

D.Mode

Time: ● Line

HR: ● Line, Cardiac Cycles # 2

Velocity1: ● D.Caliper, Horizontal L

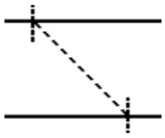
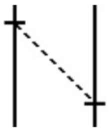
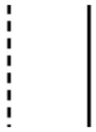
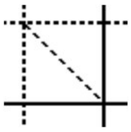
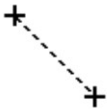
Velocity2: ● D.Caliper, Horizontal L

ACC: ● D.Caliper, Vertical L

RI: ● D.Caliper, Horizontal L

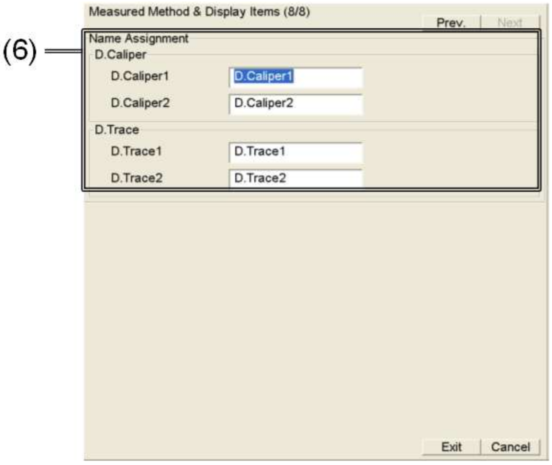
P1/2T: ● D.Caliper, Vertical L

(5)
Prev.
Next
time
HR
dT
bts#
PVel
PG
Vel1
Vel2
dV
dT
V1/V2
PG1
PG2
dPG
dPG/dt
ACC
Vel1
Vel2
dV
dT
V1/V2
PG1
PG2
dPG
dPG/dt
ACC
RI
PSV
EDV
S/D
D/S
PVel
PG
P1/2T
VA
Exit
Cancel

Options	Display example	Description
Horizontal L		Displays an auxiliary line parallel to the horizontal axis.
Vertical L		Displays an auxiliary line parallel to the vertical axis.
Line		Displays a line parallel to the vertical axis. Does not display the caliper marks.
Cross Line		Displays auxiliary lines parallel to both the vertical and horizontal axes.
Cross Point		Does not display auxiliary lines.

(6) Measurement name settings: Name Assignment

共通設計部



Measured Method & Display Items (8/8)

Name Assignment

D.Caliper

D.Caliper1 D.Caliper1

D.Caliper2 D.Caliper2

D.Trace

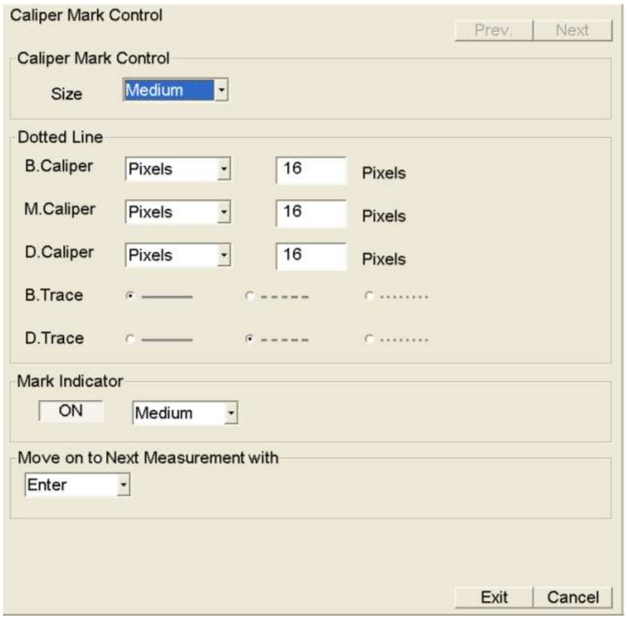
D.Trace1 D.Trace1

D.Trace2 D.Trace2

Changes the names of measurements built into the system. Names can be set up for the various application measurements, such as arterial blood flow, etc.

(b) Caliper Mark Display Settings: Caliper Mark Control

Settings for measurement mark size, dotted line display patterns, etc.



Caliper Mark Control

Caliper Mark Control

Size Medium

Dotted Line

B.Caliper Pixels 16 Pixels

M.Caliper Pixels 16 Pixels

D.Caliper Pixels 16 Pixels

B.Trace ● ——— ○ - - - - - ○ ········

D.Trace ○ ——— ● - - - - - ○ ········

Mark Indicator

ON Medium

Move on to Next Measurement with

Enter

Caliper Mark Control

Sets the size to display the measurement mark (caliper mark).

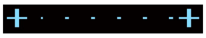
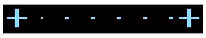
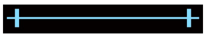
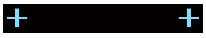
Setting item	Options	Description
Size	Small	Displays small caliper marks.
	Medium	Displays medium caliper marks.
	Large	Displays large caliper marks.

Dotted Line

Settings for the line that connects the caliper mark start and end points. Make settings separately for caliper marks and for trace lines.

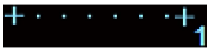
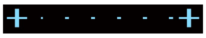
B Caliper, M Caliper, D Caliper

共通設計部

Options	Display example	Description
mm		(B mode only) Displays the line between the start and end points with a dotted line. Sets the space between points in mm units.
Pixels		Displays a dotted line between the start and end points. Set the space between points in pixel units.
Line		Displays the line between the start and end points with a straight line.
NA		Does not display any line between the start and end points.

Settings	Options	Description
B Trace D Trace	● ———	Displays a line between the start and end points.
	○ - - - - -	Displays a broken line between the start and end points.
	○ ········	Displays a dotted line between the start and end points.

Mark Indicator

Options	Display example	Description
ON		Displays the measured number to the lower right of the caliper marks (corresponding to the measurement result).
OFF		Displays only the caliper marks.
Small		Displays the measurement number in a small size font to the lower right of the caliper marks.
Medium		Displays the measurement number in a medium size font to the lower right of the caliper marks.

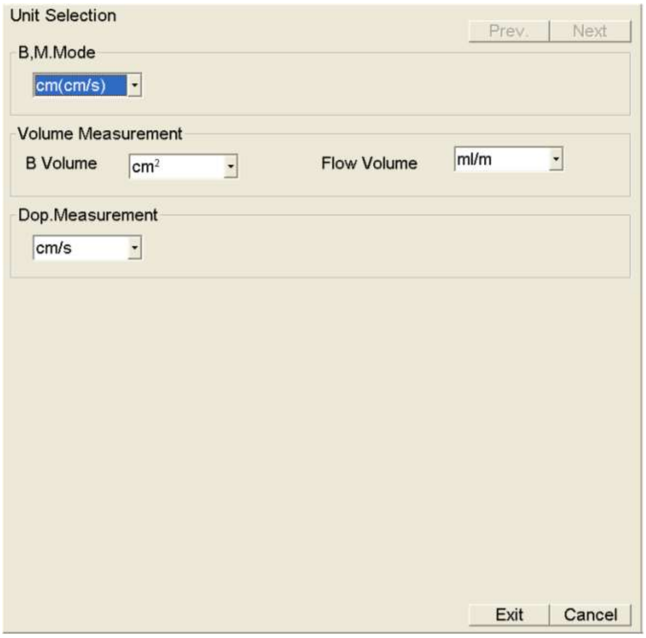
Move on to Next Measurement With

Options	Description
Enter	When you press [Enter] key, the position of the caliper mark is confirmed.
Enter & +	When you press [Enter] key, the active area of the caliper mark is switched (enables the other end to be modified).

(c) Display Unit Settings for Measurement Results: Unit Selection

Sets the units for displaying measurement results.
Select the display units from the list for both basic measurements and application measurements.

共通設計部


Unit Selection
Prev.
Next
Exit
Cancel

B,M.Mode: cm(cm/s)

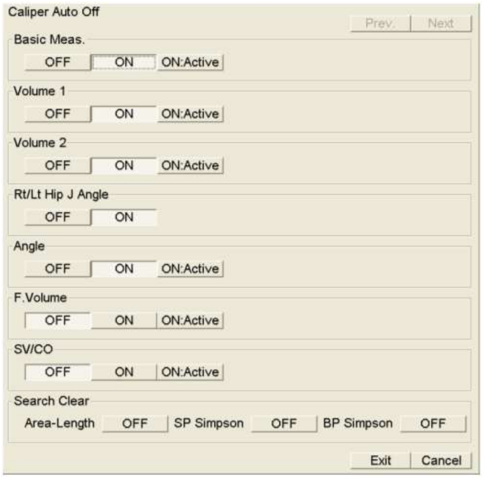
Volume Measurement: B Volume cm², Flow Volume ml/m

Dop.Measurement: cm/s

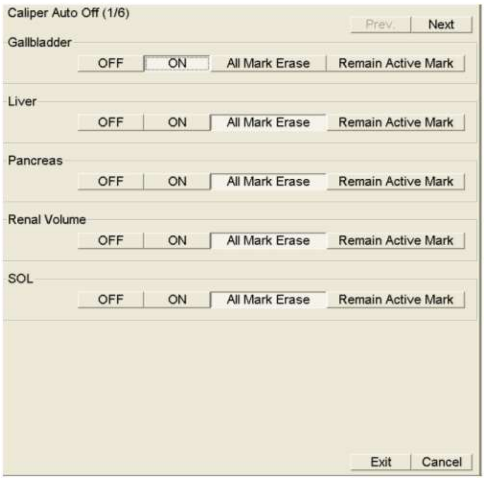
(d) Caliper Mark and Measurement Result Display Settings for When Freeze Is Canceled: Caliper Auto Off

Sets whether to show or hide caliper marks and measurement results when freeze is canceled.
The options differ between basic measurements and applied measurements.

Basic Measurement


Caliper Auto Off
Prev.
Next
Basic Meas.
OFF
ON
ON:Active
Volume 1
OFF
ON
ON:Active
Volume 2
OFF
ON
ON:Active
Rt/Lt Hip J Angle
OFF
ON
Angle
OFF
ON
ON:Active
F.Volume
OFF
ON
ON:Active
SV/CO
OFF
ON
ON:Active
Search Clear
Area-Length
OFF
SP Simpson
OFF
BP Simpson
OFF
Exit
Cancel

Application Measurement


Caliper Auto Off (1/6)
Prev.
Next
Gallbladder
OFF
ON
All Mark Erase
Remain Active Mark
Liver
OFF
ON
All Mark Erase
Remain Active Mark
Pancreas
OFF
ON
All Mark Erase
Remain Active Mark
Renal Volume
OFF
ON
All Mark Erase
Remain Active Mark
SOL
OFF
ON
All Mark Erase
Remain Active Mark
Exit
Cancel

Basic Measurement

Settings	Options	Description
Measurement parameters	OFF	Keeps displaying caliper marks and measurement results even after freeze is canceled.
	ON	Clears the display of caliper marks and measurement results when freeze is canceled.
	ON:Active	Clears the caliper marks of the active image and measurement results.

共通設計部

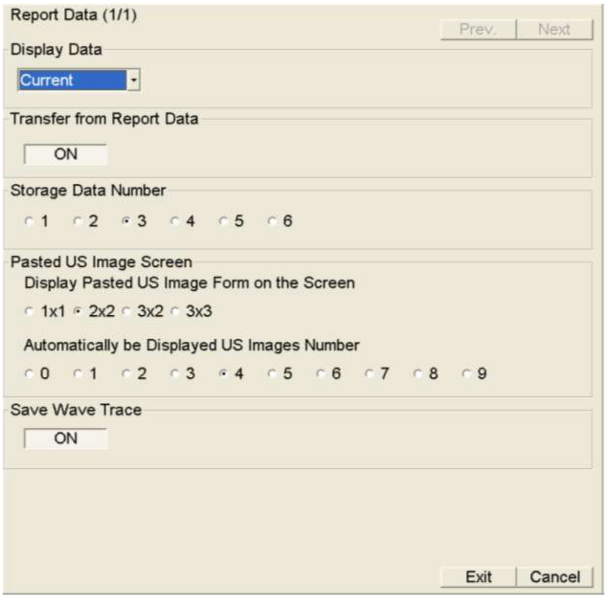
Settings	Options	Description
Search Clear Area-Length SP Simpson BP Simpson	ON	Clears caliper marks when using image search.
	OFF	Leaves caliper marks displayed when using image search.

Application Measurement

Setting item	Options	Description
Measurement parameters	OFF	Keeps displaying caliper marks and measurement results even after freeze is canceled.
	ON	Clears the display of caliper marks and measurement results when freeze is canceled.
	All Mark Erase	Clears all caliper marks when freeze is canceled.
	Remain Active Mark	Clears all caliper marks other than those currently active when freeze is canceled.

(e) Report Display Settings: Report Data

Settings for the measurement results to be displayed in reports.
NOTE: It is not for basic measurements, or for applied measurements that cannot display reports.



Report Data (1/1)

Display Data: Current

Transfer from Report Data: ON

Storage Data Number: ○ 1 ○ 2 ● 3 ○ 4 ○ 5 ○ 6

Pasted US Image Screen

Display Pasted US Image Form on the Screen: ○ 1x1 ● 2x2 ○ 3x2 ○ 3x3

Automatically be Displayed US Images Number: ○ 0 ○ 1 ○ 2 ○ 3 ● 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9

Save Wave Trace: ON

Settings	Options	Description
Display Data	Current	Displays the latest measurement results.
	Average	Displays average values for measurement results.

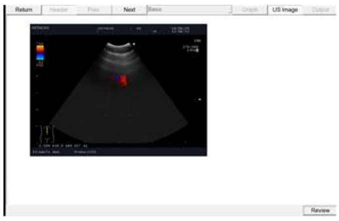
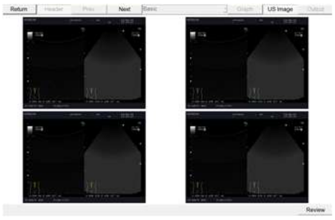
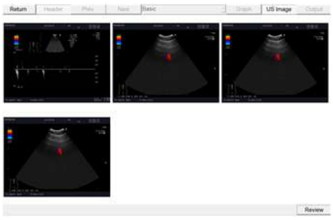
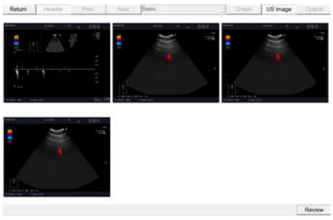
共通設計部

Settings	Options	Description
Transfer from Report Data	ON	Transfers data from reports to other measurement parameters.
	OFF	Does not transfer data from reports to other measurement parameters.
Storage Data Number	1 to 6	Sets the number of measurement results to display in the report if the same measurement is performed repeatedly.
Save Wave Trace	ON	Saves Doppler waveform trace lines.
	OFF	Does not save Doppler waveform trace lines.

Pasted US Image Screen

Sets the display conditions of ultrasonic images in reports.

- Display Pasted US Image Form on the Screen
  Settings for the layout of ultrasonic images displayed in reports. (Refer to the following.)

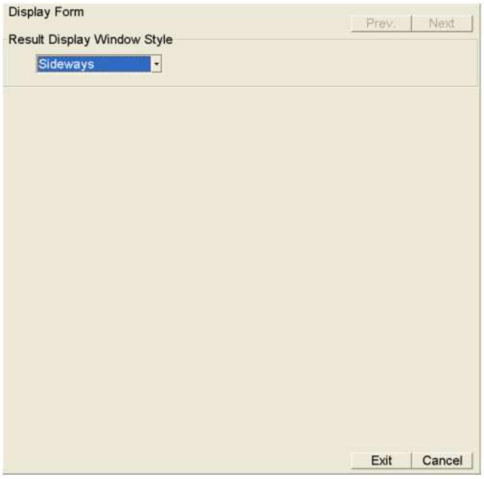
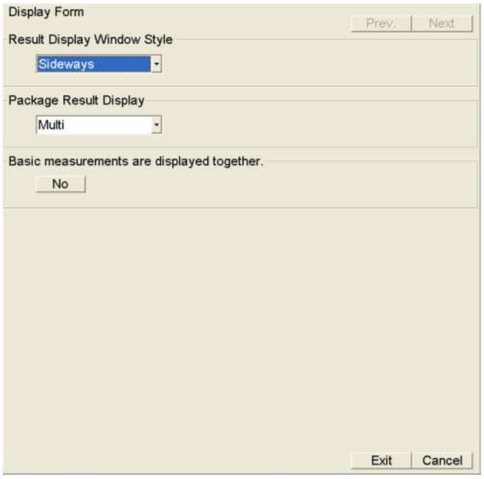
Options	Display example	Description
1X1		Displays one image on the report screen.
2X2		Displays images on the report screen in two rows x two columns.
3X2		Displays images on the report screen in three rows x two columns. In the example shown, there are 4 images.
3X3		Display images on the report screen in three rows x three columns. In the example shown, there are 8 images.

- Automatically be Displayed US Images Number
  Sets the number of images to display in the US Image Block of reports.

共通設計部

(f) Measurement Results Display Setting: Display Form

Sets the orientation to show measurement results.

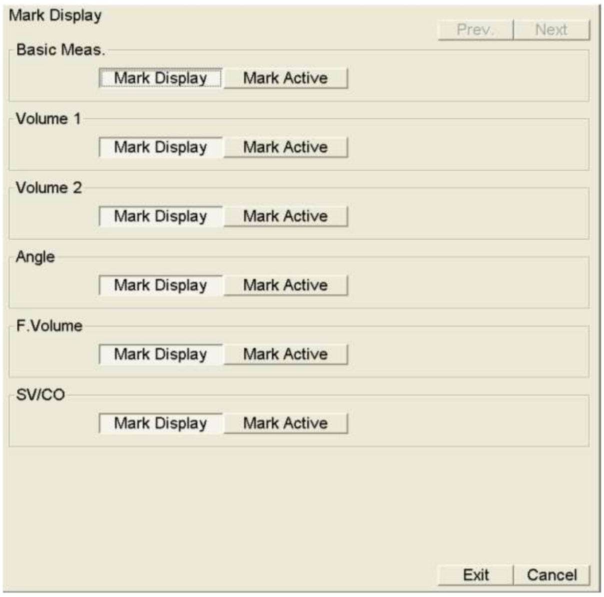
Basic Measurement	 Result Display Window Style: Sideways
Application Measurement	 Result Display Window Style: Sideways Package Result Display: Multi Basic measurements are displayed together.: No

Settings	Options	Description
Results Display Window Style	Sideways	Displays measurement results sideways.
	Lengthwise	Displays measurement results lengthwise.
Package Result Display	Multi	Displays multiple measurement results.
	Single	Displays only the current measurement result.
Basic measurements are displayed together	No	Displays only basic measurement results or applied measurement results.
	Yes	Displays both basic measurement results and application measurement results.

Mark Display

Sets to show caliper marks during measurement.

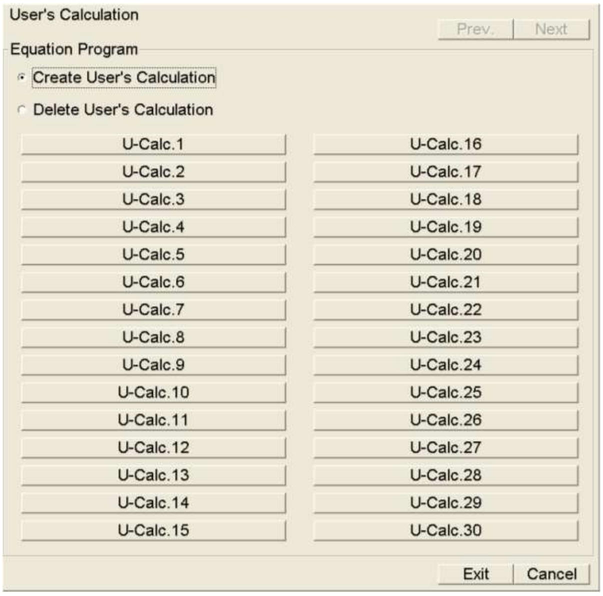
共通設計部


Mark Display
Prev.
Next
Basic Meas.
Mark Display
Mark Active
Volume 1
Mark Display
Mark Active
Volume 2
Mark Display
Mark Active
Angle
Mark Display
Mark Active
F.Volume
Mark Display
Mark Active
SV/CO
Mark Display
Mark Active
Exit
Cancel

Settings	Options	Description
Basic measurement items Application measurement items	Mark Display	Displays all caliper marks.
	Mark Active	Displays only the caliper marks currently used for measurement.

(g) User Index Formula: User's Calculation

This function is for creating measurement packages consisting of index calculation formulas that combine basic functions, such as distance, area, and flow velocity.
Up to four index formulas can be combined in one measurement package.
User index formulas (U-Calc.1 to U-Calc.30) can be created for each application.
Measurement parameters can be combined into formulas for calculating indices for each application on the system. Reserved words registered in advance by the user can be used for creating multiple formulas.


User's Calculation
Prev.
Next
Equation Program
● Create User's Calculation
○ Delete User's Calculation
U-Calc.1
U-Calc.2
U-Calc.3
U-Calc.4
U-Calc.5
U-Calc.6
U-Calc.7
U-Calc.8
U-Calc.9
U-Calc.10
U-Calc.11
U-Calc.12
U-Calc.13
U-Calc.14
U-Calc.15
U-Calc.16
U-Calc.17
U-Calc.18
U-Calc.19
U-Calc.20
U-Calc.21
U-Calc.22
U-Calc.23
U-Calc.24
U-Calc.25
U-Calc.26
U-Calc.27
U-Calc.28
U-Calc.29
U-Calc.30
Exit
Cancel

共通設計部

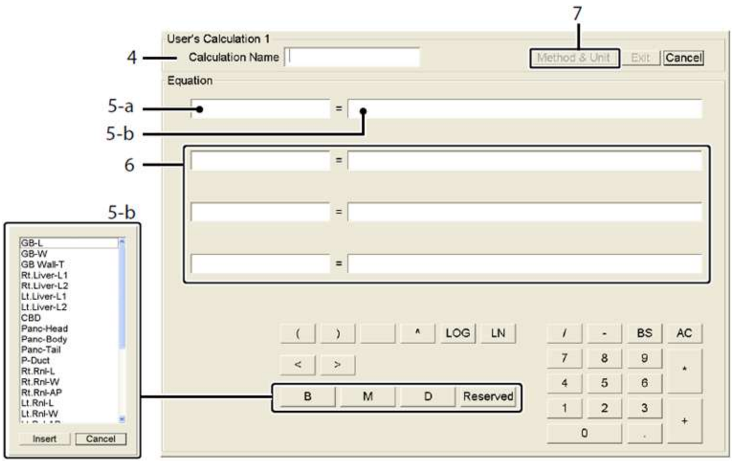
Settings	Options	Description
Equation Program	Create User's Calculation	Create measurement packages for index calculation.
	Delete User's Calculation	Deletes measurement packages and user index calculation equations.
User index calculation formula	U-Calc.1 to U-Calc.30	Select a user index calculation formula you want to create or delete. If there is a registered index calculation formula name, it is displayed.

Deleting User Index Calculation Formulas

1. Display [User's Calculation].
2. Select [Delete User's Calculation].
3. Select the index calculation to delete.

Registering User Index Calculation Formulas

1. Display [User's Calculation].
2. Select [Create User's Calculation].
3. Select index calculation formula to register.
   An Equation input dialog box opens.


7
User's Calculation 1
4
Calculation Name
Method & Unit
Exit
Cancel
Equation
5-a
5-b
6
5-b
=
GB-L
GB-W
GB Wall-T
Rt.Liver-L1
Rt.Liver-L2
Lt.Liver-L1
Lt.Liver-L2
CBD
Panc-Head
Panc-Body
Panc-Tail
P-Duct
Rt.Rnl-L
Rt.Rnl-W
Rt.Rnl-AP
Lt.Rnl-L
Lt.Rnl-W
Insert
Cancel
(
)
^
LOG
LN
<
>
B
M
D
Reserved
/
-
BS
AC
7
8
9
*
4
5
6
1
2
3
+
0
.

4. Enter the Calculation Name.
5. Input the first equation.
   a. Use keyboard input for the left side of the first formula (answer variable), in up to 12 characters.
      Input rules for the left side
      Input the first character with an alphabetic character. After that, alphanumeric characters can be input.
   b. Input the right side of the first equation (the calculation equation), using up to 180 characters. Alternatively, input by selecting from a list of operators.
      Input rules for the right side
      Input variables with up to 13 characters. Input constants with up to 20 characters.

共通設計部

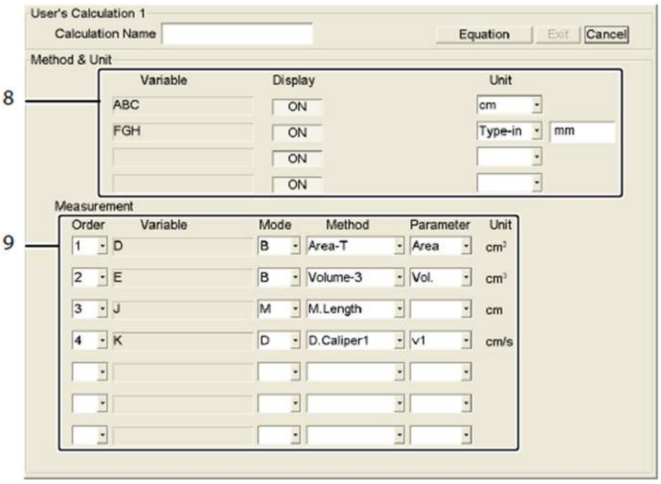
When inputting measurement item names for applied measurements, or user-registered measurement names (reserved words)

Reserved word are measurement names for applied measurements, or user-registered measurement names.

I) Select from [B], [M], [D], [Reserved]. The list that can be registered is displayed.

II) Select measurement items from the list.

6. Input the second and subsequent equations in the same way as the first.
   When using the left side of the above equations as the calculation formula
   Enclose the left side with < >. Example: First equation "A"="B+C", 2nd equation <"D"=""D"="<A>/F"
7. After inputting all equations, select [Method & Unit].
   Method & Unit is displayed.



Variable	Display	Unit	
ABC	ON	cm	
FGH	ON	Type-in	mm
	ON		
	ON		

Order	Variable	Mode	Method	Parameter	Unit
1	D	B	Area-T	Area	cm²
2	E	B	Volume-3	Vol.	cm³
3	J	M	M.Length		cm
4	K	D	D.Caliper1	v1	cm/s

8. Set the answer variables.
   a. Set the Display field to On to display the answer variable. Set the field to Off to avoid displaying it.
   b. Selecting the units for answer variables from the Unit list.
      Setting units that are not in the list.
      Select "Type-in" from the Unit list. Enter up to 5 characters in the unit field displayed on the right.
9. Make settings for measurement variables.
   a. Select measurement sequence from the Order list.
   b. Select measurement mode from the Mode list.
   c. Select measurement method from the Method list.
   d. Select parameters to use if there are multiple parameters for the measurement method.
10. Select [Exit].
    The calculation is then registered.

Methods and Parameters Used in User Calculations

共通設計部

B mode Method	Parameter	Meaning	Unit
Dist	No options	Distance	cm
Area-T	Area	Area	cm^2
	Circ	Circumference	cm
Area-C	Area	Area	cm^2
	Circ	Circumference	cm
	Diam	Diameter	cm
Area-E	Area	Area	cm^2
	Circ	Circumference	cm
	x-ax	x-axis	cm
	y-ax	y-axis	cm
Volume-3 (3 caliper)	Vol.	Volume	cm^3
	x-ax	x-axis	cm
	y-ax	y-axis	cm
	z-ax	z-axis	cm
Volume-AL (Area-Length)	Vol.	Volume	cm^3
	Area	Area	cm^2
	Circ	Circumference	cm
	Dist	Distance	cm
Volume-EC (Ellipse-Caliper)	Vol.	Volume	cm^3
	Area	Area	cm^2
	Circ	Circumference	cm
	x-ax	x-axis	cm
	y-ax	y-axis	cm
	z-ax	z-axis	cm
Volume-E (Ellipse)	Vol.	Volume	cm^3
	Area	Area	cm^2
	Circ	Circumference	cm
	x-ax	x-axis	cm
	y-ax	y-axis	cm
Type-in	-	-	Input from the keyboard

M Mode Method	Parameter	Meaning	Unit
M Length	No options	Distance	cm
Time	No options	Time	s
Heart rate	No options	Heart rate	BPM
M.VEL	v	Velocity	cm/s
	dD	Distance	cm
	dt	Time	s

共通設計部

M Mode Method	Parameter	Meaning	Unit
Type-in	-	-	Input from the keyboard

D Mode Method	Parameter	Meaning	Unit
Time	No options	Time	s
Heart rate	No options	Heart rate	BPM
D.VEL	No options	Velocity	cm/s
ACCEL	v1	Velocity1	cm/s
	v2	Velocity2	cm/s
	dt	Time	s
	ACC	Accel	cm/s^2
RI	RI	Resistance Index	
	PSV	Peak Systolic Velocity	cm/s
	EDV	End Diastolic Velocity	cm/s
	S/D	S/D Ratio	
P1/2T	No options	Pressure half time	s
D.Caliper 1 and 2	v1	Velocity1	cm/s
	v2	Peak Systolic Velocity	cm/s
	dv	V1 - V2	cm/s
	dt	Time	s
	PG1	Peak pressure gradient 1	mmHg
	PG2	Peak pressure gradient 2	mmHg
	dPG	PG1 - PG2	mmHg
	ACC	Acceleration	cm/s^2
	P1/2T	Pressure half time	s
	VA	Valve Area	cm^2
Mean VEL	MnV	Mean Velocity	cm/s
	VTI	Velocity Time Integral	cm
PI	PI	Pulsatility Index	
	RI	Resistance Index	
	S/D	S/D Ratio	
	PSV	Peak Systolic Velocity	cm/s
	EDV	End Diastolic Velocity	cm/s
	MnV	Mean Velocity	cm/s
	Vm	Mean Velocity	cm/s

共通設計部

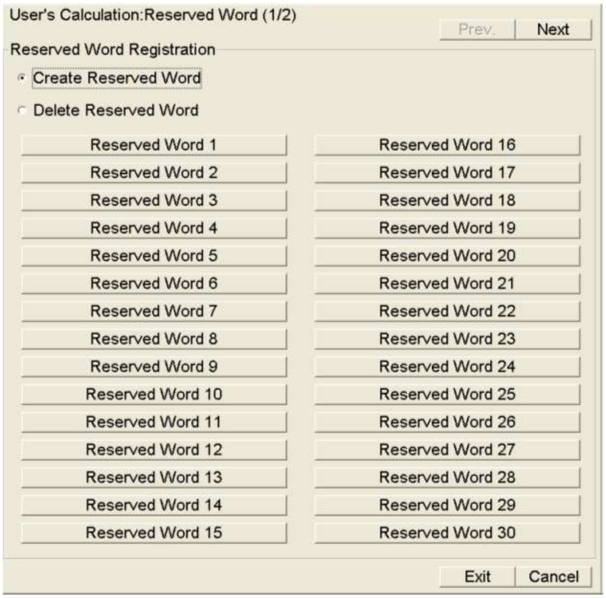
D Mode Method	Parameter	Meaning	Unit
Steno Flow Regurg Flow D.Trace1,2	PI	PI	Pulsatility Index
	RI	RI	Resistance Index
	PSV	Peak Systolic Velocity	cm/s
	EDV	End Diastolic Velocity	cm/s
	MnV	Mean Velocity	cm/s
	PG1	Peak pressure gradient 1	mmHg
	PG2	Peak pressure gradient 2	mmHg
	MPG	Mean pressure gradient	mmHg
	VTI	Velocity Time Integral	cm
	ACC	Acceleration	cm/s^2
	FlowT	Flow Time	s
	dt	Time	s
	AccT	Acceleration Time	s
Type-in	-	-	Input from the keyboard

Registration of Reserved Words: Reserved Word

This function sets the variables (reserved words) used in the user"s calculation under Reserved Word. Up to 60 words can be set. Reserved words are measurement names for applied measurements, or user-registered measurement names.

The reserved words for a preset are those reserved words that are registered by the user because they do not exist in the applied measurement items.

NOTE: The measurement item names and measurement methods for applied measurements cannot be registered or changed.



User's Calculation:Reserved Word (1/2)

Reserved Word Registration

● Create Reserved Word

○ Delete Reserved Word

Prev.
Next
Reserved Word 1
Reserved Word 2
Reserved Word 3
Reserved Word 4
Reserved Word 5
Reserved Word 6
Reserved Word 7
Reserved Word 8
Reserved Word 9
Reserved Word 10
Reserved Word 11
Reserved Word 12
Reserved Word 13
Reserved Word 14
Reserved Word 15
Reserved Word 16
Reserved Word 17
Reserved Word 18
Reserved Word 19
Reserved Word 20
Reserved Word 21
Reserved Word 22
Reserved Word 23
Reserved Word 24
Reserved Word 25
Reserved Word 26
Reserved Word 27
Reserved Word 28
Reserved Word 29
Reserved Word 30
Exit
Cancel

Settings	Display example	Description
Reserved Word Registration	Create Reserve word	Creates a reserved word.
	Delete Reserve word	Deletes a reserved word.

共通設計部

Settings	Display example	Description
(Edit reserved words)	Reserved Word 1	Selects reserved words to create or delete. If there are any reserved words, they are displayed.

- Deleting registered reserved words

  a. Display the [Reserved Word] for the preset.

  b. Select [Delete Reserved Word].

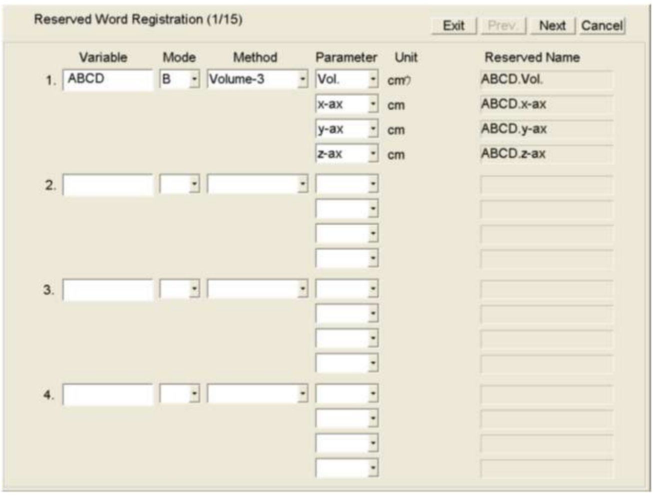
  c. Select reserved words to delete from the list.

- Setting reserved words

  a. Display the [Reserved Word] for the preset.

  b. Select [Create Reserve word].

  c. Select reserved words to set.
  Display Reserved Word Registration.



Reserved Word Registration (1/15)

	Variable	Mode	Method	Parameter	Unit	Reserved Name
1.	ABCD	B	Volume-3	Vol.	cm³	ABCD.Vol.
				x-ax	cm	ABCD.x-ax
				y-ax	cm	ABCD.y-ax
				z-ax	cm	ABCD.z-ax
2.						
3.						
4.						

  d. Use the keyboard to enter up to 7 digits for the name of the Variable.

  e. Select mode for finding the variables from Mode.

  f. Select the measurement method from Method.

  g. Up to four measurement items for use in User's Calculations can be selected under Parameter.
  The words that can be used as reserved words are listed in the Reserved Name list.

(4) Study Assignment

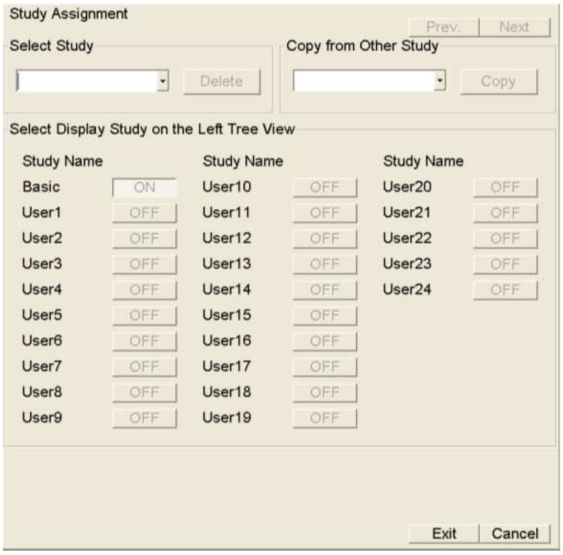
Study Assignment is used to make settings for each ultrasound examination study.

Preset items	Preset content
Study Assignment	Registers, deletes or copies new studies.
Basic (Defined study name)	Displays the selected study content for [Menu Assign], [Combined Report Display] and [Other] presets.

共通設計部

Preset items	Preset content
Menu Assign	Measurement menu settings.
Combined Report Display	Settings for the information presented in reports.
Transfer List Assign	Sets the basic measurement results that can be transferred to applied measurement items
Other	Measurement operational guide message settings.

(a) Measurement Study Registration and Display Settings: Study Assignment



Study Name		Study Name		Study Name	
Basic	ON	User10	OFF	User20	OFF
User1	OFF	User11	OFF	User21	OFF
User2	OFF	User12	OFF	User22	OFF
User3	OFF	User13	OFF	User23	OFF
User4	OFF	User14	OFF	User24	OFF
User5	OFF	User15	OFF		
User6	OFF	User16	OFF		
User7	OFF	User17	OFF		
User8	OFF	User18	OFF		
User9	OFF	User19	OFF		

NOTE: Studies installed on the system cannot be deleted or renamed.

- Registering new measurement studies:
  a. Input the study name in Select Study field.
  b. Select the [Enter] key on the virtual keyboard.
- Copying and registering an existing study:
  a. Input the copied study name in the Select Study field.
  The study is registered as a new study if the name does not exist.
  b. Select a study of a copy source from the Copy from Other Study list.
  c. Select [Copy].
- Deleting measurement studies:
  a. Select the study to delete from the Select Study list.
  b. Select [Delete].
- Setting the studies to display in the menu:
  a. Select a study to display in the menu from the Select Display Study on the Left Tree View list and then turn it [ON].
  b. Select a study to hide in the menu from the Select Display Study on the Left Tree View list and then turn it [OFF].

共通設計部

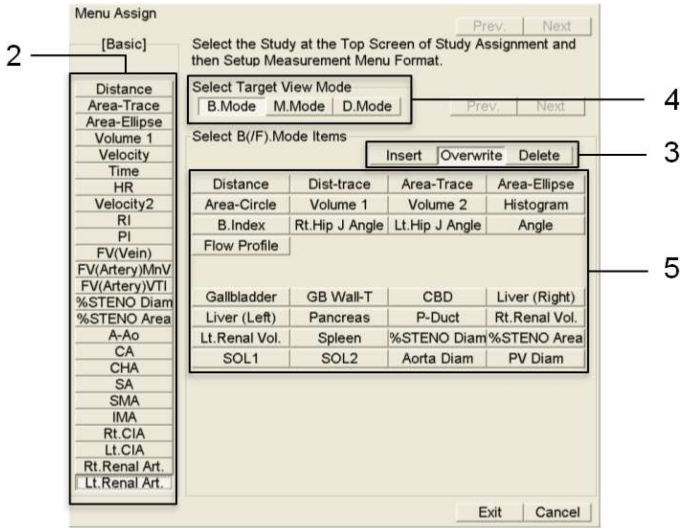
(b) Measurement Menu Settings: Menu Assign

Press [Measurement] button on the touch panel and then set the measurement menus to display.

Adding/swapping Measurement Menus

Procedure

1. Display [Menu Assign] for the set study.


Menu Assign
Prev.
Next
[Basic]
2
Distance
Area-Trace
Area-Ellipse
Volume 1
Velocity
Time
HR
Velocity2
RI
PI
FV(Vein)
FV(Artery)MnV
FV(Artery)VTI
%STENO Diam
%STENO Area
A-Ao
CA
CHA
SA
SMA
IMA
Rt.CIA
Lt.CIA
Rt.Renal Art.
Lt.Renal Art.
Select Target View Mode
B.Mode
M.Mode
D.Mode
4
Prev.
Next
Select B(/F).Mode Items
Insert
Overwrite
Delete
3
Distance
Dist-trace
Area-Trace
Area-Ellipse
Area-Circle
Volume 1
Volume 2
Histogram
B.Index
Rt.Hip J Angle
Lt.Hip J Angle
Angle
Flow Profile
5
Gallbladder
GB Wall-T
CBD
Liver (Right)
Liver (Left)
Pancreas
P-Duct
Rt.Renal Vol.
Lt.Renal Vol.
Spleen
%STENO Diam
%STENO Area
SOL1
SOL2
Aorta Diam
PV Diam
Exit
Cancel

Select the Study at the Top Screen of Study Assignment and then Setup Measurement Menu Format.

2. Select the menu position to change.
3. Select [Insert], or [Overwrite]
   - [Insert]: Inserts at the menu position selected in step 2. The menus from below where you selected shift down one position.
     NOTE: If there is no free space, delete unused menus or use [Overwrite] to replace them.
   - [Overwrite]: The menu selected in step 2 is overwritten.
4. Select the mode for measurement items from the Select Target View Mode field.
5. Select measurement items from Select Mode Items.

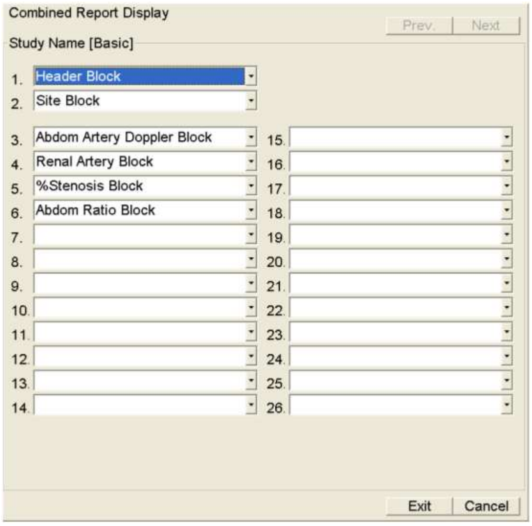
Deleting Menus

1. Display [Menu Assign] for the set study.
2. Select the menu position to change.
3. Select [Delete].

(c) Report Display Block Settings: Combined Report Display

Settings for the Block presented in reports.

共通設計部



Combined Report Display

Study Name [Basic]

1. Header Block
2. Site Block
3. Abdom Artery Doppler Block
4. Renal Artery Block
5. %Stenosis Block
6. Abdom Ratio Block
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
19.
20.
21.
22.
23.
24.
25.
26.

Procedure

1. Display [Combined Report Display] for the set study.
2. Select [▼] on the right side of the change location.
3. Select the report block to set.
   To make no setting (leave blank)
   Select highest blank space in the list.
4. Repeat steps 2 and 3 to set the composition and display order for the report display.

(d) Settings for Transferring Basic Measurement Results: Transfer List Assign

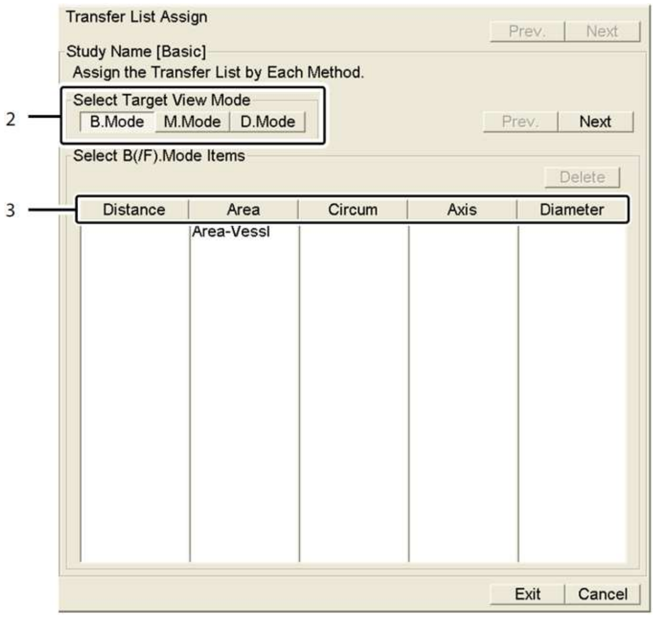
Adds Applied Measurements for the Transfer Destination

This sets up the basic measurement results that can be transfered to applied measurements that were set up in a measurement menu using the Menu Assign preset.

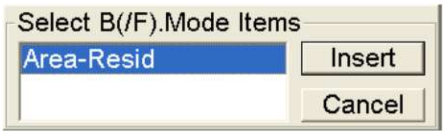
Procedure

1. Display [Transfer List Assign] for the set study.
2. Select a display mode from Select Target View Mode.

共通設計部


Transfer List Assign
Prev.
Next
Study Name [Basic]
Assign the Transfer List by Each Method.
Select Target View Mode
B.Mode
M.Mode
D.Mode
Prev.
Next
Select B(/F).Mode Items
Delete
Distance
Area
Circum
Axis
Diameter
Area-Vessl
Exit
Cancel
2
3

3. Select the basic measurement results you wish to transfer.
   The following dialog box opens.

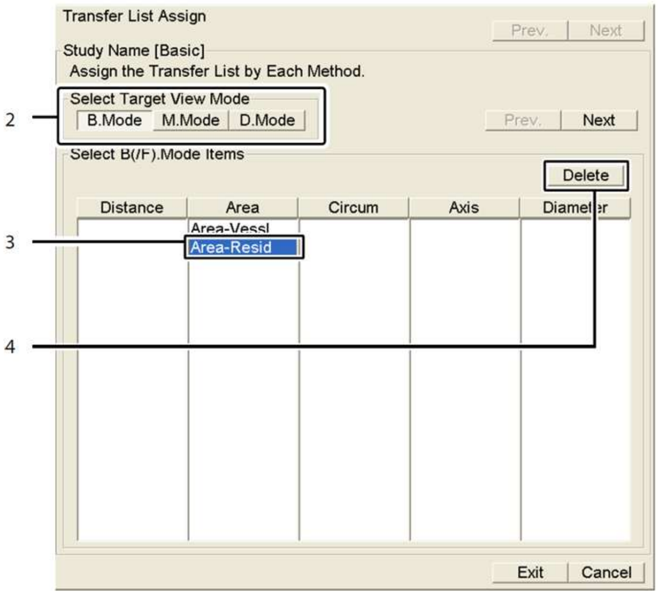

Select B(/F).Mode Items
Area-Resid
Insert
Cancel

   The list contains those applied measurements that were set up in a measurement menu using the Menu Assign preset which can use those basic measurement results.

4. Select the application measurements to be transferred to and then select [Insert].

Deleting Unnecessary Transfer Destinations

Fig.1: Deleting Area Residual from the transfer destination.


Transfer List Assign
Prev.
Next
Study Name [Basic]
Assign the Transfer List by Each Method.
Select Target View Mode
B.Mode
M.Mode
D.Mode
Prev.
Next
Select B(/F).Mode Items
Delete
Distance
Area
Circum
Axis
Diameter
Area-Vessl
Area-Resid
Exit
Cancel
2
3
4

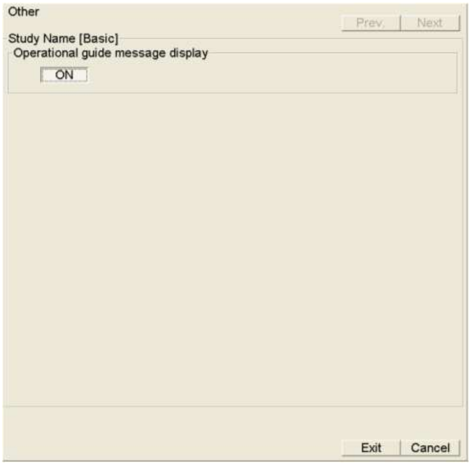
1. Display [Transfer List Assign] for the set study.
2. Select a display mode from Select Target View Mode.

共通設計部

3. Select application measurement name.
4. Select [Delete].

(e) Operational Guide Message Settings: Other

Set the display of operational guide messages (assist messages) during measurement.


Other

Study Name [Basic]

Operational guide message display: ON

Settings	Options	Description
Operational guide message display	ON	Displays operational guide messages during measurement.
	OFF	Does not display operational guide messages during measurement.

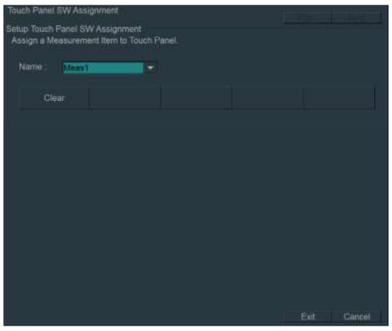
(5) SW Assignment

Sets the measurement function to start when a specific menu item is selected. SW Assignment is a setting that is common to all studies within an application.
SW Assignment has the following presets.

Preset name	Assigned to	Settings
Touch Panel SW Assignment	[Meas] tab on the function menu	Reports Presets
+Mark key Assignment	[Caliper] key	Basic measurement menu

(a) [Meas] Tab Menu Settings: Touch Panel SW Assignment

Assigns functions such as reports, presets, etc. to the [Meas] tab in the function menu.


Touch Panel SW Assignment

Setup Touch Panel SW Assignment

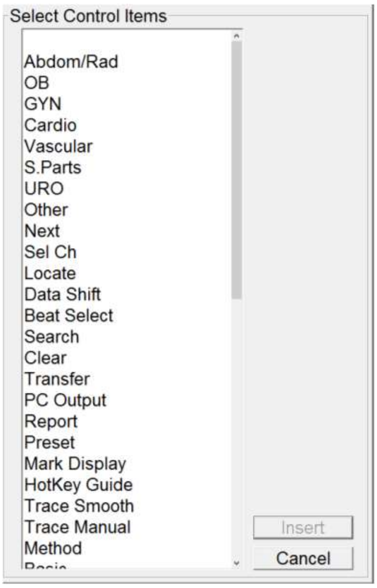
Assign a Measurement Item to Touch Panel.

Name : Meas1

共通設計部

Procedure

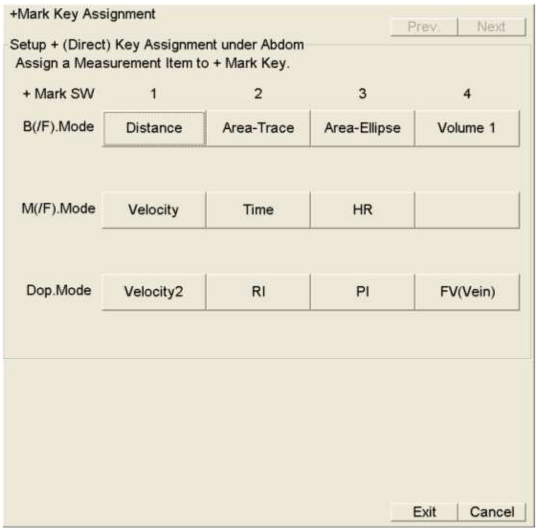
1. Display [Touch Panel SW Assignment].
2. Select the Name from the drop-down list of the page you want to change.
3. Select the menu position to change.
   A dialog box is displayed.


Select Control Items
Abdom/Rad
OB
GYN
Cardio
Vascular
S.Parts
URO
Other
Next
Sel Ch
Locate
Data Shift
Beat Select
Search
Clear
Transfer
PC Output
Report
Preset
Mark Display
HotKey Guide
Trace Smooth
Trace Manual
Method
Insert
Cancel

4. Select the items to assign from the Select Control Items list.
5. Select the items to assign from the Select Control Items list.
   The selected item is highlighted.
6. Select [Insert].

(b) Basic Measurement Menu Settings: +Mark key Assignment

Sets the measurement function to start when [Caliper] key is pressed. Up to four basic measurement menus can be set for each mode.


+Mark Key Assignment
Prev.
Next

Setup + (Direct) Key Assignment under Abdom
Assign a Measurement Item to + Mark Key.

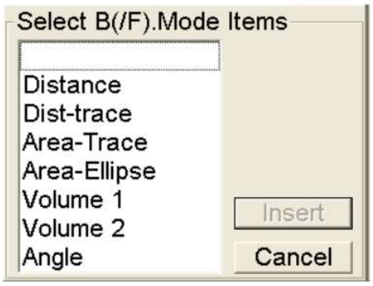
+ Mark SW	1	2	3	4
B(/F).Mode	Distance	Area-Trace	Area-Ellipse	Volume 1
M(/F).Mode	Velocity	Time	HR	
Dop.Mode	Velocity2	RI	PI	FV(Vein)

Exit
Cancel

共通設計部

Procedure

1. Display [+Mark Key Assignment].
2. Select the position to change
   The basic measurement list (example of B(F) mode below) is displayed.



Select B(/F).Mode Items

- Distance
- Dist-trace
- Area-Trace
- Area-Ellipse
- Volume 1
- Volume 2
- Angle

3. Select the basic measurement to configure.
   The selected basic measurement is highlighted.
4. Select [Insert].

2.2.8 References

(1) Formulas

(a) B mode

Measurement parameters	Formulas
Dist	Distance = $\sqrt{(X_2 - X_1)^2 + (Y_2 - Y_1)^2}$
Area-E	Area (cm^2) = π / 4 × major × minor Circumference (cm) = $\pi \sqrt{(major^2 + minor^2) / 2}$ Axes (cm) = $\sqrt{(X_2 - X_1)^2 + (Y_2 - Y_1)^2}$
Area-C	Area (cm^2) = $\pi / 4 \times Diameter^2$ Circumference (cm) = π × Diameter Diameter (cm) = $\sqrt{(X_2 - X_1)^2 + (Y_2 - Y_1)^2}$
Volume	Area-Length = $0.85 \times Area^2 / Dist$ BP Simpson = $\pi \times H / 4\ \Sigma a_i \times b_i$ SP Simpson = $\pi \times H / 4\ \Sigma a_i^2$ dist: max Length, H = Dist / 20 3 Caliper = π / 6 × (x - ax) × (y - ax) × (z - ax) Ellipse = $\pi / 6 \times (x - ax) \times (y - ax)^2$ x - ax > y - ax
Histogram	T (total # of samples) = Σf_i MN (Average gradation) = $1/T\ \Sigma (X_i \times f_i)$ S^2 (Dispersion) = $1/T\ \Sigma (X_i - MN)^2 \times f_i$ SD (Standard deviation) = $\sqrt{S^2}$ f_i: Number of pixels of brightness gradation i, X_i: Brightness gradation i, Σ: i = 0 - 63

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