M7/M7T/M7 Premium

Diagnostic Ultrasound System

Operator’s Manual

[Advanced Volume]

Content

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Preface

This manual details the procedures for operating the M7/M7T/M7 Premium Diagnostic Ultrasound System. Carefully read and understand the manual before using the system to ensure its safe and correct operation.

NOTE: When you operate the system, you can refer to the following manuals:

- Operator's Manual (Basic Volume)
- Acoustic output data

Depending on the software version, the preset settings, and optional configuration, the actual interfaces may appear different from those shown in this manual.

NOTE: The functions described in this manual are not provided for all systems sold in all regions. Functions that are available dependents on the specific system you purchased.

All the menus and screens in this manual take the system in full configuration as an example.

Product Differences

M7T: not sold in Canada, and has no B-Profile measurement.

M7 Premium: not sold in FDA, and has no B-hist measurement.

Safety Precautions

1. Meanings of Signal Words

In this manual, the signal words **⚠Danger**, **⚠WARNING**, **⚠CAUTION** and **NOTE** are used regarding safety and other important instructions. The signal words and their meanings are defined as follows. Please understand their meanings clearly before reading this manual.

Signal word	Meaning
⚠Danger	**Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.**
⚠WARNING	**Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.**
⚠CAUTION	**Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury.**
NOTE	Indicates a potentially hazardous situation that, if not avoided, may result in property damage.

2. Meaning of Safety Symbols

Symbol	Description
⚠	General warning, caution, risk of danger.

3. Safety Precautions

Please observe the following precautions to ensure patient and operator's safety when using this system.

⚠CAUTION:

1. **Select the proper patient image and measurement tools. Only the professionals can decide the appropriate measurements and results.**
2. **Confine measurement calipers to the actual Region of Interest (ROI). Measurements that extend beyond the ROI will be incorrect.**
3. **Before examining a new patient, it is necessary to press the < End Exam> key to end the current scan and delete the patient information and data. Otherwise, new patient data will be combined with the previous patient.**
4. **When the system is turned OFF or the < End Exam> key is pressed, all the data that have not been saved are lost.**
5. **Changing modes during a measurement will delete the General Measurement data.**
6. **Pressing the < Freeze> key to unfreeze the image during a measurement will clear the General Measurement data.**
7. **Pressing the < Measure> key during a measurement will clear the General Measurement data.**

8. **Pressing the < Clear> key will clear the measurement caliper, all data in the result window, comments and body mark.**
9. **In dual-B imaging mode, the measurement results of the merged image can be inaccurate. Therefore, the results are provided for reference only, not for confirming a diagnosis.**
10. **Quality of the extended image constructed in iScape (panoramic imaging) dependents on the skill of operator. Extra attention should be paid during the iScape measurement since the results could be inaccurate.**
11. **Ensure that measurement data correctly corresponds to the fetus during the Obstetric Measurement.**
12. **Fully understand the functionality of this system by referring to the *Operator's Manual - Basic Volume*.**
13. **The auto measurement might not be accurate when the result doesn't match the image exactly, please make the measurement manually.**

1 Overview

1.1 Basic Operations and Buttons

Tips:	The following descriptions for buttons and keys are used in this manual: ■ < >: Denotes key/ button on the control panel or keyboard. E.g. <Set>. ■ [ ]: Denotes button/item on the screen menu. E.g. [OK]. Click/Select [item/button]: to move the cursor over the item/button and press <Set>.

Basic Measurement Procedures

1. Press <End Exam> to start a new exam.
2. Press <Patient> and input the patient information,

   This includes patient ID, name, height, weight etc. Type in manually for a new patient, or load an existing patient from iStation or Worklist.

   The patient information entered is used for measurement data storage, analysis and exam report. For more details, refer to "Exam Preparation -> Patient Information" in the Operator's Manual [Basic Volume].
3. Press <Probe> and select a proper exam mode.

   For more details, refer to "Exam Preparation" in the Operator's Manual [Basic Volume].
4. Measure preset.

   To preset measurement parameters, obstetric formula, general/ application measurement packages, report, auto spectrum calculation results etc. See “2 Measure Preset” for details.
5. Press <Measure> to start measurement.
6. Select an item from the measurement menu to start.

   For general and application measurement items (tools), see "3 General Measurement " and the chapter of specified application measurements for details.
7. Press <Report> to view the exam report.

   For report editing and browsing, see “1.7 Report”;

   For report preset, see "2.5 Preset of Report Template".

Button Functions

Keys	Basic Operations
Measure	To enter/exit the measurement. Or, exit from measurement by pressing <Esc> on the keyboard.
Set	To select an item on the measurement menu and press <Set> to activate it. Press <Set> to confirm and end the current operation during measurement.
Update	To switch between the fixed end and active end of the caliper during a measurement.

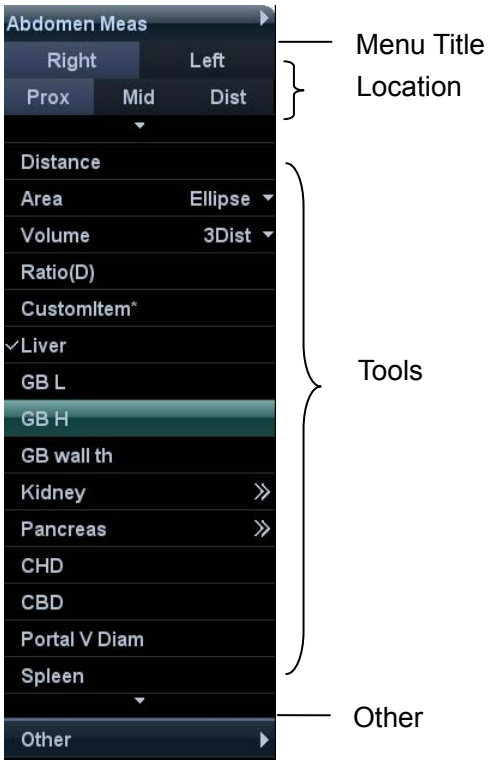
Keys	Basic Operations
Clear	Short press: to return to the previous measurement step, or delete the caliper backwards. Long press: to clear all measurement calipers on the screen and data in the result window.
Report	To enter/ exit the report page.
Cursor	To show the cursor.
Trackball	Move the cursor.
Multifunctional knob(Nav.)	To enable the commonly used measure function or used for selecting measurement item by rotating.

For details on key functions, see "System Overview" in the Operator's Manual [Basic Volume].

1.2 Measurement Menu

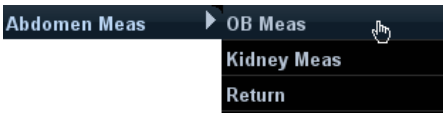
Menus of General and Application measurement are different. For more information on measurement menu, refer to "3 General Measurement" and the specified application measurement chapter.

Measurement menu items are as follows:



1.2.1 Menu Title

It displays the name of the measurement menu, i.e. name of the measurement package. As shown in figure below.



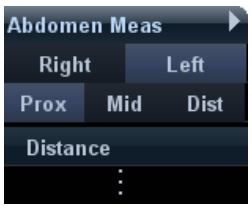
If multiple measurement packages are set in current exam mode, a "►" displays in the menu title.

Tips:	1.	In multi- imaging mode (e.g. B+PW), general measurements of all imaging modes are available.
	2.	In application measurement, the Menu Title can be used to toggle between measurement packages available in current exam mode. See section "2.4.2 Application Measurement Preset".

- To switch to other measurement menu

1. Move the cursor to ►, the submenu pops up and displays other measurement menus available.
2. Move the cursor to an item and press <Set>.

1.2.2 Measurement Location



The location widgets are used to select locations of the measurement.

- Side (Left/Right): Used to the item (e.g. kidney) that contains measurement of left/ right side parameters respectively.
- Location (Prox/Mid/Dist): Used to items (e.g. vascular) that contains measurement of Proximal, Middle or Distal parameters.

- To Select the Measurement Location

1. Move the cursor to the location widgets (e.g. Side).
2. Press <Set> to select the Measurement location.

Tips:	The location widgets are applicable only in application measurement.

1.2.3 Measurement Tool

There are two kinds of measurement tools.

- General tools: Basic measurement tools in General Measurement, such as the "distance" and "Area".
- Application tools: The measurement tools in Application Measurement. These items are classified and combined in clinical application package such as Abdomen, Obstetric, etc. E.g. HC (head circumference) in the Obstetric measurement is one of the application tools.

Tips:	1.	Actually, most application tools use the general measurement method while measuring, e.g. an "Area" tool is used when measuring the HC. Only the application measurement results are recorded in the report.
	2.	For definition of the measurement, calculation and study, refer to "1.3 Measurement, Calculation and Study".

To Active the Measurement Tool

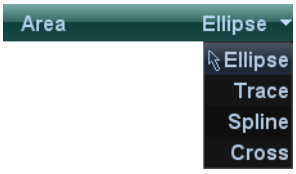
The procedures are as follows:

1. Move the cursor to the item and press <Set>.
2. A ">>" displays on the right side of the item if a submenu exists.
3. Enter the submenu by pressing <Set>.
4. Start the measurement by clicking an item on the menu.
5. Click [Return] to return to the upper menu after measurement.

Select Measurement Method Online

Some measurement tools (e.g. "Area" in 2D general measurement) have multiple methods to select.

1. Select "Area" in the menu.
2. Select a method in the drop-down list of the menu, as shown in figure below.



Other Features

Features	Descriptions
Current measurement tool/item	Highlighted.
Measured item	Performed application item/tool are marked with a "√". (If one or some items in a submenu (extended menu) of a study are already performed, this study will be marked as measured.)
User-defined item	There is an asterisk posterior to the user-defined measurement and calculation item for identification.
Page up/down	Use the ▲/▼ on the menu.
Unavailable item	Greyed out. Need switch to the proper imaging mode to enable it.

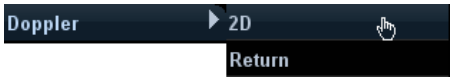
1.2.4 Other

During application measurement, the [Other] item appears at the bottom of the menu in multi-imaging mode is used to navigates between menus of different modes. As shown in figure below.

Tips: In multi-imaging mode (e.g. B+PW),

During application measurement, switch to measurement menu available for another mode by [Other].

During general measurement, switch to measurement menu available for another mode by Menu Title. As shown in figure below.



1.3 Measurement, Calculation and Study

There are three kinds of measurement items.

Measurement

Results of measurements are directly obtained via the measurement tools, which are indicated by "  ".E.g. "Distance" in the 2D general measurement, or "HC" in the OB measurement.

Calculation

Results of calculations are automatically derived by the system, using other measured or calculated values as parameters, they are indicated by "  ". E.g. EFW (Estimated Fetal Weight) in the OB measurement.

If all measurements related to a calculation tool are completed, the system will automatically calculate the result. If some measurement tools are performed again, the system will automatically update the calculation result using the latest measurement results.

Study

A group of measurements and / or calculations for a specific clinical application. E.g. AFI in the OB measurement.

Fold/ unfold the study to hide/show the measurement or calculation items included.

1.4 Measurement Caliper

A measurement caliper is a graphics consists of several points and straight line or curve drawn on the ultrasound image.

Fixed/ Active End

The ends of calipers can be active or fixed. The active end is called a Cursor.

Caliper Color

An active caliper appears green while a fixed one appears white in the system default preset.

Symbols of Caliper Ends

8 symbols are used as the caliper ends circularly, as shown in figure below.

These symbols display in calipers as well as in the result window to identify different measurements.

NOTE:	You can preset the cursor type and color in [System Preset] -> [Meas], see "2.2 Measurement Parameters Preset" for more information.

1.5 Result Window

Two types of result windows are used to display results numerically or graphically.

1.5.1 Result Display

Set [Result] to "ON" and the latest results display in result window in time sequence.

When viewing the results:

- If the result window is full, the oldest value will be replaced according to the "first in, first out" rule.

  A maximum of 8 results can display in result window, and a maximum of 2 graphical result windows can display in the screen.
- To identify the measurement results, symbols or numbers are used in the numerical result window while "No:1" or "No:2" is used in the graphical result window.

NOTE:	You can preset the appearance style and contents of the result window in [System]-> [Measure Preset], see the “2.2 Measurement Parameters Preset” for details.

The results can display in the following type:

- No result displays when a measurement item/tool is activated but without the start point fixed.
- The result displays as numbers when the value obtained is within the clinical range.
- The result displays as "?" when it is out of the ultrasonic range.

1.5.2 Moving Result Window

To move the result window,

1. Place the cursor on the result window title and press <Set>.
2. Rotate the trackball to place the result window in a desired position.
3. Press <Set> to fix the result window.

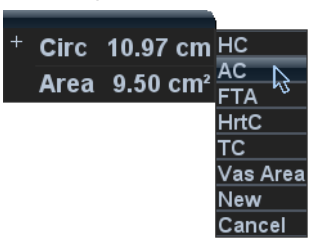
1.5.3 Result Window Assignment

An application measurement result can be assigned to a general measurement item from the result window. The application item can be an existing item in system or a new user-defined one.

Assigning an Existing Application Item

The procedures are as follows:

1. Move the cursor to a general measurement value in the result window, press <Set> when the item is highlighted in green, the matching list pops up as shown below.



Matching application items that meet the following requirements are displayed:

- Preset in current application package.
- Use the same general measurement tool with the result.

Application items in the Obstetric measurement that use the "Area" method are listed as shown above.

2. Select an application item in the list, press <Set>.
3. The assigned value displays in the result window and is saved in the exam report.

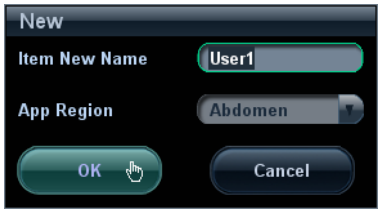
Tips: You can perform an assignment directly to the latest general measurement result by:

1. Enter an application measurement menu (e.g. Obstetric), when a general measurement (e.g. "Area") is completed.
2. Click the desired application item (e.g. HC) in the menu. The selected application item also has to meet the matching rules in step 1.
3. If the application item(s) is/are preset in the current report, the assignment results will be saved in the report.

Assigning a New Application Item

When no (desired) item displays in the matching list, you can create a new application item. The procedures are as follows:

1. Select [new] at the bottom of the matching list.
2. The following dialog box pops up.



   a) Type in the new name.
   b) Select the application region.
3. Click [OK] to assign the general result to the new item.

NOTE: Re-assignment for the assigned general result is not available.

Exiting Result Assignment

Press <Esc> in the keyboard, or select [Cancel] in the matching list to exit.

Auto Spectrum Calculation Assignment

Like a general measurement result, you can assignment the auto spectrum calculation results to an application item, with the same steps described above.

NOTE: The application item to assign should be an item using D trace in current application package.

1.6 Cross-window Measurement

Cross-window measurement is available in dual-B mode when the left and right windows are imaging with the same probe, depth and invert mode.

1.7 Report

The report records measurement results, which are saved automatically by system after each measurement.

- Press <Report> to enter the report dialog box.
- The default report of the current exam appears.

  Measurement items contained in the report are presettable. See "2.5 Preset of Report Template" for details.
- After viewing, press <Report>, <Freeze> or <Esc>, or select [Cancel] or [OK] to exit the report page.

1.7.1 Viewing Report

Items in the report page are described as follows (taking Obstetric report as an example):

- Each measurement contains three latest values and a final value.
- Value that exceeds the clinical range is displayed as “value !”
- The report only displays results of the tools that preset in the report template and completed, as shown in figure above.
- Select [Previous] or [Next] to flip the pages if the report has more than one page.

1.7.2 Editing Report

Available operations of report editing are as follows:

- Editing Measurement Data
- Entering Ultrasound Remarks
- Selecting Images
- Analyzing Report Data

Editing Measurement Data

⚠CAUTION:	**Input appropriate data when editing the measurement values, otherwise misdiagnosis may occur.**

- The 3 measurement values in text boxes are editable, move the cursor to the text box and press <Set>.
- The modified value(s) is (are) underlined.
- The final value display in the [Value] column. Select an option ([Last], [Avg], [Max] or [Min]) from [Method] to determine the method in which the final value is calculated.
- For result values used to calculate GA (Gestational Age) and SD (Standard Deviation), the formula used in this calculation can be selected from [Formula]. GA and SD value updates with the formula change.

NOTE:	1.	Only measurement values are editable while calculation values are not.
	2.	After a measurement value is modified, the average value of the tool and the corresponding calculation value will be updated automatically.

- Clearing Data

Click [Clear All] in the report page to clear all measurement data.

Entering Ultrasound Remarks

If [Prompt], [Findings] and [Comments] are selected in the report template, you can input corresponding information in the report dialog box. For report preset, see "2.5 Preset of Report Template".

Selecting Images

Image(s) saved in current exam can be added to the report.

1. Click [Image Select] in the report page to pop up the following dialog box.

Left Column: Image(s) saved in current exam.

Right Column: Images selected to add into the report.

2. Select the image.
   a) Adding/ Removing the image by pressing:
      [>] To add the selected image in the left column into the right column.
      [>>] To add all images in the left column into the right column.
      [<] To remove selected image in the right column.
      [<<] To remove all images in the right column.
   b) Adjust the image arrangement.

   Select an image in the right column and click [Move Up] or [Move Down] to adjust the image sequence, in which the images are arranged in the report.
3. Click [OK] to confirm.

Analyzing Report Data

You can preset and edit OB or Vascular anatomy information in the report.

NOTE:	If at least one of the ultrasound anatomy items is preset to display, the [Analyze] button is available in the report. For details, refer to “2.5 Preset of Report Template”.

1. Click [Analyze].

   Items of preset ultrasound anatomy (OB or vascular) are listed in the page popped up.
2. Select or type in anatomy descriptions.

Tips:	Descriptions of [Fetus Score] can only be selected from the drop-down list.

   Use the [Previous]/ [Next] to turn the pages.
3. If [Prompt], [Findings] and [Comments] are selected in the report template, you can input corresponding information in the report dialog box.
4. Click [OK] to confirm. Analysis information displays following the measurement values in the report.

⚠CAUTION:	**Input appropriate data when editing the measurement values, otherwise misdiagnose may occur.**

1.7.3 Viewing History Report

If more than one exam is performed to a patient, a drop-down list of [Exam] appears in the report.

1. Select history exams from the [Exam] drop-down list.
2. According to the exam mode, select a proper template from the [Report Type].

   Make sure the template matches the exam mode, otherwise the measurement result will not display correctly. E.g. an abdomen measurement result will not display in an OB report template that preset without any abdomen measurement items.
3. Viewing the history report.

NOTE:	1.	History reports can be viewed, but cannot be edited.
	2.	Also, you can view the patient information in iStation, see "Patient Data Management" in the Operator's Manual [Basic Volume] for details.

1.7.4 Printing Report

Click [Print] in the report page to print the report.

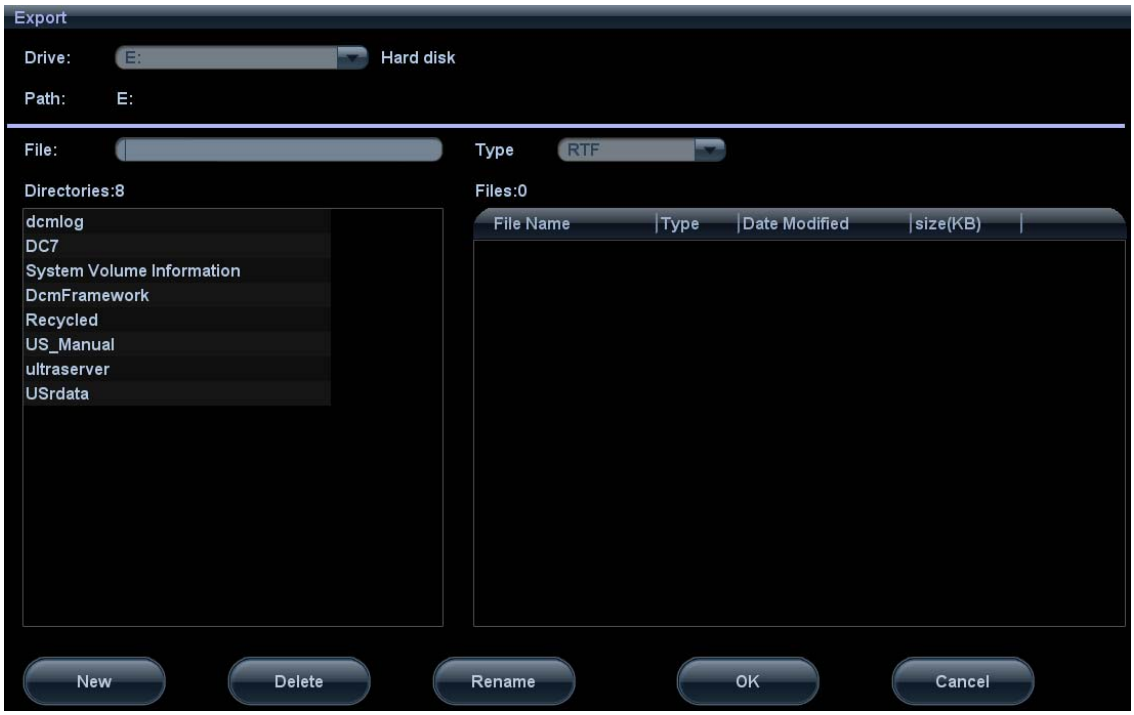
Or, click [Print View] in the report page to preview. In preview page, you can:

Print report:	Click [Print].
Page up/down:	Select [Prev Page] or [Next] to view the previous or next page.
Zoom in/out:	Select a zoom ratio from the drop-down list.
Exit the preview:	Click [Close].

1.7.5 Exporting Report

The reports can be exported in PDF or RTF documents, which can be viewed and edited on a PC.

1. In the report dialog box, select [Export] to pop up the following dialog box.



2. Select a drive in the drive list.
3. Select the desired directory. To return to the parent directory, double-click [..].
4. Input the filename for the report to export.
5. Select the file type.
6. Click [OK] to confirm.

You can create, delete or rename the directory by pressing:

[New]: To create a new template.

[Delete]: To delete the selected directory. Multi-selection can be performed by using <Shift> and <Set> key.

[Rename]: To rename a selected directory.

1.7.6 Fetal Growth Curve

If [Obstetric] in the [Patient Info] is selected in the report template (see "2.5 Preset of Report Template"), you can view the fetal growth curve by clicking the [Growth] button in the report page. See “5.7.2 Fetal Growth Curve” for details.

2 Measure Preset

Before measuring, preset the following parameters:

- Measurement Parameters Preset
- Obstetric Preset
- General Measurement Preset
- Application Measurement Preset
- Preset of Report Template

2.1 Basic Preset Procedures

The basic measure preset procedures are as follows:

1. Enter the Preset:
   - Press <Setup>; or,
   - Select [Other] -> [Setup] in the imaging menu.
     E.g. select [B] -> [Other] -> [Setup].

Tips:	If the menu does not display, press <Menu> on the control panel to show the image menu.

2. Preset the measurement parameters.

   Enter [Setup] -> [System Preset] -> [Meas] to preset the Measure ruler, result window, etc. See "2.2 Measurement Parameters Preset" for details.
3. Preset the Obstetric formula.

   Enter [Setup] -> [System Preset] -> [OB].

   Preset the GA (Fetal Gestational Age), FG (Fetal Growth) and the Fetal Weight. See "2.3 Obstetric Preset" for details.
4. Measure preset.

   Enter [Setup] -> [Measure Preset] -> [Caliper] and [Measure] to preset the measurement menu, items and soft key. See "2.4 Measure Preset" for details.
5. Preset the report template.

   Enter [Setup] -> [Measure Preset] -> [Report] to create, edit, import or export the report template. See "2.5 Preset of Report Template" for details.
6. Preset the automatic spectrum calculation parameters.

   Enter [Setup] -> [Measure Preset] -> [Parameter] to preset the result parameter in auto spectrum calculation. See "2.6 Automatic Spectrum Calculation Parameters" for details.
7. Return from the setup to make the settings taking effect.

   Select [Return] on the [Setup] menu to return from the setup.

NOTE:	The settings take effect only by clicking [Return] to exit the [Setup] menu.

2.2 Measurement Parameters Preset

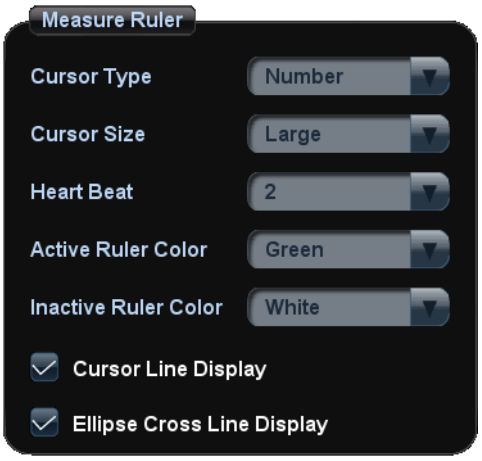
Basic operation steps are as follows:

1. Press <Setup> to show the [Setup] menu.
2. Select [Setup] -> [System Preset] -> [Measure Preset] to preset the following parameters:
   - Measurement Ruler
   - Measure Result
   - Unit
   - Follicle

   You can click [Load Factory] to restore the factory setups.
3. Click [OK] to confirm.

The following are function descriptions of the parameters.

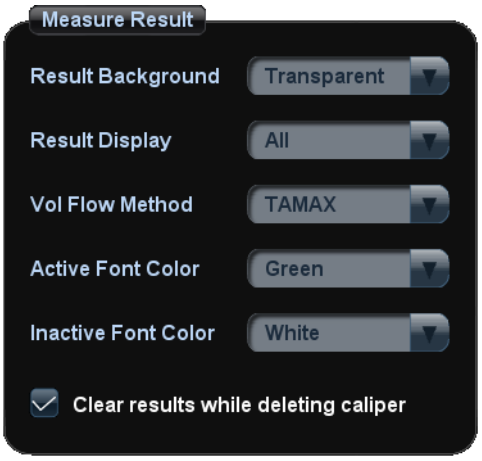
Measure Ruler



You can preset:

Tools	Descriptions
Cursor Type	Types of cursor displays on the measurement caliper and result window. Value options: ■ Number: the cursor always displays as "+" while different measurements are marked with numbers. ■ Symbols: the cursor displays sequentially in 8 symbols to identify different measurements.
Cursor Size	The size of the cursor. Value options: Large, Medium, Small
Heart Beat	The number of cardiac cycles in the heart rate calculation. (In heart rate measurement, the number of cardiac cycle should match the preset number.)
Active Ruler Color	Set color of the active ruler.
Inactive Ruler Color	Set color of the inactive ruler.
Cursor Line Display	Whether to display the dotted line between the two ends of a caliper after a measurement is completed.
Ellipse Cross Line Display	Whether to display the dotted lines to indicate the long axis and short axis in ellipse measurement method.

Measure Result



You can preset:

Tools	Descriptions
Result Background	Background color of the result window. Value options: transparent/ gray
Result Display	Presets whether to display all the measurement or the current measurement.
Vol Flow Method	Set the method to calculate volume flow. Value: TAMAX/ TAMEAN. $\text{Vol Flow(ml / min)} = \lvert \text{V(t)(cm/s)} \rvert \times \pi \left(\frac{\text{VF Diam}}{2} \right)^2 (cm^2) \times 60(s)$ Where, VF Diam is Vessel Flow Diameter; V(t) is TAMAX or TAMEAN.
Active Font Color	Set the font color of active item.
Inactive Font Color	Set the font color of inactive item.
Clear results while deleting caliper	Presets whether to clear measure results when a caliper is removed.

Unit

Presets the units of Distance, Area, Volume, Time, Velocity, Slope, and Acceleration.

Follicle

Set the method to calculate the follicle . Value options:

- 3 distances
- 2 distances
- 1 distance

2.3 Obstetric Preset

Basic procedures:

1. Press <Setup> to show the [Setup] menu.
2. Select [System Preset] -> [OB].

You can preset Fetal Gestational Age (GA), Fetal Growth (FG) and Fetal Weight (EFW) formula.

See "2.3.2 Obstetric Preset Operations" for details.

3. After setting, click [OK] to exit the [System Preset] page.
4. Continue other presets; or click [Return] on the [Setup] menu to make the settings take effect.

2.3.1 Obstetric Formula

The obstetric formulae are used in GA, EFW calculations and Fetal Growth Curve.

GA and FG Formulae

GA will be automatically calculated after the corresponding measurements are completed. The system will recalculate the GA after new measurements are completed.

Tips:
1. For preset of the default formula, See "Set the default formula."
2. For more information about GA and Fetal Growth Curve, see "5 Obstetrics".

GA and FG formulae are shown in table below:

Note: "/" means no formula provided for the item.

Tools	GA	FG
GS	Tokyo Rempen Hansmann China	Tokyo Hellman Rempen Hansmann
CRL	Hadlock Tokyo Jeanty Nelson Robinson Rempen Hansmann China ASUM RobinsonBMUS*	 Hadlock ASUM Robinson Tokyo Rempen Hansmann

Tools	GA	FG
BPD	Hadlock Tokyo Jeanty Kurtz* Hansmann Merz Rempen ChittyOI Osaka China Nicolaides ASUM	Hadlock Tokyo Jeanty* Kurtz Sabbagha Hansmann Merz Rempen ChittyOI Osaka Nicolaides ASUM
HC	Hadlock Jeanty Hansmann ChittyPL Chitty_Derived* Nicolaides ASUM	Hadlock Merz Hansmann ChittyPL Chitty_Derived* Nicolaides ASUM
AC	Hadlock Jeanty* Merz* ChittyPL* Nicolaides ASUM CFEF* Hansmann*	Hadlock Jeanty Merz ChittyPL Chitty_Derived* Nicolaides ASUM CFEF* Hansmann*
FL	Hadlock Tokyo Jeanty Hohler Merz Hansmann Warda Chitty Osaka China Nicolaides ASUM	Hadlock Tokyo Merz Hansmann O'Brien Warda Chitty Osaka Nicolaides ASUM

Tools	GA	FG
OFD	Hansmann Nicolaides ASUM	Merz Hansmann Nicolaides ASUM
APAD	/	Merz
TAD	/	Merz
FTA	Osaka	Osaka
THD	Hansmann	Hansmann
APTD	/	/
YS	/	/
TTD	/	/
HUM	Jeanty ASUM	Merz ASUM
Ulna	/	Merz
Tibia	/	Merz
RAD	/	Merz Jeanty
FIB	/	Merz Jeanty
CLAV	Yarkoni	Yarkoni
TCD	Hill Nicolaides	Goldstein Hill Nicolaides
OOD	Jeanty	/
Vertebrae	/	/
NT	/	/
Cist Magna	/	Nicolaides
EFW	Tokyo Hadlock	Hadlock Hansmann Tokyo Brenner William
EFW2	Tokyo Hadlock	Hadlock Hansmann Tokyo Brenner William
Mean Sac Diam	Daya	/

Tools	GA	FG
MCA PI	/	JSUM
MCA RI	/	JSUM
Umb A PI	/	JSUM
Umb A RI	/	JSUM
AFI	/	Moore

Note: * indicates non-FDA formula which is not available for sale in the USA or Canada.

Fetal Weight Formulae

EFW is a calculation item. If all tools required for EFW formula have been performed, EFW will be obtained automatically. The system will recalculate the EFW after new measurements are completed.

Tips: Formulae of EFW1 and EFW2 of GA/ FG are different from those in the [Fetal Weight] page.

- EFW formulae of GA/ FG are used to perform the GA calculation or the Fetal Growth Curve based on EFW.
- EFW formulae in the [Fetal Growth] page are used in EFW calculation based on some OB measure results (e.g. AC).

The Fetal Weight formulae are shown in the following table:

Formulae	Descriptions	Units	
		EFW	Item
Hadlock (AC, FL)	EFW= 10^(1.304+ (0.05281*AC)+ (0.1938*FL)- (0.004*AC*FL))	g	cm
	SD=0.154*EFW SD Type=±2SD	g	g
Hadlock (AC, FL, BPD)	EFW= 10^(1.335 -(0.0034*AC*FL) + (0.0316*BPD) + (0.0457*AC) + (0.1623*FL))	g	cm
	SD=0.146*EFW SD Type=±2SD	g	g
Hadlock (AC, FL, HC)	EFW= 10^(1.326-(0.00326*AC*FL)+ (0.0107*HC)+ (0.0438*AC)+ (0.158*FL))	g	cm
	SD=0.148*EFW SD Type=±2SD	g	g
Hadlock (AC, FL, HC, BPD)	EFW= 10^(1.3596- (0.00386*AC*FL)+ (0.0064*HC)+ (0.00061*BPD*AC)+ (0.0424*AC)+ (0.174*FL))	g	cm
	SD=0.146*EFW SD Type=±2SD	g	g
Shepard	EFW (Kg) = 10^(-1.7492+ (0.166*BPD)+ (0.046*AC)- (2.646*AC*BPD/1000))	kg	cm
	SD=0.202*EFW SD Type=±2SD	g	g
Merz1	EFW=-3200.40479+(157.07186*AC)+(15.90391*(BPD^2))	g	cm
Merz2	EFW=0.1*(AC^3)	g	cm
Hansmann	EFW = (-1.05775*BPD)+ (0.0930707*(BPD^2)+ (0.649145*THD)- (0.020562*(THD^2)+ 0.515263	kg	cm
Tokyo	EFW=(1.07*(BPD^3))+(3.42*APTD*TTD*FL)	g	cm

Formulae	Descriptions	Units	
Osaka	EFW=(1.25674*(BPD^3))+(3.50665*FTA*FL)+6.3	g	cm
Campbell	EFW (Kg) = EXP (-4.564+(0.282*AC)-(0.00331* (AC^2)))	kg	cm

Weight Percentile for Age

The Clinical Percentile (CP) and Ultrasound Percentile (UP) will be calculated and displayed in the report in the following format according to the formula selected for EFW calculation.

- CP(Calc Method)(Formula) ××%: Where Calc Method may be LMP, PRV, IVF, BBT, and EDD;
- UP(Calc Method)(Formula) ××%: Where Calc Method may be AUA, CUA.

Wherein the Formula can be preset in [Setup]-> [System Preset]-> [OB]-> [Fetal Weight]-> [EFW-GP].

E.g. CP (LMP)(Hadlock) 73.4%.

- Clinical Percentile (CP)

  Find the average value and calculate the threshold range in the formula (to calculate EFW) in the FG table according to the clinical GA (obtained in patient information such as LMP, IVF).

  If the actual EFW value is in the following range, keep calculating; otherwise, the CP will not be displayed.

  Average EFW x1.25 > EFW > Average EFW x0.75

  E.g. EFW-GP(LMP) is EFW Clinical Percentile calculated from the LMP obtained from the patient information.

- Ultrasound Percentile (UP)

  It has the same calculation method with CP except to use the ultrasound GA instead of clinical GA.

  Eg. EFW-GP(AUA) and EFW-GP(CUA) is EFW Clinical Percentile calculated from the AUA and CUA respectively.

2.3.2 Obstetric Preset Operations

2.3.2.1 Basic Procedures

Basic procedures in the OB preset are as follows:

1. Enter the [Setup] -> [System Preset] -> [OB] page.
2. Set the default formula.
   a) In the [Fetal Gestational Age], [Fetal Growth] or [Fetal Weight] page, select an OB Items in the left column.
   b) Select a formula in the right column.
   c) Click [Default], the default formulae is marked with a √.

   Following operations are also available to the formula (for more details, see the corresponding section):
   - Creating Formula/ table
   - Browsing Formula/ table
   - Editing Formula/ table
   - Deleting Formula/ table

In [Fetal Gestational Age] page, you can select whether to display SD or EDD in the obstetric result.

In the [Fetal Growth] page, you can select the number and layout of the growth curves display in the report.

3. Set the fetal weight display.
   a) Enter the [Fetal Weight] page.
   b) Select the [Fetal Weight Unit]:

   Select Metric, English or English & Metric from the drop-down list.

   c) Preset whether to display the EFW in the result window and exam report.

   Select/ deselect the [Display] check box before the item.

   d) Select the formula to calculate the weight percentile.

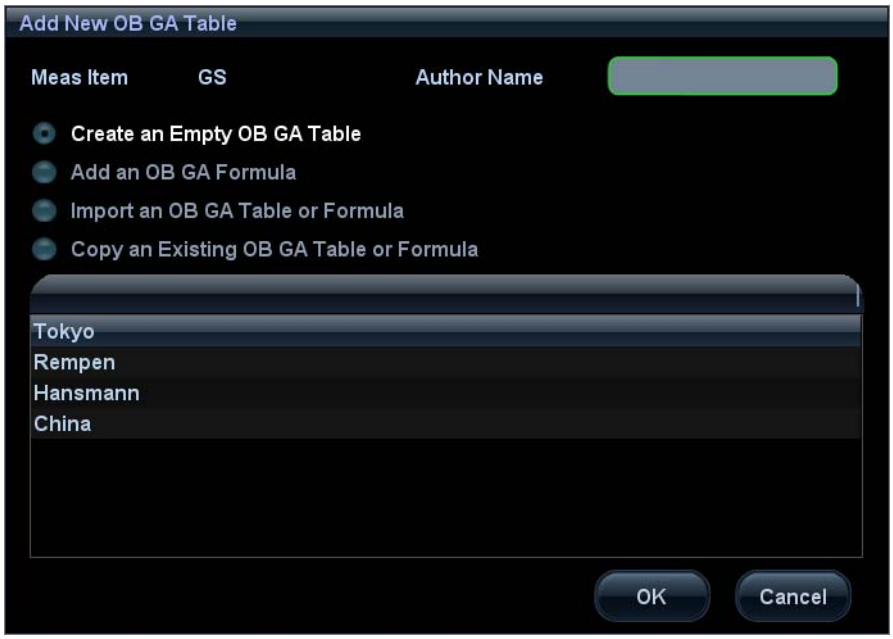
   Select the formula from the drop-down list of [EFW-GP].
4. Click [OK] to confirm.

   Click [Load Factory] to restore the factory setups.

2.3.2.2 Creating Formula

You can create a new GA or FG formula (table), the following takes adding GA table as an example.

1. In the [OB] page, select an item in the left column.
2. Select [Add] to enter the [Add New OB GA Table] dialog box. As shown in figure below.



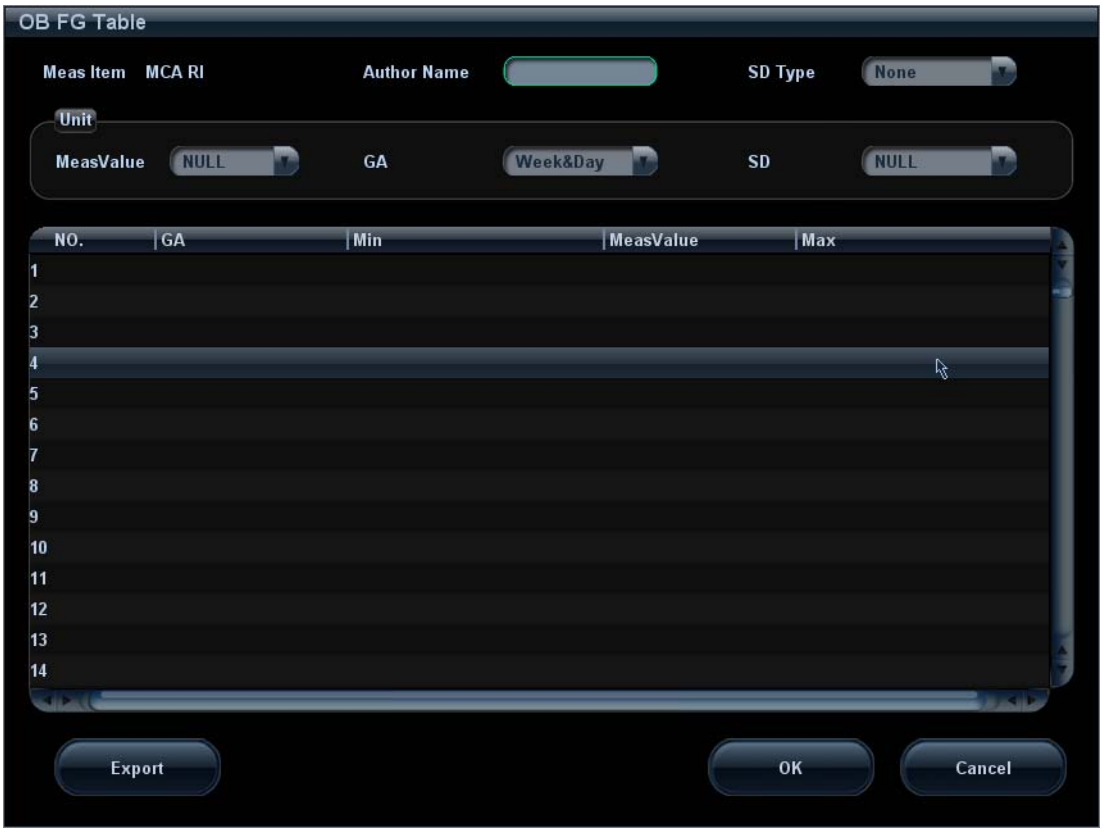
Four methods are available in creating a new table:

- Create an empty OB GA table
- Add an OB GA formula
- Import an OB GA Table or Formula
- Copy an Existing OB GA Table or Formula

Create an empty OB GA table

1. Select “Create an empty OB GA table” in the [Add New OB GA Table] dialog box.
2. Enter the Author Name.

3. Select [OK] to enter the new formula table.



4. Select the SD (Standard Deviation) Type.
   - None
   - ±1SD
   - ±2SD
   - 3%~97%
   - 5%~95%
5. Select the unit of Meas Value, GA and SD.
   - GA or SD values display in XXwXXd while setting to Week&Day.
   - GA or SD values display in XXXXd while setting to Days.
6. Add/ Edit data.

   Move the cursor to the position to add/ edit data, press <Set> and input data in the editable box. As shown in figure below.

NOTE:
1. The unit will be added automatically after the GA or SD value in entered.
2. The MeasValue and GA is constrained, but SD(-) and SD(+) can be null or zero.
3. Values in the [MeasValue] should be ascending series.
4. The range of GA is 0 to 365 and the SD range is 0 to 70 days (0 to 10 weeks).

7. Click [OK] to complete the OB GA table creation.

Add an OB GA formula

1. Select “Add an OB GA formula” in the [Add New OB GA Table] dialog box.
2. Enter the Author Name.
3. Click [OK] to pop up the [OB GA Formula] dialog box. As shown in figure below.

4. Select the SD (Standard Deviation) Type.
   - None;
   - ±1SD
   - ±2SD
   - 3%~97%
   - 5%~95%
5. Select the GA Unit and Deviation Unit.
6. Input the GA Formula and Deviation (±).

   Double click an item in the [Meas Item] list to input the item to the formula or deviation input box.

   Descriptions to the functions are shown in the following table.
7. Verify the formula. Click [Verify] to verify the input value.

Function descriptions:

(NOTE: number, power and base in the table below refer to numbers or variables.)

Functions	Syntax	Descriptions
sin	sin(number)	The sine of number.
cos	cos(number)	The cosine of number
tan	tan(number)	The tangent of number
atan	atan(number)	The arctangent of number
exp	exp(number)	The power of e with exponent number

Functions	Syntax	Descriptions
min	min(number1, number2,…)	The minimal of number1, number2, …
max	max(number1, number2,…)	The maximal of number1, number2, …
pow	pow (number, power)	Power value of number
sqr	sqr(number)	Square value of number
ln	ln(number)	Natural logarithm of number
log	log(number)	Logarithm of number (based as 10)
sqrt	sqrt(number)	Square root value of number
abs	abs(number)	Absolute value of number
PI	/	The circumference ration, with accuracy of 15 digits

Import an OB GA Table or Formula

1. Select “Import an OB GA Table or Formula” in the [Add New OB GA Table] dialog box.
2. Select [OK] to pop up the [Load Data] dialog box.
3. Select the drive and file path the data located.
4. Select the data file to load.
5. Click [OK] to confirm.

Copy an Existing OB GA Table or Formula

1. Select “Copy an Existing OB GA Table or Formula” in the [Add New OB GA Table] dialog box.
2. Select a formula in the list.
3. Input the Author Name.
4. Click [OK] to pop up the [OB GA Table] dialog box.
5. Modify the table according to step 4, 5 and 6 in "Create an empty OB GA table".
6. Click [OK] to confirm.

2.3.2.3 Browsing Formula

Formulae provided by the system can be browsed, but cannot be edited or deleted.

1. In the [OB] page, select the OB item from the left column.
2. Select the formula to be edited in the right column.
3. Select [Browse] to view data in the table.

2.3.2.4 Editing Formula

Only user-defined formula is editable.

1. In the [OB] page, select the OB item from the left column.
2. Select the formula to be edited in the right column.
3. Click [Edit] to enter the editing status.
4. Modify the table according to step 4, 5 and 6 in "Create an empty OB GA table".

2.3.2.5 Deleting Formula

Only user-defined formulae can be deleted.

1. In the [OB] page, select the OB item from the left column.
2. Select the formula to be edited in the right column.
3. Select [Delete] to delete the formula.

2.4 Measure Preset

Basic Procedures:

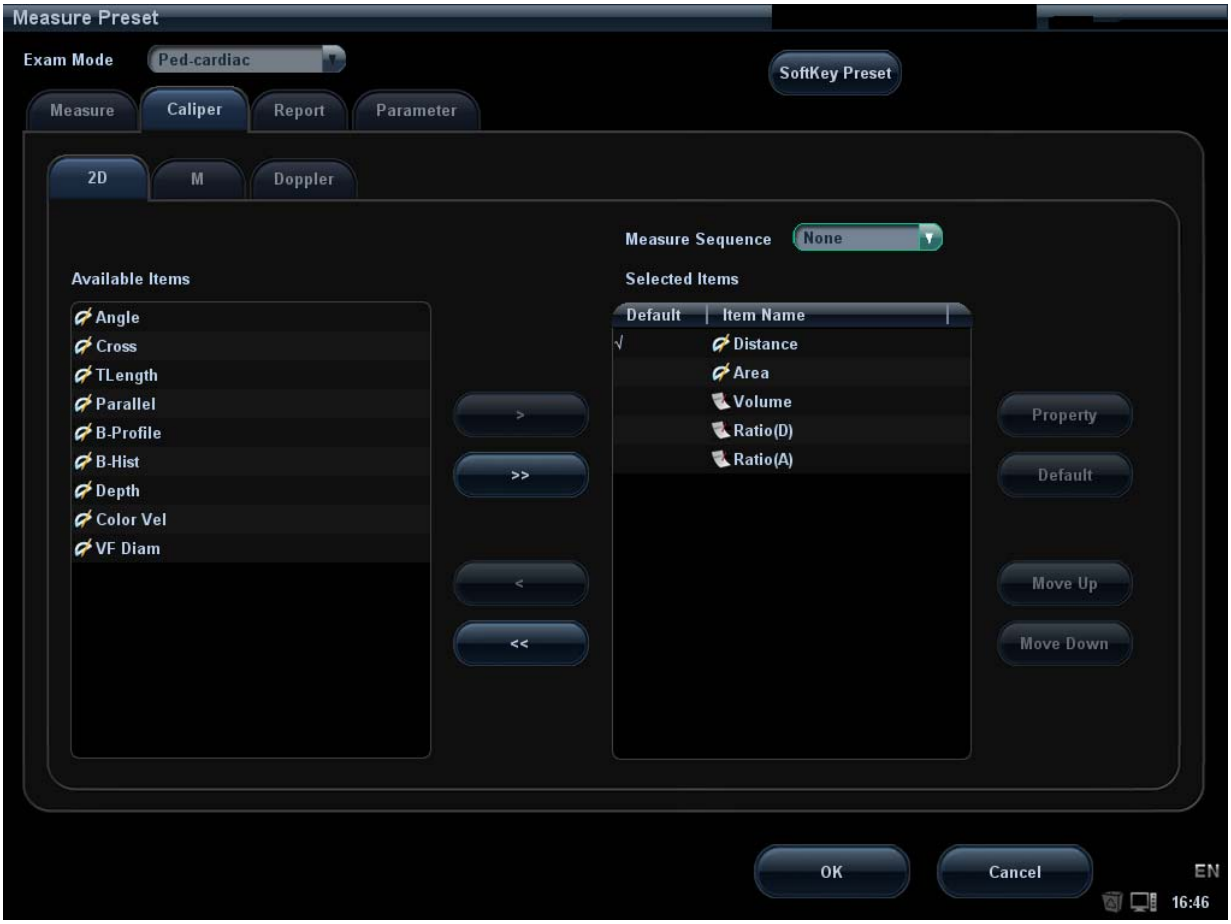
1. Press <Setup> to show the [Setup] menu.
2. Select [Measure Preset] in the [Setup] menu.
3. Preset the general measurement, application measurement and the soft key.

   For details, refer to "2.4.1 General Measurement Preset", "2.4.2 Application Measurement Preset" and "2.4.3 Soft Key Preset".
4. Click [OK] to confirm.
5. Continue other presets; or click [Return] on the [Setup] menu to make the settings take effect.

2.4.1 General Measurement Preset

You can preset the General Measurement packages for 2D (B / Color / Power / DirPower Mode), M Mode, or Doppler (PW / CW) Mode respectively.

1. Select the [Caliper] in the [Measure Preset] page. As shown in figure below.



2. Select an Exam Mode.

NOTE:	The general measurement menu preset here are exam mode-related. E.g. change of OB general measure preset will not affects the Adult ABD general measurement menu.

3. Select the [2D], [M] or [Doppler] tab sheet to go to the corresponding preset.

   [Available Items]: available general measurement tools configured by the system in the current scanning mode, but they are not assigned yet.

   [Selected Items]: displays the tools to be added to the menu.

4. Add/ Remove the item.

   Add/ Remove the general measurement item by the following buttons:

[>]	To add the tool selected from the [Available Items] into the [Selected Items].
[>>]	To add all tools (need not selected) in the [Available Items] into the [Selected Items].
[<]	To remove the tool selected from the [Selected Items] to the [Available Items].
[<<]	To remove all tools in the [Selected Items] to the [Available Items]. You need not select any item before removing.

5. Set the default item.

   Select an item in the [Selected Items], click [Default]. The item is marked with a √.

   The default item is activated automatically while entering this general measurement menu.

6. Adjust the item position.

   Select an item in the right column and click [Move Up]/ [Move Down] to adjust the sequence in which the items are arranged in the corresponding general measurement menu.

7. Modify the property of measurement item.

   The [Property] dialogue box varies by measurement items. The following takes D trace as an example to show how to set the properties of a measurement tool.

   a) Enter the [Measure Preset] -> [Caliper] -> [Doppler] page.

   b) Select [D Trace] in the [Selected Items] and click [Property] to pop up the following dialog box.

Descriptions of the attributes are shown in the following table.

Attributes	Descriptions
Item Name & Result	Results obtained from D trace are listed. The selected items will be displayed in the result window. ■ If PV is selected, other results become deselected (except the temporary result “velocity”). ■ Some results such as PS and ED can derived via simply method (e.g. Velocity); but others such as TAMAX can only derived via complicated method like Manual, Spline, Auto etc. ● Only Vel in the [Method] is available if only PS or ED is selected. ● Only 2 PT in the [Method] is available if both PS and ED are selected (with others deselected). ● More complicated methods to obtain PS and TAMAX simultaneously are available if both PS and TAMAX are selected.
Meas Method	Select a default measurement method for the tool if more than one method is available.
Online Select	Select a default method for the tool if more than one method is available. If deselected, measure method for this tool is set to the default one and cannot be selected during measuring.
[Move Up] / [Move down]	Adjusts the position of the item in the item list as well as in the result window.
Menu	When [Online Select] is deselected, results displayed in the window can be added to the measurement menu in different ways. ■ [Extend Sub Menu]: The selected results will display in the sub-menu of D trace in the measurement menu. ■ [Composite Menu]: The selected results will display in the measurement menu independently.

c) Click [OK] to confirm the setting.

8. Select the measure sequence.

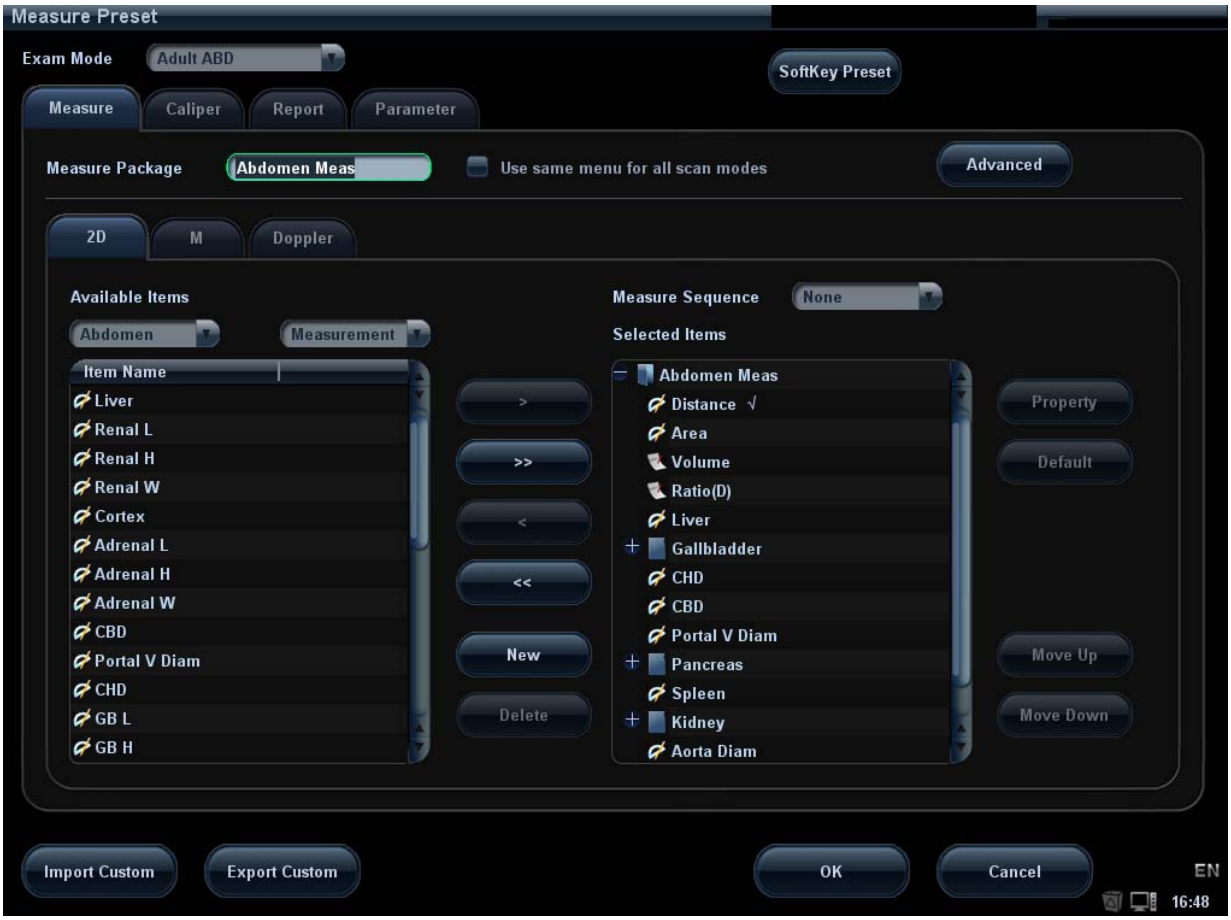
- [Repeat]: after the current measurement is completed, the system automatically activates the current tool again.
- [Next]: after the current measurement is completed, the system automatically activates the next tool in the menu.
- [None]: after the current measurement is completed, the cursor can be moved on the whole screen. And the cursor will automatically return to the menu of the corresponding measurement.

9. Click [OK] to confirm.

2.4.2 Application Measurement Preset

2.4.2.1 Basic Procedures

1. Select the [Measure] in the [Measure Preset] page. As shown in figure below.



2. Select an Exam Mode.
3. Select the 2D, M or Doppler scanning mode.

   If [Use same menu for all scan modes] is selected, all items for 2D, M and Doppler mode display in the [Available Items] list.

4. Choose or edit the Measurement Package.

   Generally, the corresponding package appears in the [Measure Package] when the [Exam Mode] is selected.

   - If no package appears, a default measurement package for the current exam mode needs to be added. You can input the package name directly in the [Measure Package] text box then add items into it; or click [Advanced] to enter the dialog box to add a new package.
   - If the package appears is not the one desired, click [Advanced] and select a new default package for current exam mode.

For details about creating, deleting and setting default package, see “2.4.2.2 Measurement Package Preset”.

5. Select an application region from the drop-down list under [Available Items].
6. Select [Measurement], [Calculate], [Study] or [All] from the drop-down list under [Available Items], the corresponding items appear in the list.

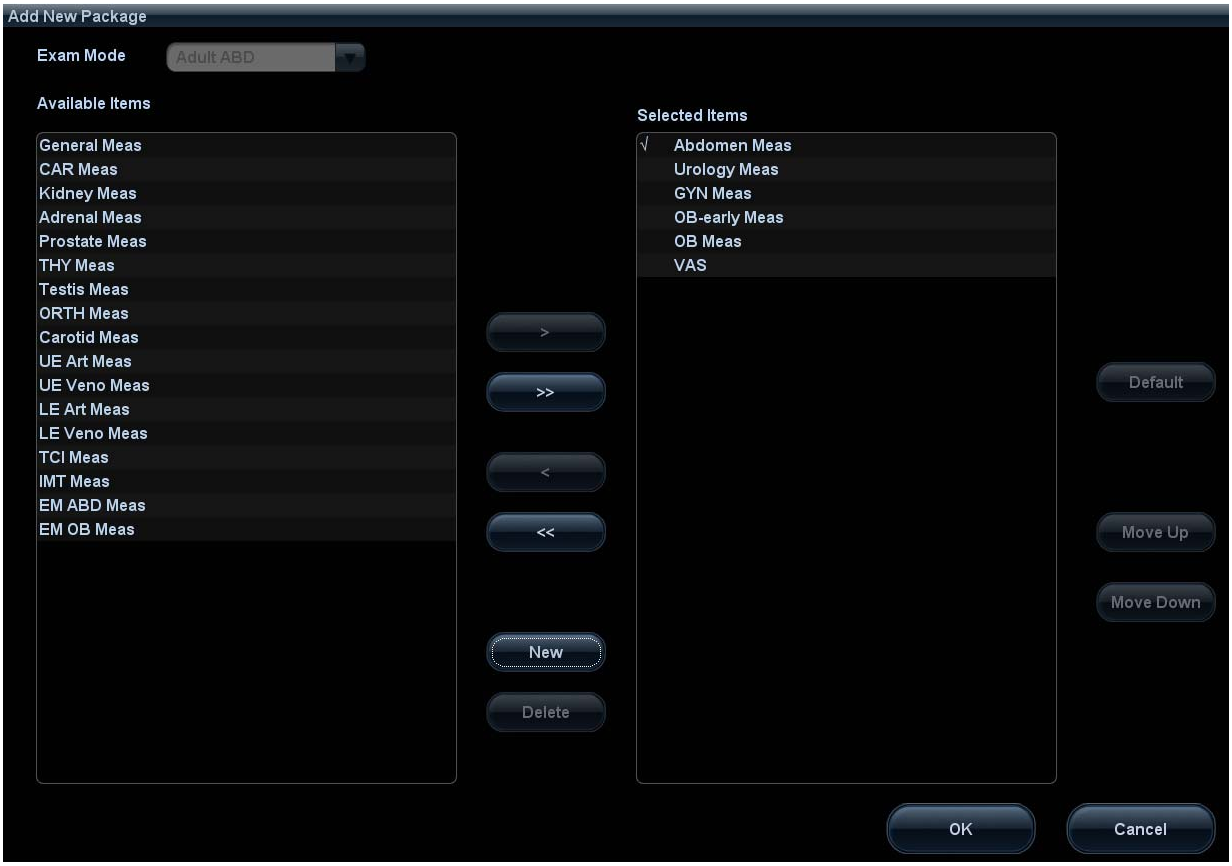
   For details about measurement, calculation and study, refer to "1.3 Measurement, Calculation and Study".
7. Preset the measurement menu.

   For details on adding, creating and setting default item, see “2.4.2.3 Preset of Measurement Menu”.
8. Select the measure sequence.
   - [Repeat]: after the current measurement is completed, the system automatically activates the current tool again.
   - [Next]: after the current measurement is completed, the system automatically activates the next tool in the menu.
   - [None]: after the current measurement is completed, the cursor can be moved on the whole screen. And the cursor will automatically return to the menu of the corresponding measurement.
9. Click [OK] to confirm.

2.4.2.2 Measurement Package Preset

During measurement, the preset package displays in menu. Items in package are presettable and may belong to different application region.

1. In the [Measure Preset] page, select an exam mode from [Exam Mode].
2. Click [Advanced] to enter the following page.



Where,

- [Available Items]: shows application packages configured in the system but not assigned to the current mode yet.
- [Selected Items]: shows application packages assigned to the current exam mode. If more than one package is assigned to the current exam mode, you can switch measurement package via the menu title in the measuring status. See section “1.2.1 Menu Title”.

The package editing includes Creating Package, Add/ Remove the item, Deleting Measurement Package, Setting Default Package, Adjusting Package Position.

Creating Package

1. Click [New].
2. Input name for the new package in the dialog box pop up.
3. Click [OK] to confirm.

   New package d*i*splays in the [Available Items] list as shown in the following figure.

Adding/ Removing Package

Adding/ removing the package by pressing:

[>]	To add the package selected from the [Available Items] into the [Selected Items].
[>>]	To add all packages (need not be selected) in the [Available Items] into the [Selected Items].
[<]	To remove the package selected from the [Selected Items] to the [Available Items].
[<<]	To remove all packages (need not be selected) in the [Selected Items] to the [Available Items].

Deleting Package

1. Select a package in the [Available Items] list.
2. Click [Delete].

Tips:	To delete an item in [Selected Items], you need to remove it to the [Available Items] first.

Setting Default Package

1. Select a package in the [Selected Items] list, click [Default].
2. The default package is marked with a √.

Tips:	1.	The default package displays when entering the [Measure Preset] page.
	2.	The measurement menu of the default package (corresponding to the exam mode) displays when entering the measuring status.

Adjusting Package Position

Select a package in the [Selected Items] and click [Move Up]/ [Move Down] to adjust the sequence of the package in which the menu are arranged.

2.4.2.3 Preset of Measurement Menu

In the [Measure Preset] -> [Selected Items] field.

The following operations are available.

- Adding/ Removing Item
- Setting Default Item
- Adjusting Item Position
- Setting Item Property

NOTE:	Before editing the measurement item, make sure that the [Exam Mode], [Measure Package], scanning mode (2D, M or Doppler), application region (e.g. Abdomen, Obstetric etc.) and the item type (Measurement, Calculation or Study) are correctly selected. See step 2, 3, 4, 5 or 6 in “Application Measurement Preset” for details.

Adding/ Removing Item

- Adding Item

You can add measurements, calculations or study items in the [Available Items] to the [Selected Items] column or the study item in the [Selected Items] column (added items display as sub-item in the study). The selected items displays in the menu.

Add/ Remove the general measurement item by the following buttons:

[>]	To add the tool selected from the [Available Items] into the [Selected Items].
[>>]	To add all tools (need not selected) in the [Available Items] into the [Selected Items].
[<]	To remove the tool selected from the [Selected Items] to the [Available Items].
[<<]	To remove all tools in the [Selected Items] to the [Available Items]. You need not select any item before removing.

Tips:	To display the measurement tools in the study as submenu, select [Extended Menu]. For more details about submenu, see "1.2.3 Measurement Tool". For how to set study property, see "Modify the property of measurement item."

Setting Default Item

You can set a measurement, calculation or study in the [Selected Items] as the default item. The default item will be activated automatically while entering the measurement menu containing it.

1. Select an item in the [Selected Items].
2. Click [Default], and the defaulted item is marked with a √ .

   To deselect the default tool, select it and click [Default] or set another item as default.

Tips:	If a certain study is set to the default item, it displays the submenu of the study automatically when entering this measurement menu.

Adjusting Item Position

You can adjust the position of the measurement, calculation or study in the [Selected Items] list.

1. Select an item in the [Selected Items].
2. Click [Move Up]/ [Move Down].

   The order in the list is also the item position in the menu.

Setting Item Property

You can set the property of measurement and study (the property of calculation items are unchangeable).

■ Modify the property of measurement item

Procedures of setting the application measurement item property is similar as the general measurement item, see step 7 “Modify the property of measurement item” in the "2.4.1 General Measurement Preset" for references.

The differences are:

- You can add/ delete / modify user-defined calculation in the result list of the item. See "User-defined Measurement" and "User-defined Calculation" for details.
- You can select a method from the [CalcMethod] column as the default calculation method for a result value.

■ Modify the property of study item

1. Select a study in the [Selected Items] list.
2. Click [Property] to pop up the following dialog box.

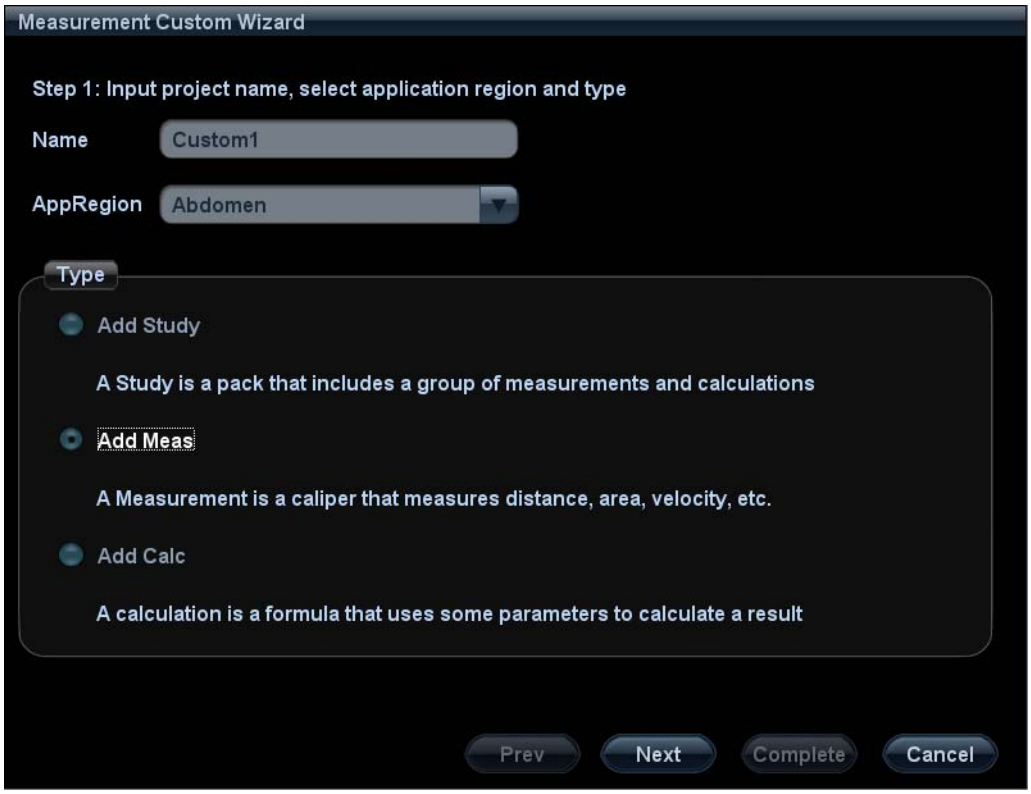
Descriptions of the attributes in the dialog box are shown in the following table.

Attributes	Descriptions
Measure Sequence	Measuring order of the items in the study. Value options: ● [Repeat]: after the current measurement is completed, the system automatically activates the current tool again. ● [Next]: after the current measurement is completed, the system automatically activates the next tool in the menu. ● [None]: after the current measurement is completed, the cursor can be moved on the whole screen. And the cursor will automatically return to the menu of the corresponding measurement.
Extended Menu	Display the measurement items in the study as submenu.

2.4.2.4 User-defined Measurement

1. Enter [Measure Preset] -> [Measure] page, and make sure the [Exam Mode] and [Measure Package] are correctly selected.
2. Select the position to place the user-defined measurement item on the right column. (Select the study firstly if you want to add user-defined item into a study).
3. Click [New].

   The “Measurement Custom Wizard” dialog box pops up, as shown in the following figure.

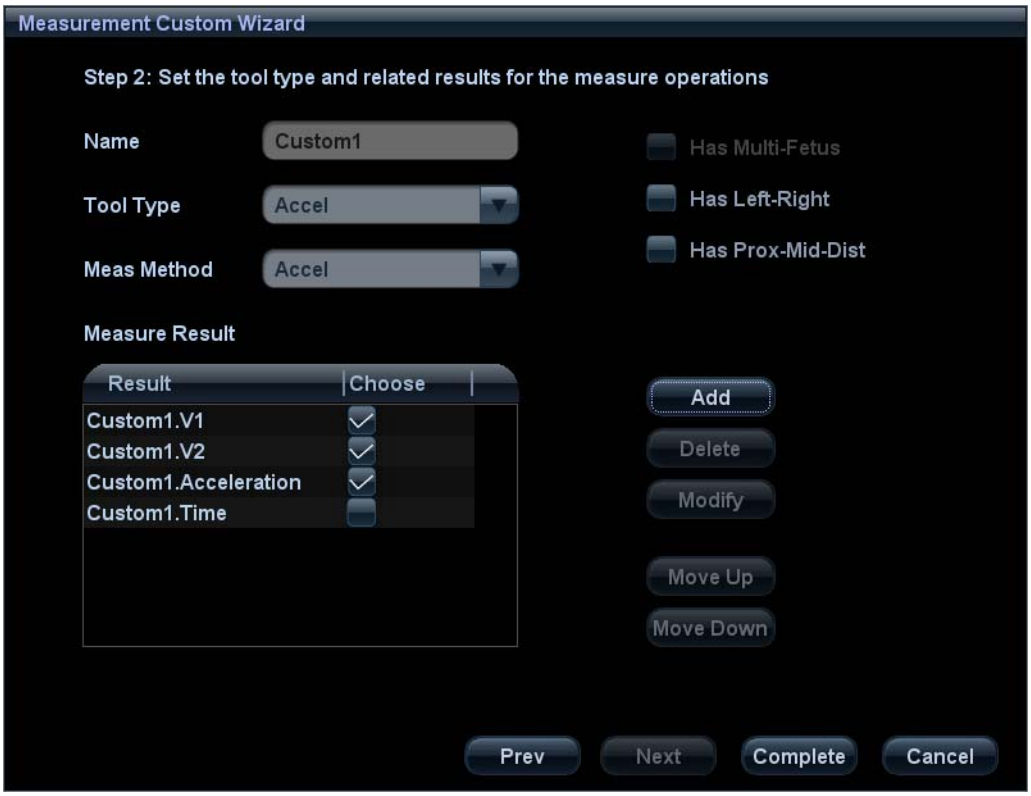


Available functions:

- Add user-defined measurement
- Add user-defined calculation
- Add user-defined study

User-defined Measurement

1. Input Name in the "Measurement Custom Wizard" dialog box, select the [AppRegion], choose [Add Meas] and click [Next].
2. Select the [Tool Type], [Meas Method] and the Measure Result.



Descriptions of the attributes in the dialog box are shown in the following table.

Attributes	Descriptions
Tool Type	General measurement tool type of the user-defined item. E.g. select Area if you want to add a new item to measure the area.
Meas Method	The measurement methods of the chosen tool. E.g. measurement methods of Area are Ellipse, Trace, Spline and Cross.
Has Multi-Fetus	If selected, you can choose different fetus in the measurement menu (available in Obstetric application region only).
Has Left-Right	If selected, you can choose left or right side in the measurement menu.
Has Prox-Mid-Dist	If selected, you can choose proximal, middle or distal in the measurement menu.
Measure Result	Choose the result(s) to be displayed in the result window. The result name is changeable. Move the cursor onto an item and press <Set>, then input the name in the text box.
[Add]	Add a calculation item ■ With the user-defined formula and the parameters derived from the current result item of the measurement. ■ This new calculation appears as one of the current results. See "User-defined Calculation" for details.
[Delete]	Delete the selected result item.
[Modify]	Used to modify the formula or parameters in the user-defined calculation.
[Move Up] / [Move Down]	Adjusts the position of the item in the list as well as in the result window.

3. Click [Complete] to finish the setting. The user-defined measurement item lists in the menu. An asterisk appears posterior to the user-defined item for identification.

User-defined Calculation

The user-defined calculation is derived from arithmetic operations, in which the parameters are measurement or calculation results obtained in measurement items existing in system or user-defined.

1. Input Name in the "Measurement Custom Wizard" dialog box, select the [AppRegion], choose [Add Calc] and click [Next].
2. Edit the formula.

Descriptions of the attributes in the dialog box are shown in the following table.

Attributes	Descriptions
Formula	Displays the user-defined formula.
Verify	Used to verify the input value.
Meas Item	All available measurement items of the application region selected in the previous step.
Calculator/ Function	Used to input numbers and functions in the formula.
Calculate Result	Used to set the Unit and the range of result.

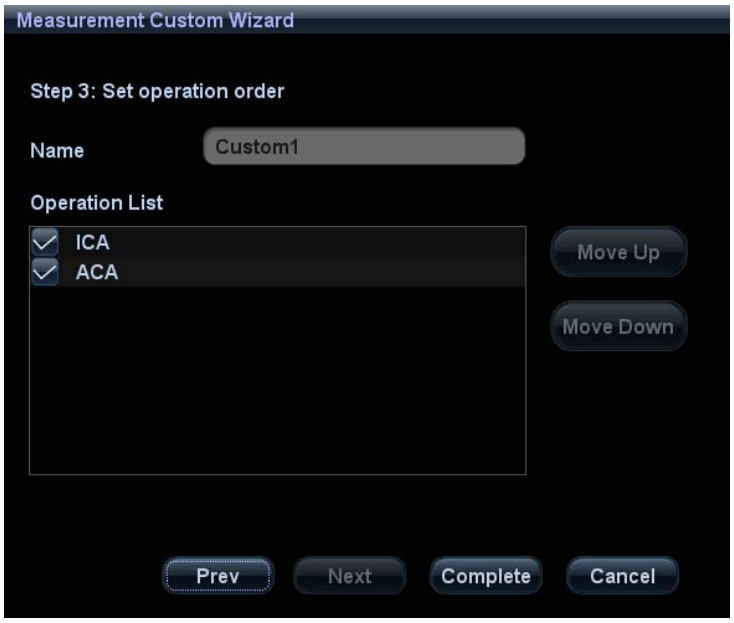
E.g. to input the function sin (xx).

a) Click [sin] in the [Function] field. Then "sin ()" displays in the [Formula] input box.

b) Double click an item in the [Meas Item] list to put it into the bracket of sin (). E.g. sin ([Aorta PS]).

NOTE:	1. Operator of the trigonometric functions is in degree, not radian.
	2. The accuracy of PI is 15 digits.

3. Verify the formula and select the unit and range of the result, then click [Complete].
4. Click [Next] to set the measuring order of the items in the calculation if more than one measurement items are set as parameter in the formula.

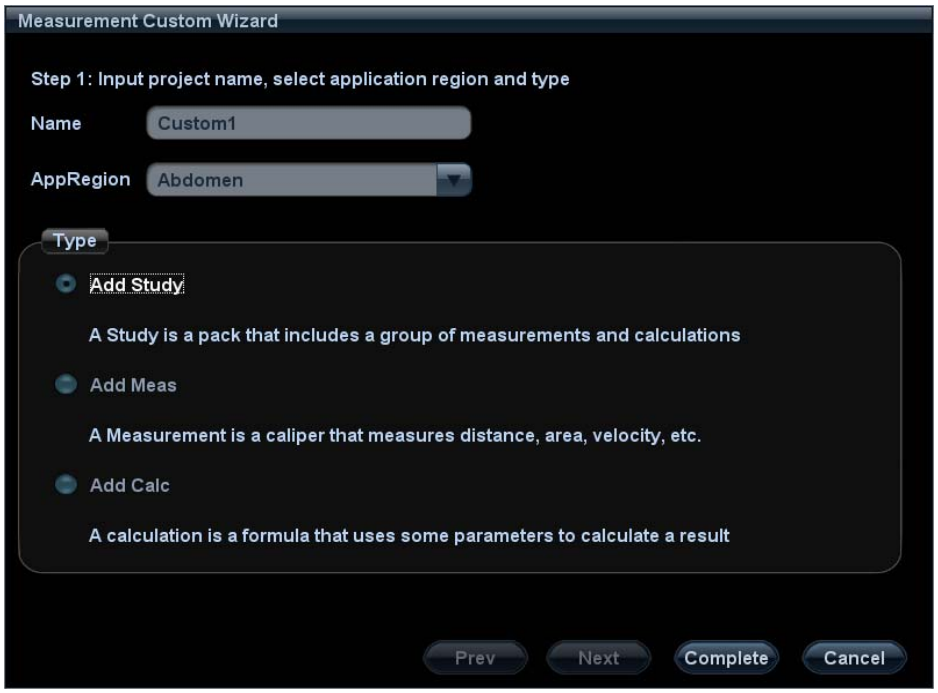


5. Select the item in the [Operation List], then click [Move Up]/ [Move Down] to adjust the position.
6. Click [Complete] to return to the [Measure Preset] page.

   The new added user-defined calculation displays in the [Selected Items] list. An asterisk appears posterior to the user-defined item for identification.

User-defined Study

The user-defined study is to create an empty study, and add measurement, calculation or study tools (existing in system or user-defined) into it.



1. Input Name in the "Measurement Custom Wizard" dialog box, select the [AppRegion], choose [Add Study] and click [Next].
2. Click [Complete] and the empty study new added displays in the [Selected Items].
3. Select the user-defined study, add items into it. See "Adding/ Removing Item" for details.

Removing User-defined Item

- Removing measurement/ calculation item
  1. Select the user-defined measurement/ calculation item from the [Available Items] list.
  2. Click [Delete]. The item is removed from Selected Items and Available Items.
- Removing study item
  1. Select a user-defined study from the [Selected Items] list.
  2. Click [<] to delete it.

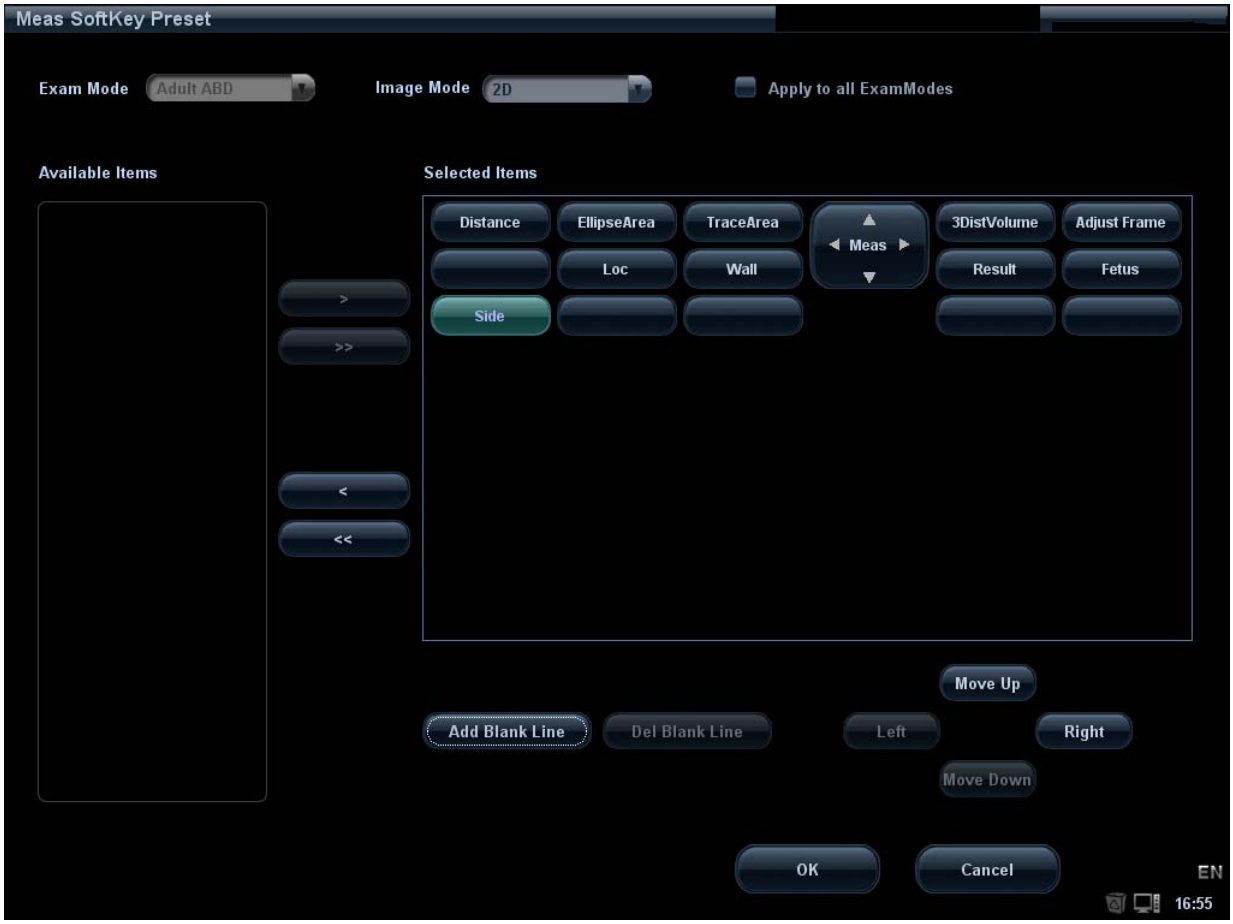
Importing/ Exporting User-defined Data

Click [Import Custom]/ [Export Custom] in the [Measure Preset] page to import/ export the user-defined item data.

2.4.3 Soft Key Preset

Soft keys in the soft menu of the current exam mode can be preset in [Measure Preset].

1. Click [SoftKey Preset] in [Measure Preset] page and the following dialog box pops up.



2. Select [Image Mode] (2D/ M or Doppler).
3. The soft key preset will be applied to all exam modes if [Apply to all ExamModes] is selected.

4. Preset the soft key by the following buttons.

[>]	Add the selected item in [Available Items] to a free space in the [Selected Items].
[>>]	Add all items (no more than 5 and need not be selected) in [Available Items] to the [Selected Items].
[<]	Remove the selected item in [Selected Items] to the [Available Items].
[<<]	Remove all items (need not be selected) in [Selected Items] to the [Available Items].
[left]/[right]/[Move Up]/[Move Down]	Move the selected item in [Selected Items] to left/right/up/down.
[Add Blank Line]	Add a blank line (with five blank keys) to the [Selected Items] field.
[Del Blank Line]	Delete a blank line from the [Selected Items] field (disabled when there is no blank line available).

5. Click [OK] to return to the [Measure Preset] page after setting the softkey.

2.5 Preset of Report Template

NOTE: Editing, importing, exporting and deleting are not supported by IVF and the EM reports.

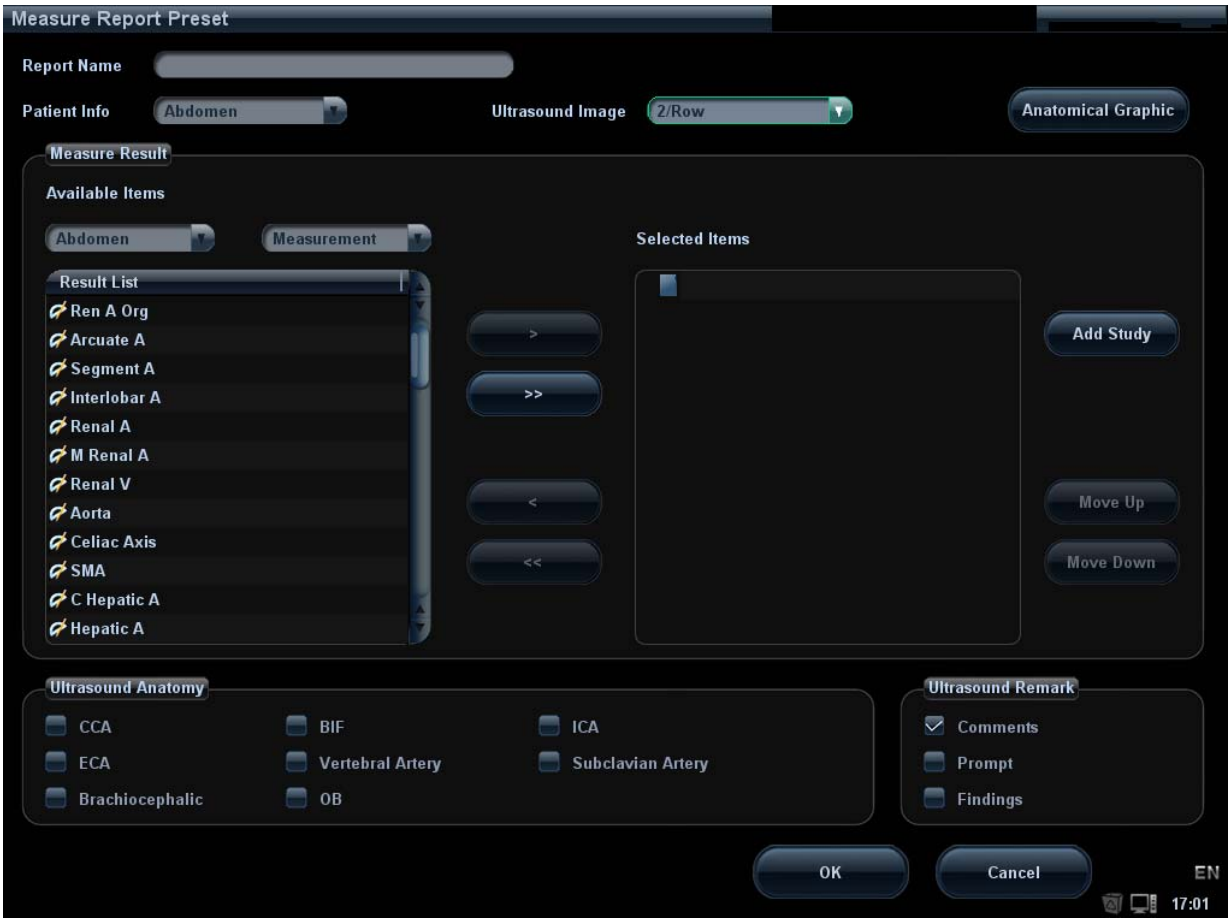
2.5.1 Basic Procedures

1. Select [Report] in the [Measure Preset] page.
2. Select an Exam Mode.

   The report template should match the exam mode.
3. Manage the report template. Available operations:
   - Creating Report Template
   - Deleting Report Template
   - Editing Report Template
   - Setting Default Template
   - Exporting/ Importing Template
   - Setting Template Order
4. Click [OK] and exit the [Measure Preset] page after setting.
5. Continue other presets; or click [Return] on the [Setup] menu to make the settings take effect.

2.5.2 Creating Report Template

1. Enter [Measure Preset] -> [Report] page.
2. Click [New] to enter the editing dialog box of report template.



Descriptions of attributes and functions are shown in table below.

Attributes	Descriptions
Report Name	Name of the report template.
Patient Info	Selects the category of patient information to be displayed in the report. Patient information items displays in the report are different for each category. (If “Obstetric” is selected, item OB in the [Ultrasound anatomy] will be selected automatically; same with the vascular anatomy items when “Vascular” is selected in the [Patient Info].)
Ultrasound Image	Select numbers and arrangement of images display in the report.
Anatomical Graphic	Select the vascular graphics that added into the report.
Measure Result	Select what items to be displayed in the report and how the items are grouped.
Ultrasound Anatomy	Whether to display the anatomy information. If one (or all) anatomy item is selected, you can enter the anatomy options page when clicking the [Analyze] button in the report, and the [Growth] button will appear in the report if OB is selected.
Ultrasound Remark	Whether to display Comments, Prompt and Findings in the report. If selected, the corresponding item will appear in the report.

3. Select an application region from the drop-down list under [Available Items].

4. Select [Measurement], [Calculate], [Study] or [All] from the drop-down list under [Available Items], the corresponding items appear in the list.
5. Adding/ Removing items.

   Use the [>] or [>>] button to add single or all items in the [Available Items] list.

   Only the tools appear in the right column and are completed in the ultrasound exam can be displayed in the report.

   See “Adding/ Removing Item” for details.
6. Add the study.

   See "Adding Study" for details.
7. Adjusting the item position.

   Select an item in the [Selected Items] list, click [Move Up]/ [Move Down] to adjust the position of the item in the list as well as in the report template.
8. Click [OK] to confirm.

Adding Study

You can add new study into the report template in the following procedures:

1. Click [Add Study] in the [Measure Report Preset] page to pop up the following dialog box.

Tips:	Select an item in the [Selected Items] list and click [Add Study], the new added study displays as a sub-study of the selected one.

2. Input study name in the text box.
3. Click [OK] to confirm. New added study appears in the [Selected Items] list.

2.5.3 Deleting Report Template

1. Enter [Measure Preset] -> [Report] page.
2. Select the template to delete, Click [Delete].
3. Click [OK] to delete the selected template.
4. Click [OK] in the [Report] tab sheet to confirm the settings.

2.5.4 Editing Report Template

1. Enter [Measure Preset] -> [Report] page.
2. Select the template to be modified in the list.
3. Select [Edit] to enter the [Measure Report Preset] dialog box.

   See section “2.5.2 Creating Report Template” for editing the template.
4. Click [OK] in the [Report] tab sheet to confirm the settings.

2.5.5 Setting Default Template

1. Enter [Measure Preset] -> [Report] page.
2. Select an exam mode from [Exam Mode].
3. Select a report template in the list.
4. Click [Default] to set the selected template as the default report of the current exam mode.
5. Similarly, set default report template for other exam mode.

Tips:	The report template should match the exam mode to make sure the correct display of the measurement results in the report.

6. Click [OK] to confirm.

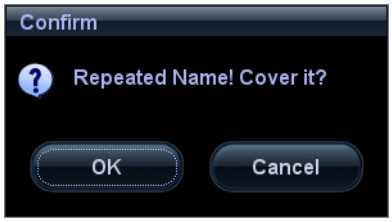
2.5.6 Exporting/ Importing Template

2.5.6.1 Exporting Template

1. Enter [Measure Preset] -> [Report] page.
2. Select the template to export in the list, Click [Export].
3. Select drive and directory in the window pop up.
   Select [New], [Delete] or [Rename] to manage the directory. See “1.7.5 Exporting Report”.
4. Input the file name in [File].
5. Click [OK] to export the template.

2.5.6.2 Importing Template

1. Enter [Measure Preset] -> [Report] page.
2. Click [Import].
3. Select drive and directory in the window pop up.
   Select [New], [Delete] or [Rename] to manage the directory. See “1.7.5 Exporting Report”.
4. Select the report template to be imported in the right side file list.
5. Click [OK] to import the template.
   a) If the imported report template already exists, the following dialog box pops up.



Tips:	It's the Report Name of the template (not the file name of DAT file) to determine whether the template is existed.

   b) Select [OK] to replace the existed template; or, select [Cancel] to abandon.

2.5.7 Setting Template Order

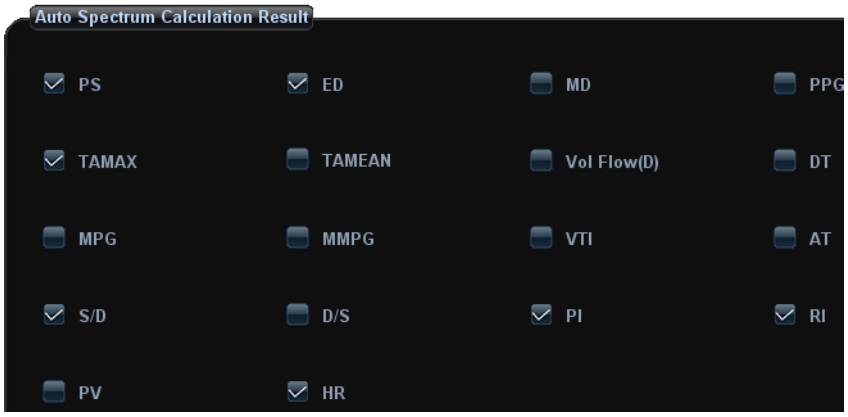
1. Enter [Measure Preset] -> [Report] page.
2. Select the template to move in the list.
3. Select [Move Up] or [Move Down] to move the selected template.
4. Click [OK] to confirm the order.

2.6 Automatic Spectrum Calculation Parameters

The system has parameter automatic calculation function, this means you can obtain a group of clinical indices by tracing Doppler spectrum. The function can be performed in real-time, in frozen image and in cine status (including the cine files). It can be preset whether the automatically calculated value will be displayed in the result window or not.

NOTE:	Heart Rate obtained by auto spectrum calculation may be of deviation, please adopt manual measurement or ECG function (optional) to get the precise value.

1. Enter [Measure Preset] -> [Parameter] page.



2. Move the cursor to an item and press <Set> to select it.
3. Click [OK] to confirm.

2.7 Fast OB Measurement

Enter [Preset]-[System Preset]-[Key Config] page, and assign functions to the keys for functions in the “Measurement” list on the right side. For details, please refer to [Basic Volume].

3 General Measurement

General Measurement Tools:

- 2D (B/ Color/ Power/ DirPower) Mode
- M General Measurements
- Doppler(PW/ CW) Mode

3.1 Basic Procedures of General Measurement

1. Preset the general measurement parameters and start the exam.
2. Select the imaging mode (B/M/Doppler), then scan and freeze the image.
3. Enter the 2D/M/Doppler general measurement menu.

   You can preset which key to press to enter the menu, see “Key Config” in the Operator's Manual [Basic Volume] for details.
4. Select an item from the general measurement menu to start the measurement.

Tips:	The order of the measurement items is presettable, see "2.4.1 General Measurement Preset" for details.

3.2 2D General Measurements

3.2.1 Depth

Function:

- Sectorial surface probe: The depth is the distance from the center of sector to the cursor.
- Convex array or linear array probe: The depth is the distance from the transducer surface to the measuring cursor in the direction of ultrasonic wave.

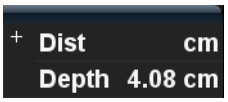
Method 1

1. Make sure the depth result is preset to display in the item property.

   From several measurement items can depth be obtained, take "distance" as an example.

See step 7 in "2.4.1 General Measurement Preset" for how to preset item property.

2. Select the item on a 2D image. The real-time depth value displays in the result window, as shown in the following figure.



Tips:	The real-time depth displays in the result window only before the <Set> key is pressed to fix the starting point. History value of the depth is not displayed in the result window.

Method 2

1. Preset Depth in the item property of the general measurement item. See section "Adding/ Removing Item".
2. Click [Depth] in the measurement menu, and the cursor appears on the screen.
3. Use the trackball to move the cursor to the desired point.
4. Press <Set> to set the measurement point and the result displays in the result window.

3.2.2 Distance

Function: Measures the distance between two points on the image.

1. Click [Distance] in the measurement menu, and the cursor appears on the screen.
2. Move the cursor to the starting point with the trackball.
3. Press <Set> to set the starting point.
4. Move the cursor to the end point with the trackball. Here,
   Press <Clear> to cancel setting the starting point. Or,
   Press <Update> to switch between the fixed end and the active end of the caliper.
5. Press <Set> to set the end point.

3.2.3 Angle

Function: Measures the angle of two crossing planes on the image and the range is: 0°- 180°.

1. Click [Angle] in the measurement menu, and the cursor appears on the screen.
2. Set two line segments as described in "3.2.2 Distance".

   The angle appears in the result window after setting the line segments.

3.2.4 Area

Function: measures the area and circumference of a closed region on the image. Four measurement methods are available:

- Ellipse: Fix an ellipse region by two equal-cut perpendicular axes.
- Trace: Fix a closed region by free tracing.
- Spline: Fix a spline curve by a series of points (12 points at most).
- Cross: Fix a closed region with two axes perpendicular to each other. The starting point and the end point of the axes can both be fixed freely.

Tips:	These four methods are also applicable to other measurement items, and will not be repeated when mentioned below. The operations are as follows.

Ellipse

1. Select [Ellipse] from the drop-down list on the right of [Area] in the measurement menu. The cursor appears on the screen.
2. Move the cursor to an area of interest.
3. Press <Set> to set the starting point of the first axis of the ellipse.
4. Move the cursor to position the end point of the first axis of the ellipse. Here,

   Press <Update> to switch between the fixed end and the active end of the first axis. Or,

   Press <Clear> to cancel the start point of the first axis.
5. Press <Set> to set the end point of the first axis of the ellipse. The second axis appears on the screen.
6. Move the trackball will increase or decrease the ellipse from the fixed axis. Move the trackball to trace the area of interest as closely as possible.

   Or, press the <Update> or <Clear> key to return to the step before setting the first axis.
7. Press <Set> to anchor the ellipse region, and the measure result will be displayed in the results window.

Trace

1. Select [Trace] from the drop-down list on the right of [Area] in the measurement menu. The cursor appears on the screen.
2. Move the cursor to an area of interest.
3. Press <Set> to fix the starting point.
4. Move the cursor along the target to trace the outline of the target.

   To modify the trace line, please rotate the <Multi-Functional knob>:

   Anticlockwise: to cancel a series of points.

   Clockwise: to resume a series of points.
5. Press <Set> and the trace line will be closed with a straight line connecting the starting and end points. The trace will also be closed when the cursor is very near to the starting point.

Spline

1. Select [Spline] from the drop-down list on the right of [Area] in the measurement menu. The cursor appears on the screen.
2. Move the cursor to an area of interest.
3. Press <Set> to set the first reference point of the spline.
4. Move the cursor along the area of interest and press <Set> to anchor the second reference point.
5. Roll the trackball and a spline defined by three points of the first, second reference points and the active cursor appears on the screen.
6. Move the cursor along the edge of the target and set more reference points (12 at most) to make the spline approach the target region as close as possible.

   To correct a previous point, press <Clear>.
7. Press <Set> twice to anchor the last reference point. The spline is fixed and the results display in the result window.

Cross

1. Select [Cross] from the drop-down list on the right of [Area] in the measurement menu. The cursor appears on the screen.
2. Move the cursor to an area of interest.
3. Press <Set> to fix the starting point of the first axis.
4. Use the trackball to position the end point of the first axis and then press <Set>. Here,

   Press <Update> to switch between the starting point and the end point of the first axis. Or,

   Press <Clear> to cancel setting the starting point of the first axis.
5. Press <Set> to set the end point of the first axis. The second axis (perpendicular to the first axis) of cross appears on the screen.
6. Move the trackball and press <Set> to fix the starting point of the second axis.
7. Move the cursor to the end point of the second axis. Here,

   Press <Update> to switch between the starting point and the end point of the first axis. Or,

   Press <Clear> to cancel setting the starting point of the first axis.
8. Press <Set> to set the end point of the second axis and fix the region. The results appear in the result window.

3.2.5 Volume

Function: Measures the volume of the target object.

Method:

- 3Dist

  To calculate the object's volume with 3 axes of two images scanned in the plane perpendicular to each other in B mode. Calculation formulae are as follow:

$$\mathrm{V}olume\ (cm^3) = \frac{\pi}{6} \times D1(cm) \times D2(cm) \times D3(cm)$$

  Where, D1, D2, D3 are the length of three axes of the target object.

- Ellipse

  To calculate the object's volume by its horizontal section area. Calculation formula is as follow:

$$\mathrm{V}olume\ (cm^3) = \frac{\pi}{6} \times a(cm) \times b^2(cm)$$

  Where, a is the length of the major axis of the ellipse while b the minor.

- EDist

  To calculate the object's volume by its horizontal and vertical section area. Calculation formula is as follow:

$$Volume\,(cm^3) = \frac{\pi}{6} \times a(cm) \times b(cm) \times m(cm)$$

  Here, a, b and m indicate the length of the major, minor and the third axis of the ellipse respectively.

Operations:

3Dist

1. Select [3Dist] from the drop-down list on the right of [Volume] in the measurement menu. The cursor appears on the screen.
2. Here, D1, D2, D3 are length of three axes of the target object.

   See "3.2.2 Distance" for detailed procedures.

   Generally, D1, D2, D3 should belong to different scanning plane.

Ellipse

1. Select [Ellipse] from the drop-down list on the right of [Volume] in the measurement menu. The cursor appears on the screen.
2. The procedures are similar to that of Ellipse in the area measurement, see "3.2.4 Area" for details.

EDist

1. Select [EDist] from the drop-down list on the right of [Volume] in the measurement menu. The cursor appears on the screen.
2. Use the Ellipse method to measure the vertical section area.

   The procedures are similar to that of Ellipse in the Area measurement, see "3.2.4 Area" for details.
3. Unfreeze the image. Rescan the area of interest perpendicular to the previous image.
4. Measure the length of the third axis with the Distance measurement method, see "3.2.2 Distance" for detailed procedures.

3.2.6 Cross

Function: measures the lengths of line segments A and B perpendicular to each other.

1. Click [Cross] in the measurement menu, and the cursor appears on the screen.
2. Move the cursor to the measure starting point.
3. Press <Set> to set the starting point of the first line segment.
4. Use the trackball to position the end point of the first axis and then press <Set>. Here,

   Press <Update> to switch between the starting point and the end point of the first axis. Or,

   Press <Clear> to cancel setting the starting point of the first axis.
5. Press <Set> to set the starting point of the first line segment. The second line segment perpendicular to the fixed line segment appears on the screen.
6. Move the cursor to the starting point of the second line segment.
7. Press <Set> to set the starting point of the second line segment. Or, press the <Update> or <Clear> to return to the last step.
8. Move the cursor to the end point of the second line segment. Here,

Press <Update> to switch between the starting point and the end point of the second axis. Or,

Press <Clear> to cancel setting the starting point of the second axis.

9. Press <Set> to confirm the end point of the second line segment.

3.2.7 Parallel

Function: Measures the distance between every two line segments of five parallel line segments, namely, four distances in total.

1. Select [Parallel] in the measurement menu, and then two lines perpendicular to each other appear on the screen. The intersection is the starting point of the line segment.
2. Rotate the Multifunctional Knob to change the angle of the lines and press <Set> to confirm.
3. Move the cursor to the starting point of the line segment.
4. Press <Set> to confirm the starting point and the first line.
5. Move the cursor, press <Set> to confirm the other four parallel lines, when the last parallel line is set, also the end point of the line that is perpendicular to the five parallel lines is confirmed. During the measurement, press <Set> twice to set the last parallel line and complete the measurement.

3.2.8 TLength

Function: Measures the length of a curve on the image. Measurement methods available include Trace and Spline.

Trace

1. Select [Trace] from the drop-down list on the right of [TLength] in the measurement menu. The cursor appears on the screen.
2. Move the cursor to an area of interest.
3. Press <Set> to fix the starting point.
4. Move the cursor along the target to trace the outline of the target.

   To modify the trace line, please rotate the <Multi-Functional knob>:

   Anticlockwise: to cancel a series of points.

   Clockwise: to resume a series of points.
5. Press <Set> to anchor the end point of the trace line.

Spline

1. Select [Spline] from the drop-down list on the right of [TLength] in the measurement menu. The cursor appears on the screen.
2. Move the cursor to an area of interest.
3. Press <Set> to fix the starting point.
4. Move the trackball along the target and press <Set> to anchor the second, third, fourth … points. A maximum of 12 points can be anchored.

   To correct a previous point, press <Clear>.
5. Press <Set> twice to set the end point of the spline.

3.2.9 Ratio (D)

Function: Measures the lengths of two line segments and then calculates their ratio.

1. Click [Ratio (D)] in the measurement menu, and the cursor appears on the screen.

2. Measure the length of the two line segments, see "3.2.2 Distance" for detailed procedures.

   The result displays in the result window after the measurement of the second line is completed.

3.2.10 Ratio (A)

Function: Measures the area of two closed regions and then calculates their ratio. The methods are Ellipse, Trace, Cross, Spline.

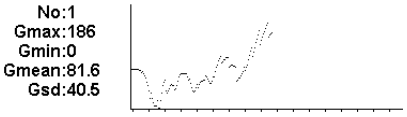
1. Select method from the drop-down list on the right of [Ratio (A)] in the menu. The cursor appears on the screen.
2. Measure the area of the two closed regions, see "3.2.4 Area" for detailed procedures.

3.2.11 B-Profile

Function: measures the gray distribution of ultrasonic echo signals on a line.

1. Click [B-Profile] in the measurement menu, and the cursor appears on the screen.
2. Set a line segment, see "3.2.2 Distance" for detailed procedures.

   The result is shown in figure below:



Where,

No:	The number of the graph. Value: 1 or 2. The last two results will be displayed on the screen.
Gmax:	The maximum gray.
Gmin:	The minimum gray.
Gmean:	The average gray.
Gsd:	The variance of gray.

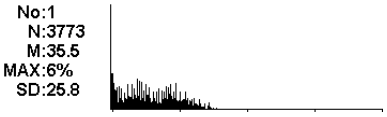
3.2.12 B-Hist

Function: Measures and counts the gray distribution of ultrasonic echo signals within a closed region. The methods to set a closed region are Ellipse, Trace, Spline and Rect (Rectangle).

Rect

Rect sets a rectangle with two points on the cross. The operations are:

1. Click [B-Hist] in the measurement menu, and the cursor appears on the screen.
2. Move the cursor to the first vertex of the rectangle, press <Set>.
3. Move the cursor to the second vertex of the rectangle, press <Set>. The result is shown in the following figure:



Where,

Horizontal axis: The gray of the image

The vertical axis: The gray distribution percentage.

No: The number of the graph. The last two results will be displayed on the screen.

N: The total pixel number in the area to be measured.

M: $M = \sum Di / N$;

MAX: MAX = the pixel number in the maximum gray/ N×100%

SD: Standard deviation. $SD=(\sum Di^2/N-(\sum Di/N)^2)^{1/2}$

Di: The gray at each pixel point;

$\sum Di$: The total grays of all pixels.

Ellipse

See "Ellipse" in the "3.2.4 Area" for detailed procedures.

Trace

See "Trace" in the "3.2.4 Area" for detailed procedures.

Spline

See "Spline" in the "3.2.4 Area" for detailed procedures.

3.2.13 Color Vel

Tips:	This measurement item is meant for a general estimation, not for accurate measurement.

Function: measures the velocity of blood flow on the Color Mode image.

1. Click [Color Vel] in the measurement menu, and the cursor appears on the screen.
2. Move the cursor to the point to be measured for blood flow velocity.
3. Press <Set> to fix the point, a floating line is displayed in the direction parallel to the ultrasonic wave beam at that point.

   The compensation angle is 0°at the moment; you can change the angle (0°-80°) by rotating the Multifunctional Knob to align the floating line in the direction same to that of blood flow at the point to be measured.
4. Press <Set> to set the direction of the blood flow, and the result displays in the result window.

3.2.14 Volume Flow

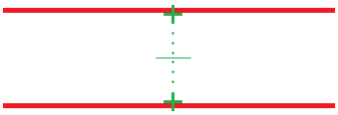
Function: measures blood flow through some vascular cross section per unit time.

For details, please refer to “**3.4.7** Volume Flow”.

3.2.15 Color Velocity Profile

Function: detects velocity profile as well as diameter of the maximum diameter vessel to get blood flow volume per unit time.

This feature is suitable for blood flow investigation such as carotid and peripheral vascular (tube type).The system assumes to divide vessel cavity into infinite concentric rings to get velocity of the maximum diameter vessel, thus volume flow of the certain vessel location is calculated.



1. Obtain long-axis view of the vessel with consistent flow direction. Select image of largest diameter in the vessel.
2. Enter Color mode, obtain several cardiac cycles and freeze the image.
3. Select [Color Vel Profile] in the menu, and the cursor appears on the screen.
4. Press <Set> to confirm the starting point of the vessel inner diameter. Move the cursor to make the dotted caliper line vertical to the blood flow direction.

   The correction angle is 0°at the moment, you can change the angle (0°-89°) by rotating the Multifunctional Knob to align the dotted line in the direction same to that of blood flow at the point to be measured.
5. Press <Set> to confirm the end point of the vessel inner diameter. Measurement result are obtained: Vmax, Vmean, Vas Diam (inner) and volume flow; velocity profile figure is displayed on the top-right part of the image.

Note: Aliasing flow image cannot be used for calculation.

This feature is not suitable for non-circular vessel such as vein or cardiac blood flow evaluation.We recommend using this feature in carotid or peripheral vessel evaluation.

This measurement tool rely on display of color Doppler signal, please adjust image parameters to get premium color image, such as scale, gain, WF, persistence and so on.

For details, please refer to Image Optimization chapter in [Basic Volume].

3.3 M General Measurements

3.3.1 Distance

Function: Measures the distance between two points on the M Mode image.

1. Click [Distance] in the measurement menu, and two dotted lines perpendicular to each other appear on the screen.
2. Move the crossing point of the dotted lines to the measurement starting point and press <Set>.
3. Move the crossing point to the end point, and then the crossing point can only be moved in vertical direction. Here,

   Press <Update> to switch between the fixed end and active end of the caliper. Or,

   Press <Clear> to cancel setting the starting point.
4. Press <Set> to set the end point.

3.3.2 Time

Function: Measures the time interval between two points on the M Mode image.

1. Click [Time] in the measurement menu, and two dotted lines perpendicular to each other appear on the screen.
2. Move the crossing point of the dotted lines to the measurement starting point and press <Set>.

3. Move the crossing point to the measurement end point. The crossing point can only be moved in the horizontal direction. Here,

   Press <Update> to switch between the fixed end and active end of the caliper. Or,

   Press <Clear> to cancel setting the starting point.

4. Press <Set> to set the end point.

3.3.3 Slope

Function: Measures the distance and time between two points on the M Mode image and calculates the slope between the two points.

1. Click [Slope] in the measurement menu, and two dotted lines perpendicular to each other appear on the screen.
2. Move the crossing point of the dotted lines to the measurement starting point and press <Set>.
3. Move the crossing point to the measurement end point. The cross point is connected to the starting point by a dashed line. Here,

   Press <Update> to switch between the fixed end and active end of the caliper. Or,

   Press <Clear> to cancel setting the starting point.

4. Press <Set> to set the end point.

3.3.4 Velocity

Function: Measures the distance and time between two points on the M Mode image and then calculates the average velocity between the two points.

1. Click [Velocity] in the measurement menu, and two dotted lines perpendicular to each other appear on the screen.
2. Move the crossing point of the dotted lines to the measurement starting point and press <Set>.
3. Move the crossing point to the end point, and then the crossing point can only be moved in vertical direction.

   Here, Press <Update> to switch between the fixed end and active end of the caliper. Or,

   Press <Clear> to cancel setting the starting point.

4. Press <Set> to set the end point.

3.3.5 HR

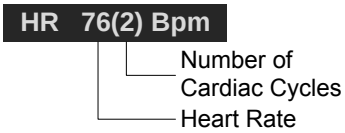
Function: Measures the time of n (n≤8) cardiac cycles on the M Mode image and calculates the heart rate.

The number of cardiac cycles “n” can be preset in the [System Preset] -> [Meas Param] preset dialog box, see "2.2 Measurement Parameters Preset" for details.

⚠CAUTION:	**During the measurement, the number of cardiac cycles between the measurement starting and end points must be exactly the same as preset. Otherwise, misdiagnosis may occur.**

1. Click [HR] in the measurement menu, and two dotted lines perpendicular to each other appear on the screen.
2. Select n cardiac cycles.

   The HR result in the result window, as shown in the figure below, displays the measured heart rate value and the preset number of cardiac cycles. As shown in figure below.



3.4 Doppler General Measurements

3.4.1 Time

Function: Measures the time interval between two points on the Doppler image.

The operations are similar to the Time measurement in M Mode. See "3.3.2 Time" for details.

3.4.2 HR

Function: measures the time interval between n (n≤8) cardiac cycles on the M Mode image and calculates the number of heart beats per minute (BPM).

The operations are similar to the Heart Rate measurement in M Mode. See "3.3.5 HR" for details.

3.4.3 D Vel

Function: measures the velocity, pressure gradient and correction angle of a certain point on the Doppler spectrum.

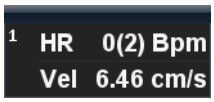
Method 1

1. Make sure the depth result is preset to display in the item property.

   Several measurement items can obtain depth, take Doppler "HR" as an example, as shown in the following figure.

   See step 7 in "2.4.1 General Measurement Preset" for how to preset item property.

2. Select the measurement item (preset with D velocity result displaying) in the measurement menu. The real-time velocity value displays in the result window, as shown in the following figure.



Tips:	The real-time velocity displays in the result window only before the <Set> key is pressed to fix the starting point. History value of the velocity is not displayed in the result window.

Method 2

1. Click [D Vel] in the measurement menu, and the cursor appears on the screen.
2. Move the cursor to the point to be measured for velocity.
3. Press <Set> and the result displays in the result window.

3.4.4 Acceleration

Function: Measures the velocities of two points and their time interval on the Doppler image, and calculates the acceleration, pressure gradient, velocity difference and correction angle.

1. Click [Acceleration] in the measurement menu, and the cursor appears on the screen.
2. Move the cursor to the first point to be measured for velocity.
3. Press <Set> to fix the first point.
4. Move the cursor to the second point to be measured for velocity.
5. Press <Set> to fix the second point. The results displays in the result window.

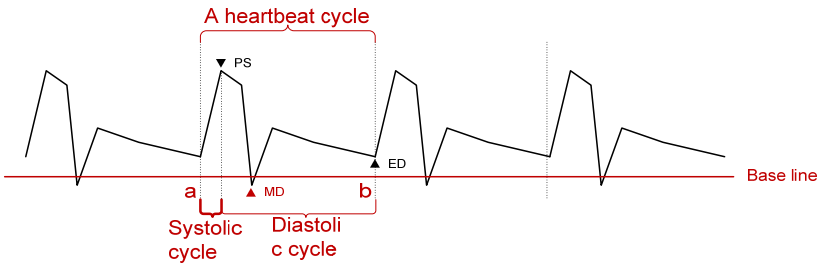
   Results displayed in the result window can be preset in the measurement item property, as shown in the following figure.

See step 7 in "2.4.1 General Measurement Preset" for how to preset item property.

3.4.5 D Trace

Function: measures clinical indices through tracing Doppler spectrum. Measurement methods available are Trace, Spline, Auto, Vel (Velocity) and 2 PT (Two Points).

The sketch map of Doppler spectrum is shown as below:



NOTE:	When doing D trace, please set systolic starting time as the starting point and the next systolic ending time as end point. That is, by tracing the Doppler spectrum from systolic to diastolic to calculate indices.

Result parameters

Results obtained from D trace are:

Parameters	Descriptions	
PS	Peak Systolic Velocity	The highest velocity of the red blood cells crossing the sample volume.
ED	End-Diastolic Velocity	Measures the blood velocity at the end of the cardiac cycle.
MD	Min-Diastolic Velocity	Minimum absolute Velocity in diastolic cycle.
Vel	/	Flow velocity
Average velocity	/	The average flow velocity in the whole traced Doppler spectrum. ■ TAMAX (Time Averaged Maximum Velocity): $\mathrm{TAMAX}(\ cm/s) = \int_{Ta}^{Tb} V(t)dt \Big/ (T_b - T_a)$ Where V(t) is the maximum velocity ■ TAMEAN (Time Averaged Mean Velocity): Obtained by auto spectrum calculation. $\mathrm{TAMEAN}(\ cm/s) = \int_{Ta}^{Tb} V(t)dt \Big/ (T_b - T_a)$ Where V(t) is the mean velocity.
PPG	Peak Pressure Gradient	It is the corresponding pressure gradient of the peak systolic velocity. PPG (mmHg) = 4 × PS (m/s)^2
Average Pressure Gradient	/	Average pressure gradient in the whole traced Doppler spectrum. ■ MPG: Maximum Pressure Gradient. $\mathrm{MPG}(mmHg) = \int_{Ta}^{Tb} 4(V(t))^2 dt \Big/ (T_b - T_a)$ Where V(t) is the peak systolic velocity. ■ MMPG: Mean velocity Mean Pressure Gradient. (Obtained during auto-spectrum calculation.) $\mathrm{MMPG}(mmHg) = \int_{Ta}^{Tb} 4(V(t))^2 dt \Big/ (T_b - T_a)$ Where V(t) is the mean systolic velocity.
VTI	Velocity-Time Integral	Velocity-time Integral. It is the integral of the product of Doppler instantaneous velocity and the total time interval. $VTI(m) = \int_{T_a}^{T_b} V(t)dt$
AT	Acceleration Time	It is the time of the blood velocity accelerating from the end of diastole to the systolic peak. Generally, it's the time interval between the end of the first cardiac cycle and the peak of the next cardiac cycle. Choose the first peak when two peaks existing the systolic cycle.
DT	Deceleration Time	Deceleration Time.
HR	Heart Rate	Calculates the heart rate per minute by measuring the time interval of one cardiac cycle.
S/D	/	PS/ED. S/D (No unit) = PS (m/s) / ED (m/s)

Parameters	Descriptions	
D/S	/	ED/PS. D/S (No unit) = ED (m/s) / PS (m/s)
PI	Pulsative Index	Pulsatile Index. PI (No unit) = |(PS (m/s) – ED (m/s)) / TAMAX (m/s)|
RI	Resistive Index	Resistance index. RI (No unit) = |(PS (m/s) – ED (m/s)) / PS (m/s)|
θ	/	Correction angle is the spectrum angle during measurement, which is a result obtained from a non D trace measurement tool and usually be displayed together with the spectral measurement results.
PV	Peak Velocity	The peak velocity in systolic or diastolic cycle (with no difference), which is the highest velocity of the red blood cell(s) that cross the sample volume, and it can be used to examine the venous vessel.

NOTE:

1. In the formulae above, T means time, the unit is s; V means the velocity at each point during T, the unit is cm/s; a is the traced starting point, while b is the traced end point.
2. The above parameters are all the information obtained in D trace, while in application, the system only displays part of them according to operation and preset.

Measurement Method

In D trace item property, you can preset to display one or more results. See step 7 in "2.4.1 General Measurement Preset" for how to preset item property.)

The measurement method varies by the result selected.

- Velocity

  Function: measures the velocity, pressure gradient and correction angle of a certain point on the Doppler spectrum.

  The operations are similar to the Time measurement in M Mode. See "3.4.3 D Vel" for details.

- 2 PT
  1. Select [2 PT] on the measurement menu, the cursor displays as a big “+”.
  2. Move the cursor to the starting point to be measured and press <Set> to fix the point.
  3. Move the cursor to the end point to be measured and press <Set> to fix the point.
- Trace
  1. Select [Trace] from the drop-down list on the right of [D Trace] in the measurement menu.
  2. Move the cursor to the starting point to be measured and press <Set> to fix the point.
  3. Move the cursor around the object.

     Move the cursor right: draw a trace line overlapping the spectrum as much as possible.

     Move the cursor left (or rotate the <Multifunctional Knob> anticlockwise to correct the trace line already drawn.
  4. Trace the end point to be measured and press <Set> to fix the point.

- Spline
  1. Select [Spline] from the drop-down list on the right of [D Trace] in the measurement menu.

2. Move the cursor to the starting point to be measured and press <Set> to fix the point.
3. Move the cursor along the edge of the desired region. Continue to fix the second, third … point (50 points at most) of spectrum.
4. Press <Set> twice to anchor the last reference point. Or,

   The measurement ends automatically when there are 50 reference points.

- Auto

1. Select [Auto] from the drop-down list on the right of [D Trace] in the measurement menu, the measure cursor appears on the screen.
2. Move the cursor to the starting point to be measured and press <Set> to fix the point.
3. Press <Set> to anchor the end point of the trace line. The spectrum between the start point and the end point is traced.

3.4.6 PS/ED

Function: measures the Peak Systolic (PS) and End Diastolic (ED) velocities on the Doppler spectrum, and calculates their resistance index (RI), S/D and correction angle.

1. Click [PS/ED] in the measurement menu, and the cursor appears on the screen.
2. Move the cursor to the Systolic Peak and press <Set> to fix the point.
3. Move the cursor to the Diastolic End and press <Set> to fix the point.

   Results displayed in the result window can be preset in the measurement item property, as shown in the following figure.

See step 7 in "2.4.1 General Measurement Preset" for how to preset item property.

3.4.7 Volume Flow

Function: measures blood flow through some vascular cross section per unit time.

1. Click [Volume Flow] in the measure menu, and the submenu displays.
2. Select calculation method of [Vas Area], and the value of [PW scope].

   Measure the vascular area.
3. Measure [TAMEAN] or [TAMAX] on Doppler spectrum.

The volume flow is calculated automatically.

Item		Description	Method or formula
Vas Area	Dist	Acquire the area by measuring the vascular diameter.	Vas Area=π × Vas Diam (cm)^2/ 4
	Trace	Acquire the area by trace method.	Area in 2D General Measurements
TAMEAN		Vol Flow(Area)-TAMEAN	Vol Flow(A) (ml/min) = |Vas TAMEAN (cm/s)| × Vas Area (cm^2) × 60 (s) Vas TAMEAN - Time Averaged Mean Velocity, obtained from Vas Trace measurement.
TAMAX		Vol Flow(Area)-TAMAX	Vol Flow(A) (ml/min) = |Vas TAMAX (cm/s)| × Vas Area (cm^2) × 60 (s) Vas TAMAX - Time Averaged Maximum Velocity, obtained from Vas Trace measurement.

3.4.8 Velocity Ratio

Function: measure two D velocity values on one or two spectrum and calculate the ratio to analysis the flow information.

1. Click [Vel Ratio] in the measure menu, and the cursor appears on the screen.
2. Move cursor and press <Set> to obtain two velocity values.
3. The system calculates the ratio automatically.

   Where,

$$Vel\ Ratio(\ Nounit\ ) = \left| \mathrm{Vel}1(\ cm/s\ ) / \mathrm{Vel}2(\ cm/s\ ) \right|$$

3.4.9 VTI Ratio

Function: measure two VTI values on the spectrum and calculate the ratio.

1. Click [VTI Ratio] in the measure menu, and the cursor appears on the screen.
2. Move the cursor to obtain VTI1 and VTI2 values by D trace method.
3. The system calculates the ratio automatically.

   Where,

$$\mathrm{VTI\ Ratio}(\ Nounit\ ) = \left| \mathrm{VTI}1(\ cm\ ) / \mathrm{VTI}2(\ cm\ ) \right|$$

3.5 References

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Volume Flow(Diam)-TAMAX	Burns, P.N., "The Physical Principles of Doppler and Spectral Analysis," Journal of Clinical Ultrasound, November/December 1987, 15(9):587.
Volume Flow(Area)-TAMAX	Burns, P.N., "The Physical Principles of Doppler and Spectral Analysis," Journal of Clinical Ultrasound, November/December 1987, 15(9):587.

4 Abdomen

4.1 Abdomen Exam Preparations

Make the following preparations before measurement:

1. Confirm that the current probe is appropriate.
2. Check if the current date of the system is correct.
3. Press <Patient>, register the patient information in [Patient Info] -> [ABD] dialog box.

   For more details, refer to "Exam Preparation -> Patient Information" in the Operator's Manual [Basic Volume].
4. Switch to the correct exam mode.

4.2 Basic Abdomen Measurement Procedures

1. Press <Patient>, register the patient information in [Patient Info] -> [ABD] dialog box.
2. Press <Measure> to enter the Application Measurements.

   If the current menu is not the one containing Abdomen Measurement tools, move the cursor to the menu title and select the package having Abdomen Measurement tools.
3. Select measurement tool in the menu to start the measurement.

   See section "4.3 Abdomen Measurement Tools" and steps in "3 General Measurement" for measurement methods.
4. Press <Report> to view the exam report, see "4.5 Abdomen Exam Report" for details.

4.3 Abdomen Measurement Tools

NOTE:	Measurement tools mentioned below are configured in the system. The application measurement packages provided in this system are generally different combinations of measurement tools. For more information about package preset, see "2.4.2.2 Application Measurement Preset".

Measurement, calculation and study measurement items in 2D and Doppler mode (no M mode measurement item) are list below:

2D Abdomen Measurements

Types	Tools	Descriptions	Methods or Formulae
Measurement	Liver	/	Distance in 2D General Measurements
	Renal L	Renal Length	
	Renal H	Renal Height	
	Renal W	Renal Width	
	Cortex	Renal Cortical Thickness	

Types	Tools	Descriptions	Methods or Formulae
	Adrenal L	Adrenal Length	
	Adrenal H	Adrenal Height	
	Adrenal W	Adrenal Width	
	CBD	Common bile duct	
	Portal V Diam	Portal Vein Diameter	
	CHD	Common hepatic duct	
	GB L	Gallbladder Length	
	GB H	Gallbladder Height	
	GB wall th	Gallbladder wall thickness	Distance in 2D General Measurements
	Panc duct	Pancreatic duct	
	Panc head	Pancreatic head	
	Panc body	Pancreatic body	
	Panc tail	Pancreatic tail	
Measurement	Spleen	/	
	Aorta Diam	Aorta Diameter	
	Aorta Bif	/	
	Iliac Diam	Iliac Diameter	
	Pre-BL L	Pre-void Bladder Length	
	Pre-BL H	Pre-void Bladder Height	
	Pre-BL W	Pre-void Bladder Width	
	Post-BL L	Post-void Bladder Length	
	Post-BL H	Post-void Bladder Height	
	Post-BL W	Post-void Bladder Width	
Calculation	Renal Vol	Renal Volume	See “Renal Vol” (9 Urology)
	Pre-BL Vol	Pre-void Bladder Volume	See “Pre-BL Vol” (9 Urology)
	Post-BL Vol	Post-void Bladder Volume	See “Post-BL Vol” (9 Urology)
	Mictur.Vol	Micturated Volume	See “Mictur.Vol” (9 Urology)
Study	Kidney	/	See “Kidney” (9 Urology)
	Adrenal	/	See “Adrenal” (9 Urology)
	Bladder	/	See “Bladder” (9 Urology)

Doppler Abdomen Measurements

Types	Tools	Descriptions	Methods or formulae
Measurement	Ren A Org	Renal Artery Origin	D trace in General D measurements
	Arcuate A	Arcuate Artery	
	Segment A	Segmental Artery	
	Interlobar A	Interlobar Artery	
	Renal A	Renal Artery	
	M Renal A	Main Renal Artery	
	Renal V	Renal Vein	
	Aorta	/	
	Celiac Axis	/	
	SMA	Superior Mesenteric Artery	
	C Hepatic A	Common Hepatic Artery	
	Hepatic A	Hepatic Artery	
	Splenic A	Splenic Artery	
	IVC	Inferior Vena Cava	
	Portal V	Portal Vein	
	M Portal V	Main Portal Vein	
	Hepatic V	Hepatic Vein	
	Lt Hepatic V	Left Hepatic Vein	
	Rt Hepatic V	Right Hepatic Vein	
	M Hepatic V	Middle Hepatic Vein	
	Splenic V	Splenic Vein	
	SMV	Superior Mesenteric Vein	
Calculation	RAR	Ratio of Renal Artery PS the Abdominal Aorta PS	The system will calculate RAR automatically after Renal Artery and Abdominal Aorta are measured. RAR (no unit)= |Renal A PS (cm/s)/ Aorta PS (cm/s)|
	SMA/Ao	Ratio of Superior Mesenteric Artery PS and Abdominal Aorta PS	The system will calculate SMA/Ao automatically after Superior Mesenteric Artery and Abdominal Aorta are measured. SMA/Ao (no unit)= |SMA PS (cm/s)/ Aorta PS (cm/s)|
	CA/Ao	Ratio of Celiac Axis PS and Abdominal Aorta PS	The system will calculate CA/Ao automatically after Celiac Axis and Abdominal Aorta are measured. CA/Ao (no unit)= |Celiac Axis PS (cm/s)/ Aorta PS (cm/s)|

Types	Tools	Descriptions	Methods or formulae
Study	/	/	

4.4 Abdomen Measurement Operations

Tips:

1. See the table in "4 Abdomen Measurement Tools" above for measurement tools and methods.
2. For the definitions of measurement, calculation and study, refer to "1.3 Measurement, Calculation and Study".
3. The order of the measurement items is presettable, see "2.4.2 Application Measurement Preset" for details.

1. Select the item/tool in the measurement menu.
2. Perform the measurement referring to the methods in table above.

4.5 Abdomen Exam Report

During or after a measurement, press <Report> on the Control Panel to browse the report.

For details about report browsing, printing and exporting etc, see "1.7 Report".

5 Obstetrics

Obstetric measurements are used to estimate the GA and EDD, to calculate the growth indices, including the EFW. The growth estimation is determined by growth curve and fetal biophysical profile.

5.1 Obstetric Exam Preparations

Make the following preparations before measurement:

1. Confirm that the current probe is appropriate.
2. Check if the current date of the system is correct.
3. Press <Patient>, register the patient information in [Patient Info] -> [OB] dialog box.

   For more details, refer to "Exam Preparation -> Patient Information" in the Operator's Manual [Basic Volume].
4. Switch to the correct exam mode.

⚠CAUTION:	**Ensure the date of the system is correct, otherwise, GA and EDD calculated will be wrong.**

5.2 Basic Measurement Procedures

1. Press <Patient>, register the patient information in [Patient Info] -> [OB] dialog box.

   The clinical GA is calculated when the corresponding data input in this page, see "5.3.1 Clinical GA" for details.
2. Press <Measure> to enter the Application Measurements.

   If the current menu is not the one having Obstetric Measurement tools, move the cursor to the menu title and select the package having Obstetric Measurement tools.
3. Select measurement tool in the menu to start the measurement.

   See the table in "5.4 Obstetric Measurement Tools" below for measurement tools.

   See section "5.5 Obstetric Measurement Operations" and steps in "3 General Measurement" for measurement methods.
4. Press <Report> to view the exam report, see "5.7 Obstetric Exam Report" for details.

5.3 GA

5.3.1 Clinical GA

The GA (Gestational Age) and EDD (Estimated Delivery Date) are calculated according to clinical parameter(s).

1. Press <Patient>, register the patient information in [Patient Info] -> [OB] dialog box.

   The system automatically calculates the GA and EDD after enter the relative information.

The calculating methods are listed as follows:

- LMP: input the LMP, the system will calculate the GA and EDD.
- IVF: After you enter IVF, the system will calculate GA and EDD.
- PRV: input the date and GA of the last exam, the system will calculate a new GA and EDD.
- BBT: After you enter BBT, the system will calculate GA and EDD.
- EDD: input the EDD, the system will calculate GA and LMP.

2. The clinical GA is shown at the head of the obstetric report.

Tips:	The latest EDD and GA calculation is considered as the final value if more than one EDD and GA calculations are valid.

5.3.2 Ultrasound GA

Ultrasound GA and ultrasound EDD are calculated according to the parameters obtained in measurements.

- GA in OB Items
- AUA (Average Ultrasound Age)
- CUA (Composite Ultrasound Age)

GA in OB Items

The GA in the OB items is calculated by the related GA tables/ formulae, it is independent from the clinical GA.

1. You can preset the GA formulae and whether to display SD and EDD or not in [System Preset] -> [OB], see “2.3 Obstetric Preset” for details.
2. The GA and other measurement values display in the result window after a measurement.

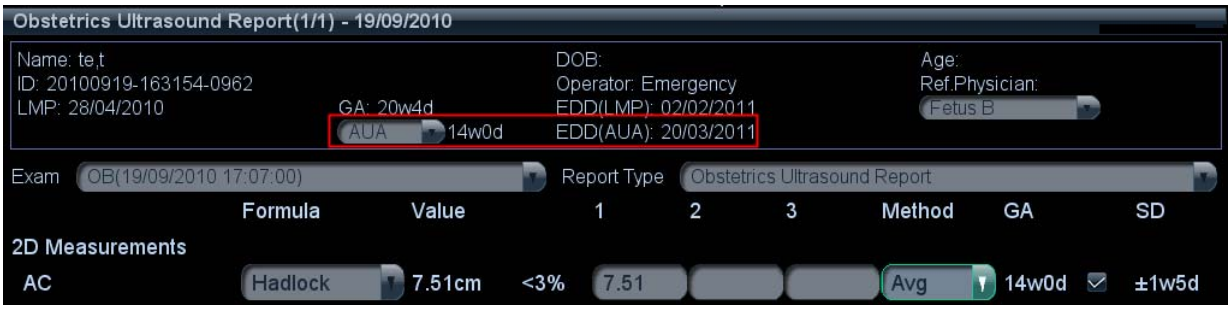
   If the Diagnostic GA exceeds the threshold, an OOR (out of range) displays in the result window and this result is not recorded in the report.
3. The GA of an OB item displays in the right side of the item measurements.
4. For result values used to calculate GA (Gestational Age) and EDD (Estimated Date of Delivery), the formula used in this calculation can be selected from [Formula].

Tips:	SD is also calculated through GA table/ formulae, it displays in the result window and report only when the system has clinical GA.

AUA

AUA is the average of valid GAs that are calculated according to biparietal diameter (BPD), head circumference (HC), abdomen circumference (AC), femur length (FL), Gestational Sac (GS), crown rump length (CRL) etc.

1. All valid values of all above items will be involved in AUA calculation in the system default method.
2. Clicking the check boxes at the right side of related items to select whether to involve the item in AUA calculation or not. The AUA value varies by the selection.



CUA

CUA is calculated according to formulae based on some measurement items (the involved items are among biparietal diameter (BPD), head circumference (HC), abdomen circumference (AC), and femur length (FL)). To calculate CUA, all the GA formulae of the parameters involved must be Hadlock, the unit of the parameters is cm, and unit of CUA is week. The formulae are listed as follows:

1. CUA(BPD) = 9.54+1.482*BPD+0.1676*BPD^2
2. CUA(HC) = 8.96+0.540*HC+0.0003*HC^3
3. CUA(AC) = 8.14+0.753*AC+0.0036*AC^2
4. CUA(FL) = 10.35+2.460*FL+0.170*FL^2
5. CUA(BPD, HC) = 10.32+0.009*HC^2+1.3200*BPD+0.00012*HC^3
6. CUA(BPD, AC) = 9.57+0.524*AC+0.1220*BPD^2
7. CUA(BPD, FL) = 10.50+0.197*BPD*FL+0.9500*FL+0.7300*BPD
8. CUA(HC, AC) = 10.31+0.012*HC^2+0.3850*AC
9. CUA(HC, FL) = 11.19+0.070*HC*FL+0.2630*HC
10. CUA(AC, FL) =10.47+0.442*AC+0.3140*FL^2 - 0.0121*FL^3
11. CUA(BPD, HC, AC) = 10.58+0.005*HC^2 +0.3635*AC+ 0.02864*BPD*AC
12. CUA(BPD, HC, FL) = 11.38+0.070*HC*FL+0.9800*BPD
13. CUA(BPD, AC, FL) = 10.61+0.175*BPD*FL+0.2970*AC+0.7100*FL
14. CUA(HC, AC, FL) = 10.33+0.031*HC*FL+0.3610*HC+0.0298*AC*FL
15. CUA(BPD, HC, AC, FL)=10.85+0.060*HC*FL+0.6700*BPD+0.1680*AC

The default method to calculate CUA is to use the formula that involves more measurement items. Also, you can select the parameters by clicking the check boxes at the right side of the related items.

OB Growth Percentile

The obstetric growth percentile is used to estimate the fetal growth. It calculates the difference between ultrasound measurement results and the measurement results corresponding to the clinical GA in the FG table. The percentile will not be calculated when there is no clinical GA, or no FG table, or the SD Type of the FG table is set to “None”.

The premise is: data in the FG table are (approximately) normal distributed, and support “lower-limit < average value < upper-limit”.

The system does not calculate the OB growth percentile if:

- A FG table is not normal distributed.
- There is no upper/ lower deviation set in the FG table.
- The FG table has the upper/ lower deviation set, but certain clinical GA value has no upper/ lower deviation or the deviation value is not plus. The fetal growth curve is not affected. E.g. Jeanty FG table of RAD.

The OB growth percentile is displayed in the result window, measurement report, exported PDF/RTF report and the OB structured report, and it supports print viewing and printing.

5.4 Obstetric Measurement Tools

The system supports the following 2D/M/Doppler obstetric measurements.

NOTE: 1. Measurement tools mentioned below are configured in the system. The application measurement packages provided in this system are generally different combinations of measurement tools. For more information about package preset, see "2.4.2.2 Application Measurement Preset".

2. If the results of the calculation items of CI, FL/BPD, FL/AC, HC/AC and FL/HC exceeds the clinical range, the result value displays as “value*”.

2D Obstetric Measurements

Types	Tools	Descriptions	Methods or formulae
Measurement	GS	Gestational Sac Diameter	Distance in 2D General Measurements
	YS	Yolk Sac	
	CRL	Crown Rump Length	Line (same as Distance in 2D General Measurements), Trace, Spline
	NT	Nuchal Translucency	Distance in 2D General Measurements
	BPD	Biparietal Diameter	Distance in 2D General Measurements (Support Smart OB method if the Smart OB function is configured)
	OFD	Occipital Frontal Diameter	
	FL	Femur Length	
	HC[1]	Head Circumference	Circumference in 2D General Measurements (Support Smart OB method if the Smart OB function is configured)
	AC	Abdominal Circumference	
	TAD	Abdominal Transversal Diameter	Distance in 2D General Measurements
	APAD	Anteroposterior Abdominal Diameter	
	TCD	Cerebellum Diameter	Distance in 2D General

[1] Head Circumference: in HC measurement, if the measure cursor of BPD appears on the screen, then the measurement starting point will be automatically posited at the measure cursor starting point of the last BPD; if you use “Ellipse” to measure the HC, the measure cursor of the last BPD will be the first axis of the ellipse in the default status.

Types	Tools	Descriptions	Methods or formulae
	Cist Magna	Cist Magna	Measurements
	LVW	Lateral Ventricle Width	
	HW	Hemisphere Width	
	OOD	Outer Orbital Diameter	
Measurement	IOD	Inter Orbital Diameter	
	HUM	Humerus Length	
	Ulna	Ulna Length	
	RAD	Radius Length	
	Tibia	Tibia Length	
	FIB	Fibula Length	
	CLAV	Clavicle Length	
	Vertebrae	Length of Vertebrae	
	MP	Middle Phalanx Length	
	Foot	Foot Length	
	Ear	Ear Length	
	APTD	Anteroposterior trunk diameter	
	TTD	Transverse trunk diameter	
	FTA	Fetal Trunk Cross-sectional Area	Area in 2D General Measurements
	THD	Thoracic Diameter	Distance in 2D General Measurements
	HrtC	Heart Circumference	Area in 2D General Measurements
	TC	Thoracic circumference	
	Umb VD	Umbilical Vein Diameter	Distance in 2D General Measurements
	F-kidney	Fetal kidney Length	Distance in 2D General Measurements
	Mat Kidney	Matrix Kidney Length	
	Cervix L	Cervical Length	
	AF	Amniotic Fluid	
	NF	Nuchal Fold	
	Orbit	Orbit	Distance in 2D General Measurements
	PL Thickness	Placental Thickness	
	Sac Diam1	Gestational Sac Diameter 1	
	Sac Diam2	Gestational Sac Diameter 2	
	Sac Diam3	Gestational Sac Diameter 3	
	AF1	Amniotic Fluid 1	

Types	Tools	Descriptions	Methods or formulae
	AF2	Amniotic Fluid 2	
	AF3	Amniotic Fluid 3	
	AF4	Amniotic Fluid 4	
	LVIDd	Left Ventricular Internal Diameter at End-diastole	
	LVIDs	Left Ventricular Internal Diameter at End-systole	
	LV Diam	Left Ventricular Diameter	
	LA Diam	Left Atrium Diameter	
	RVIDd	Right Ventricular Internal Diameter at End-diastole	
	RVIDs	Right Ventricular Internal Diameter at End-systole	
	RV Diam	Right Ventricular Diameter	
	RA Diam	Right Atrium Diameter	
Measurement	IVSd	Interventricular Septal Thickness at End-diastole	Distance in 2D General Measurements
	IVSs	Interventricular Septal Thickness at End-systole	
	IVS	Interventricular Septal Thickness	
	LV Area	Left Ventricular Area	
	LA Area	Left Atrium Area	
	RV Area	Right Ventricular Area	
	RA Area	Right Atrium Area	
	Ao Diam	Aorta Diameter	
	MPA Diam	Main Pulmonary Artery Diameter	
	LVOT Diam	Left Ventricular Outflow Tract Diameter	
	RVOT Diam	Right Ventricular Outflow Tract Diameter	
Calculation	Mean Sac Diam	Mean Gestational Sac Diameter	The average value of three sac diameters
	AFI	/	Measure the maximum AFs of the four amniotic fluid pockets of pregnant woman. AFI = AF1+AF2+AF3+AF4
	EFW	Estimated Fetal Weight	EFW is calculated by the default

Types	Tools	Descriptions	Methods or formulae
	EFW2	Estimated Fetal Weight 2	EFW formulae, based on multiple measured parameters, See “2.3.1 Obstetric Formula”. The formulae can be reselected in the OB report.
	HC/AC	/	HC/AC
	FL/AC	/	FL/AC×100
	FL/BPD	/	FL / BPD ×100%
	AXT	/	APTD × TTD
	CI	/	BPD / OFD ×100%
	FL/HC	/	FL/AC×100
	HC(c)	/	$HC(c) = 2.325\times(BPD^2 + OFD^2)^{1/2}$
	HrtC/TC	/	HrtC / TC
	TCD/AC	/	TCD / AC
	LVW/HW	/	LVW / HW × 100%
	LVD/RVD	/	LV Diam/RV Diam
	LAD/RAD	/	LA Diam/RA Diam
	AoD/MPAD	/	Ao Diam/MPA Diam
	LAD/AoD	/	LA Diam/Ao Diam
Study	AFI(Auto)	/	Measures AF1, AF2, AF3, AF4, calculates AFI

M Obstetric Measurements

Types	Tools	Descriptions	Methods or formulae
Measurement	FHR	Fetal Heart Rate	Heart Rate in M General Measurements
	LVIDd	Left ventricular short-axis diameter at end diastole	Distance in 2D General Measurements
	LVIDs	Left ventricular short-axis diameter at end systole	
	RVIDd	Right ventricular short-axis diameter at end diastole	
	RVIDs	Right ventricular short-axis diameter at end systole	
	IVSd	interventricular septal thickness at en diastole	
	IVSs	interventricular septal thickness at en systole	
Calculation	/	/	
Study	/	/	

Doppler Obstetric Measurements

Types	Tools	Descriptions	Methods or formulae
Measurement	Umb A	Umbilical Artery	D trace in General D measurements.
	Placenta A	Placenta Artery	
	MCA	Middle Cerebral Artery	
	Fetal Ao	Fetal Aorta	
	Desc Aorta	Descending Aorta	
	Ut A	Uterine Artery	
	Ovarian A	Ovarian Artery	
	Duct Veno	Ductus Veno	D trace in General D measurements. Use 3-PT method to measure peak value of ventricular systole (S), peak value of early diastole (D) and minimum value of atrial contraction (a) to acquire Duct Veno D result.
	FHR	Fetal Heart Rate	Heart Rate in Doppler General Measurements
Calculation	/	/	
Study	/	/	

5.5 Obstetric Measurement Operations

Operations of measurement, calculation and study are described by examples.

Tips:
1. See the table in "5.4 Obstetric Measurement Tools" above for measurement tools and methods.
2. For the definitions of measurement, calculation and study, refer to "1.3 Measurement, Calculation and Study".
3. The order of the measurement items is presettable, see "2.4.2 Application Measurement Preset" for details.

5.5.1 Measurement Tool Operations

Take the HC measurement as an example.

1. Select the [HC] item/tool in the measurement menu.
   See “Select Measurement Method Online” for details on how to select method online.
2. Measure area according to the Area method in 2D General Measurements.
   Measurement results, GA calculation and OB growth percentile display in the result window.
   You can preset whether to display SD and EDD or not in [System Preset] -> [OB] -> [Fetal Gestational Age].

For more details about GA, see “5.3 GA”.

- Auto OB Measurement (Smart OB)

Smart OB is an option and not available in FDA region.

There is an auto measurement method for commonly-used OB measurement items (BPD, HC, AC, FL, OFD, NT and etc.). The procedure is as follows:

1. Scan the proper image.
2. Select the OB measurement item from the menu and select the [Auto] method.
3. The measurement caliper is drawn on the image automatically.

   You can rotate the trackball to modify the caliper if the result of the auto measurement does not match the image exactly.
4. Press <Set> to confirm the measurement.

   Or, press <Update>/<Clear> to modify the caliper for a more accurate result.

5.5.2 Calculation Tool Operations

Take the HC/AC measurement as an example.

1. Select the [HC/AC] item/tool in the measurement menu.
2. Measure the HC and AC according to the Area method in 2D General Measurements.

   The second measurement is activated automatically when the first one is completed. The results display in the result window after measurement.

5.5.3 Study Tool Operations

The operation of AFI measurement is as follows.

1. Select [AFI] in the measurement menu. Enter the submenu.

Tips:	Whether to display the submenu or not can be preset, see “Setting Item Property” for details.

2. Measure the maximum AFs of the four amniotic fluid pockets of pregnant woman, and AFI is calculated automatically.

5.6 Multi-fetus Exam

The system allows multi-fetus (3 at most) examination.

NOTE:	Ensure that the Fetus displayed in the multi-fetus measurement menu is the one on which you are intended to perform the measurements.

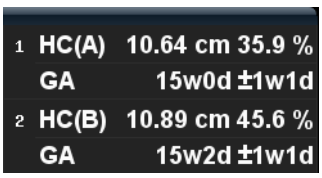
Similar to the OB measurement,

1. Set the number of fetuses in [Gestations] via [Patient Info] -> [OB].

   If the [Gestations] is set to 2 or 3, the [Fetus] widget displays in the OB measurement menu , as shown in the figure below.

   You can switch among [Fetus A], [Fetus B] or [Fetus C] via the widget.
2. Perform measurement to the fetus respectively.

   The measurement results in the result window are marked with fetus label A, B or C.



3. In the Obstetric report, select [Fetus A], [Fetus B], or [Fetus C] to switch among results of different fetuses.
4. In the [Obstetric Growth Curve] dialog box, select [A], [B], or [C] on the lower part to display the growth curves of different fetuses.
   - Data of Fetus A/ Fetus B/ Fetus C: Three symbols + × ✳ are used on the growth curves to identify measurement data of different fetuses.
   - History/ current data: Symbol size is used to distinguish them, with the history data appeared in smaller symbol.

5.7 Obstetric Exam Report

During or after a measurement, press <Report> on the Control Panel to browse the report.

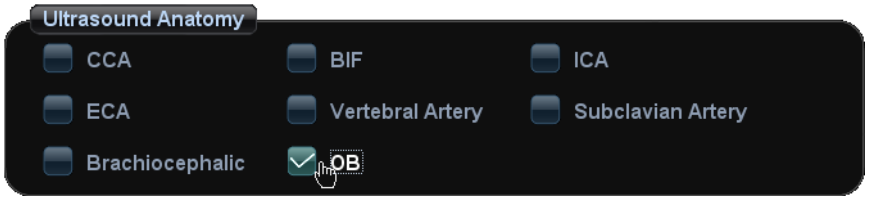
See "5.6 Multi-fetus Exam" for multi-fetus exam report.

For details about report browsing, printing and exporting etc, see "1.7 Report".

5.7.1 Fetal Biophysical Profile

Fetal Biophysical Profile means to first obtain a few indexes related to fetal growth through experiment or measurement and then evaluate the hazardous situation that the fetus is facing by grading these indexes respectively.

1. Select [OB] of the Ultrasound Anatomy in the report template preset page.



   See section "2.5 Preset of Report Template".
2. Click [Analyze] in the OB report page, the fetus Score is listed after the fetal analysis.

   The scoring criteria the system provides are based on Vintzileos formula, as shown in table below.

Fetal growth index	0 score	2 score	Observation time	Remarks
FHR	<2, or Reactive FHR ≤15bpm	Reactive FHR ≥15bpm, duration≥15s, ≥2 times	30 minutes	The score(s) can be manually input into the system.
FM	≥2 fetal movements	FM ≥3 times (Continuous movement is deemed to 1 time)	30 minutes	
FBM	No FBM or duration≤30s	FBM≥1 times; duration≥30s	30 minutes	
FT	Limbs stretch, no bend, fingers loose	Limbs and spine stretch-bend ≥1 times	/	
AF	No AF, or AF volume <2×2cm	One or more AF volume > 2×2cm	/	

Fetal scoring results criteria:

Total scores	Growth condition
8-10 scores	Normal, chronic asphyxia risk low
4-6 scores	Chronic asphyxia risk suspicious
0-2 scores	Chronic asphyxia risk high

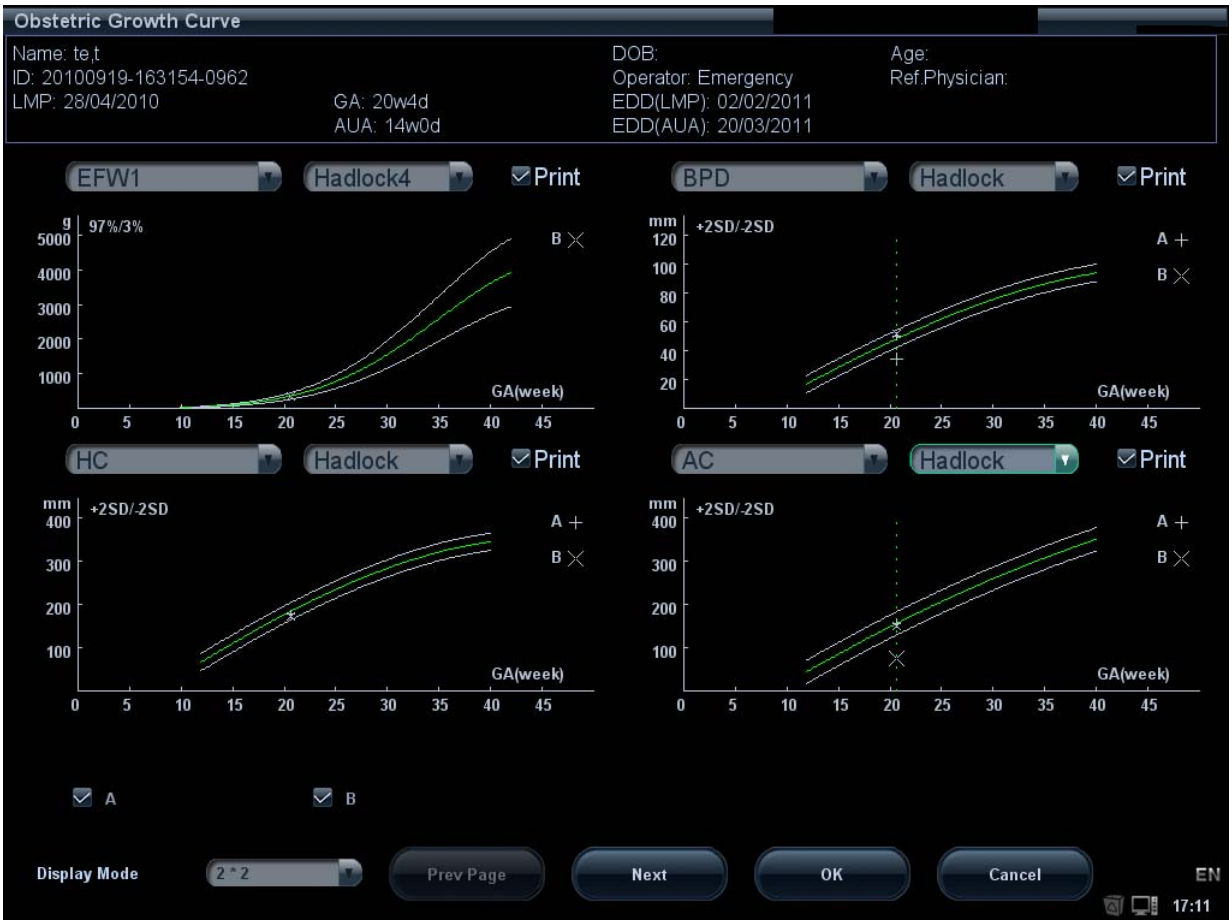
3. Scores of each index as well as the total score will be appended to the report.

5.7.2 Fetal Growth Curve

Fetus growth curve means to compare the measured data of the fetus with the normal growth curve to judge whether the fetus is in normal growth state. Data of growth curve is all sourced from Fetal Growth Table.

1. Select [Obstetric] of the [Patient Info] in the report template preset page, and the button [Growth] in the report viewing page is available.

   See section "2.5 Preset of Report Template".
2. Enter patient information and obstetric information in [Patient Info] -> [OB] dialog box.
3. Perform one or more tools of fetal growth parameters.
4. Click [Growth] in the report page to display the Obstetric Growth Curve dialog box. The dialog box displays the growth curve and the position of measurement value.



- Two drop-down lists above the curve display the measurement item/tool and formula of the curve, which can be changed.
- Three symbols ＋ ✕ ✳ are used on the growth curves to identify measurement data of different fetuses.
- Current and history data of one fetus are displayed in the same symbol with the history data appeared in smaller size.
- Click the [Print] check box to determine whether to include the growth curve in the printed report or not.
- The green dotted line indicates the clinical GA on the X-axis.
- Select the number and layout of the curves from [Display Mode].

  1*1: one curve displays in the screen.

  2*1: two curves (up/ down) display in the screen.

  2*2: four curves display in the screen.
- Click [Prev Page]/ [Next] to turn the growth curve pages.

5. Click [OK] to confirm the setting and exit the page.

Tips:	If the patient ID is blank, clinical GA is not calculated, or the measurement value is not valid, measurement values will not be displayed on the curve.

5.7.3 Z-Score

As the FL, BPD and GA are most relevant to the fetus cardiac structure and the Z-Score regression equation is related to the natural logarithm value of the FL, BPD and GA variables, the

Z-Score of cardiac structures can be obtained by looking at the Z-Score table, which is important in fetus cardiac growth evaluation and intrauterine interventional therapy.

ln (predicted cardiac dimension) = m*ln(FL, GA or BPD)+c

Z-Score = (ln(actual)-ln(predicted cardiac dimension))/root MSE

Where the unit of FL and BPD is cm, GA is week, m is multiplier, c is intercept and root MSE is root-mean-square error, which can be obtained from the table.

1. Enter the patient's basic information and obstetric information in the [Patient Info] → [OB] dialog box.
2. Measure the BPD and FL.
3. Select Z-Score parameters (with Z-Score tag in the name) from the measurement menu.
4. Open the report to check the Z-Score result.

Tip: the Z-Score study is effective for fetuses aged 15~40 weeks.

Z-Score feature is not available in FDA region.

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Department of Obstetrics and Gynecology, Osaka University Medical School
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6 Cardiology

6.1 Cardiac Exam Preparations

Make the following preparations before measurement:

1. Confirm that the current probe is appropriate.
2. Check if the current date of the system is correct.
3. Press <Patient>, input patient information in [Patient Info] -> [CARD] page.

   For more details, refer to "Exam Preparation -> Patient Information" in the Operator's Manual [Basic Volume].
4. Switch to the correct exam mode.

6.2 Basic Cardiac Measurement Procedures

1. Press <Patient>, input patient information in [Patient Info] -> [CARD] page.
2. Press <Measure> to enter the Application Measurement.

   If the current menu is not the one containing Cardiac Measurement tools, move the cursor to the menu title and select the package containing Cardiac Measurement tools.
3. Select measurement tool in the menu to start the measurement.

   See the table in "6.3 Cardiac Measurement Tools" for measurement tools.

   See section "6.4 Cardiac Measurement Operations" and steps in "3 General Measurement" for measurement methods.
4. Press <Report> to view the exam report, see "6.5 Cardiac Exam Report" for details.

6.3 Cardiac Measurement Tools

The system supports the following cardiac measurements:

NOTE:

1. Measurement tools mentioned below are configured in the system. The application measurement packages provided in this system are generally different combinations of measurement tools. For more information about package preset, see "2.4.2.2 Application Measurement Preset".
2. The heartbeat of the traced spectrum in VTI measurement should equal to that is preset, otherwise the obtained HR (Heart Rate) is incorrect. See "2.2 Measurement Parameters Preset" for relevant preset.
3. Some application items in the measurement preset library (and matching list in result assignment) are displayed different from that in the measurement menu and result window.

   In preset library (and matching list in result assignment), the item is followed with the word indicating the mode or location. Such as LA Diam (2D) means that the item is measured during 2D mode; LA Diam(LA Vol A-L) means that the item is contained in a study named LV Vol(A-L).

6.3.1 2D Cardiac Measurements

Types	Tools	Descriptions	Methods or formulae
Measurement	LA Diam	Left Atrium Diameter	Distance in 2D General Measurements
	LA Major	Left Atrium major Diameter	
	LA Minor	Left Atrium minor Diameter	
	RA Major	Right Atrium major Diameter	
	RA Minor	Right Atrium minor Diameter	
	LV Major	Left Ventricular major Diameter	
	LV Minor	Left Ventricular minor Diameter	
	RV Major	Right Ventricular major Diameter	Distance in 2D General Measurements
	RV Minor	Right Ventricular minor Diameter	
	LA Area	Left Atrium area	Area in 2D General Measurements
	RA Area	Right Atrium area	
	LV Area(d)	Left Ventricular area at end-diastole	
	LV Area(s)	Left Ventricular area at end-systole	
	RV Area(d)	Right Ventricular area at end-diastole	
	RV Area(s)	Right Ventricular area at end-systole	
	LVIDd	Left Ventricular Internal Diameter at end-diastole	Distance in 2D General Measurements
	LVIDs	Left Ventricular Internal Diameter at end-systole	
	RVDd	Right Ventricular Diameter at end-diastole	
	RVDs	Right Ventricular Diameter at end-systole	
	LVPWd	Left Ventricular Posterior wall thickness at end-diastole	
	LVPWs	Left Ventricular Posterior wall thickness at end-systole	
	RVAWd	Right Ventricular Anterior wall thickness at end-diastole	
	RVAWs	Right Ventricular Anterior wall thickness at end-systole	
	IVSd	Interventricular Septal thickness at end-diastole	

Types	Tools	Descriptions	Methods or formulae
	IVSs	Interventricular Septal thickness at end-systole	
Measurement	Ao Diam	Aorta Diameter	
	Ao Arch Diam	Aorta arch Diameter	
	Ao Asc Diam	Ascending Aorta Diameter	
	Ao Desc Diam	Descending Aorta Diameter	
	Ao Isthmus	Aorta Isthmus Diameter	
	Ao st junct	Aorta ST junct Diameter	
	Ao Sinus Diam	Aorta Sinus Diameter	
	Duct Art Diam	Ductus Arteriosus Diameter	
	Pre Ductal	Previous ductal Diameter	
	Post Ductal	Posterior ductal Diameter	
	ACS	Aortic Valve Cusp Separation	Distance in 2D General Measurements
	LVOT Diam	Left Ventricular Outflow Tract Diameter	
	AV Diam	Aorta Valve Diameter	
	AVA	Aortic Valve Area	Area in 2D General Measurements
	PV Diam	Pulmonary valve Diameter	Distance in 2D General Measurements
	LPA Diam	Left pulmonary Artery Diameter	
	RPA Diam	Right pulmonary Artery Diameter	
	MPA Diam	Main pulmonary Artery Diameter	
	RVOT Diam	Right Ventricular Outflow Tract Diameter	
	MV Diam	Mitral Valve diameter	
	MVA	Mitral Valve area	Area in 2D General Measurements
	MCS	Mitral Valve Cusp Separation	Distance in 2D General Measurements
	EPSS	Distance between point E and Interventricular Septum when mitral valve is fully open	
	TV Diam	Tricuspid valve Diameter	
	TVA	Tricuspid Valve Area	Area in 2D General Measurements
	IVC Diam(Insp)	Inferior vena cava inspiration Diameter	Distance in 2D General Measurements
	IVC Diam(Expir)	Inferior vena cava expiration Diameter	

Types	Tools	Descriptions	Methods or formulae
Measurement	SVC Diam(Insp)	Superior vena cava inspiration Diameter	
	SVC Diam(Expir)	Superior vena cava expiration Diameter	
	LCA	Left Coronary Artery	
	RCA	Right Coronary Artery	
	VSD Diam	Ventricular Septal defect Diameter	Distance in 2D General Measurements
	ASD Diam	Atrial Septal defect Diameter	
	PDA Diam	Patent ductus Arteriosus Diameter	
	PFO Diam	Patent Oval Foramen Diameter	
	PEd	Pericardial Effusion at diastole	
	PEs	Pericardial Effusion at systole	
Calculation	LA/Ao	Left Atrium Diameter/Aorta Diameter	LA Diam (cm) / Ao Diam (cm)
	Ao/LA	Aorta Diameter/Left Atrium Diameter	Ao Diam (cm) / LA Diam (cm)
Study	See below		

6.3.2 M Cardiac Measurements

Types	Tools	Descriptions	Methods or formulae
Measurement	LA Diam	Left Atrium Diameter	Distance in M General Measurements
	LVIDd	Left Ventricular Internal Diameter at end-diastole	
	LVIDs	Left Ventricular Internal Diameter at end-systole	
	RVDd	Right Ventricular Diameter at end-diastole	
	RVDs	Right Ventricular Diameter at end-systole	
	LVPWd	Left Ventricular Posterior wall thickness at end-diastole	
	LVPWs	Left Ventricular Posterior wall thickness at end-systole	
	RVAWd	Right Ventricular Anterior wall thickness at end-diastole	
	RVAWs	Right Ventricular Anterior wall thickness at end-systole	

Types	Tools	Descriptions	Methods or formulae
	IVSd	Interventricular Septal thickness at end-diastole	
	IVSs	Interventricular Septal thickness at end-systole	
	Ao Diam	Aorta Diameter	
	Ao Arch Diam	Aorta arch Diameter	
	Ao Asc Diam	Ascending Aorta Diameter	
	Ao Desc Diam	Descending Aorta Diameter	
	Ao Isthmus	Aorta Isthmus Diameter	
	Ao st junct	Aorta ST junct Diameter	
	Ao Sinus Diam	Aorta Sinus Diameter	
	LVOT Diam	Left Ventricular outflow tract Diameter	
	ACS	Aortic valve Cusp Separation	
	LPA Diam	Left pulmonary Artery Diameter	
	RPA Diam	Right pulmonary Artery Diameter	
	MPA Diam	Main pulmonary Artery Diameter	
	RVOT Diam	Right Ventricular outflow tract Diameter	
	MV E Amp	Amplitude of the Mitral Valve E wave	
	MV A Amp	Amplitude of the Mitral Valve A wave	
	MV E-F Slope	Mitral Valve E-F slope	Slope in M General Measurements
	MV D-E Slope	Mitral Valve D-E slope	
	MV DE	Amplitude of the Mitral Valve DE wave	Distance in M General Measurements
	MCS	Mitral Valve Cusp Separation	
	EPSS	Distance between point E and the interventricular septum	
	PEd	Pericardial effusion at diastole	
	PEs	Pericardial effusion at systole	
	LVPEP	Left Ventricular pre-ejection period	Time in M General Measurements
	LVET	Left Ventricular ejection time	
	RVPEP	Right Ventricular pre-ejection period	
	RVET	Right Ventricular ejection time	

Types	Tools	Descriptions	Methods or formulae
	TAPSE	Tricuspid Annular Plane Systolic Excursion	Distance in M General Measurements
	HR	Heart Rate	Heart Rate in M General Measurements
Calculation	LA/Ao	Left Atrium diameter/Aorta diameter	LA Diam (cm) / Ao Diam (cm)
	Ao/LA	Aorta Diameter/Left Atrium Diameter	Ao Diam (cm) / LA Diam (cm)
Study	See below		

6.3.3 Doppler Cardiac Measurements

Types	Tools	Descriptions	Methods or formulae
Measurement	MV Vmax	Mitral Valve Maximum Velocity	D Vel in Doppler General Measurements
	MV E Vel	Mitral Valve E-wave Velocity	
	MV A Vel	Mitral Valve A-wave Velocity	
	MV E VTI	Mitral Valve E-wave Velocity-Time Integral	D Trace in Doppler General Measurements
	MV A VTI	Mitral Valve A-wave Velocity-Time Integral	
	MV VTI	Mitral Valve Velocity-Time Integral	
	MV AccT	Mitral Valve Acceleration Time	Acceleration in Doppler General Measurements
	MV DecT	Mitral Valve Deceleration Time	
	IVRT	Isovelocity Relaxation Time	Time in Doppler General Measurements
	IVCT	Isovelocity Compression Time	
	MV E Dur	Mitral Valve E-wave Duration	
	MV A Dur	Mitral Valve A-wave Duration	
	LVOT Vmax	Left Ventricular Outflow Tract Velocity	D Vel in Doppler General Measurements
	LVOT VTI	Left Ventricular Outflow Tract Velocity-Time Integral	D trace in Doppler General measurements
Measurement	LVOT AccT	Left Ventricular Outflow Tract Acceleration Time	Time in Doppler General Measurements
	AAo Vmax	Ascending Aorta Maximum Velocity	D Vel in Doppler General Measurements
	DAo Vmax	Descending Aorta Maximum Velocity	

Types	Tools	Descriptions	Methods or formulae
	AV Vmax	Aorta Valve Maximum Velocity	
	AV VTI	Aorta Valve Velocity-Time Integral	D trace in Doppler General measurements
	LVPEP	Left Ventricular Pre-ejection Period	Time in Doppler General Measurements
	LVET	Left Ventricular Ejection Time	
	AV AccT	Aorta Valve Acceleration Time	
	AV DecT	Aorta Valve Deceleration Time	
	RVET	Right Ventricular Ejection Time	Time in Doppler General Measurements
	RVPEP	Right Ventricular Pre-ejection Period	
	TV Vmax	Tricuspid Valve Maximum Velocity	D Vel in Doppler General Measurements
	TV E Vel	Tricuspid Valve E-wave Flow Velocity	
	TV A Vel	Tricuspid Valve A-wave Flow Velocity	
	TV VTI	Tricuspid Valve Velocity-Time Integral	D trace in Doppler General measurements
	TV AccT	Tricuspid Valve Acceleration Time	Acceleration in Doppler General Measurements
	TV DecT	Tricuspid Valve Deceleration Time	
	TV A Dur	Tricuspid Valve A-wave Duration	Time in Doppler General Measurements
	RVOT Vmax	Right Ventricular Outflow Tract Maximum Velocity	D Vel in Doppler General Measurements
	RVOT VTI	Right Ventricular Outflow Tract Velocity-Time Integral	D trace in Doppler General measurements
	PV Vmax	Pulmonary Valve Maximum Velocity	D Vel in Doppler General Measurements
	PV VTI	Pulmonary Valve Velocity-Time Integral	D trace in Doppler General measurements
	PV AccT	Pulmonary Valve Acceleration Time	Acceleration in Doppler General Measurements
	MPA Vmax	Main Pulmonary Artery Maximum Velocity	D Vel in Doppler General Measurements
	RPA Vmax	Right Pulmonary Artery Maximum Velocity	

Types	Tools	Descriptions	Methods or formulae
	LPA Vmax	Left Pulmonary Artery Maximum Velocity	
	PVein S Vel	Pulmonary Vein S-wave Flow Velocity	D Vel in Doppler General Measurements
	PVein D Vel	Pulmonary Vein D-wave Flow Velocity	
	PVein A Vel	Pulmonary Vein A-wave Flow Velocity	
	PVein A Dur	Pulmonary Vein A-wave Duration	Time in Doppler General Measurements
	PVein S VTI	Pulmonary Vein S-wave Velocity-time Integral	D trace in Doppler General measurements
	PVein D VTI	Pulmonary Vein D-wave Velocity-time Integral	
	PVein DecT	Pulmonary Vein Deceleration Time	Time in Doppler General measurements
	IVC Vel (Insp)	Inferior Vena Cava Inspiration Maximum Velocity	D Vel in Doppler General Measurements
	IVC Vel (Expir)	Inferior Vena Cava Expiration Maximum Velocity	
	SVC Vel (Insp)	Superior Vena Cava Inspiration Maximum Velocity	
	SVC Vel (Expir)	Superior Vena Cava Expiration Maximum Velocity	
	MR Vmax	Mitral Valve Regurgitation Maximum Velocity	
	MR VTI	Mitral Valve Regurgitation Velocity-Time Integral	D trace in Doppler General measurements
	MS Vmax	Mitral Valve Stenosis Maximum Velocity	D Vel in Doppler General Measurements
	dP/dt	Rate of Pressure change	dP/dt Measurement
	AR Vmax	Aortic Valve Regurgitation Maximum Velocity	D Vel in Doppler General Measurements
	AR VTI	Aortic Valve Regurgitation Velocity-Time Integral	D trace in Doppler General measurements
	AR DecT	Aortic Valve Regurgitation Deceleration Time	Acceleration in Doppler General Measurements
	AR PHT	Aortic Valve Regurgitation Pressure Half Time	Doppler measurement
	AR Ved	Aortic Valve Regurgitation Velocity at end-Diastole	D Vel in Doppler General Measurements
	TR Vmax	Tricuspid Valve Regurgitation Maximum Velocity	

Types	Tools	Descriptions	Methods or formulae
	TR VTI	Tricuspid Valve Regurgitation Velocity-Time Integral	D trace in Doppler General measurements
	PR Vmax	Pulmonary Valve Regurgitation Maximum Velocity	D Vel in Doppler General Measurements
	PR VTI	Pulmonary Valve Regurgitation Velocity-Time Integral	D trace in Doppler General measurements
	PR PHT	Pulmonary Valve Regurgitation Pressure Half Time	Doppler Measurement
	PR Ved	Pulmonary Valve Regurgitation Velocity at end-Diastole	D Vel in Doppler General Measurements
	VSD Vmax	Ventricular Septal Defect Maximum Velocity	
	ASD Vmax	Atrial Septal Defect Maximum Velocity	
	PDA Vel(d)	Patent Ductus Arteriosus Velocity at End-diastole	
	PDA Vel(s)	Patent Ductus Arteriosus Velocity at End-systole	
	Coarc Pre-Duct	Coarctation of Pre-Ductus	
	Coarc Post-Duct	Coarctation of Post-Ductus	
	Hepatic V S Vel	Hepatic Vein Systolic Peak Velocity	
	Hepatic V D Vel	Hepatic Vein Diastolic Peak Velocity	
	HR	Heart Rate	Heart Rate in Doppler General Measurements
	AV HR	Aortic Valve Heart Rate	
	MV HR	Mitral Valve Heart Rate	
	TV HR	Tricuspid valve Heart Rate	
	PV HR	Pulmonary Valve Heart Rate	
	RAP	Right Atrium Pressure	Select from the pop-up dialog box or input a value manually. See RAP measurement in “RVSP”
Calculation	MV E/A	Mitral Valve E-Vel/A-Vel	MV E Vel (cm/s) / MV A Vel (cm/s)
	MVA(PHT)	Mitral Valve Orifice Area (PHT)	MVA(PHT) (cm^2) = 220 / MV PHT (ms)
	TV E/A	Tricuspid Valve E-Vel/A-Vel	

Types	Tools	Descriptions	Methods or formulae
	TVA(PHT)	Tricuspid Valve Orifice Area (PHT)	
Study	See below		

6.3.4 TDI Cardiac Measurements

The following measurement items are performed in TDI mode.

Types	Tools	Descriptions	Methods or formulae
Measurement	Ea(medial)	Mitral Valve medial Early diastolic motion	D Vel in Doppler General Measurements
	Aa(medial)	Mitral Valve medial Late diastolic motion	
	Sa(medial)	Mitral Valve medial Systolic motion	
	ARa(medial)	Mitral Valve medial Acceleration Rate	
	DRa(medial)	Mitral Valve medial Deceleration Rate	D Vel in Doppler General Measurements
	Ea(lateral)	Mitral Valve lateral Early diastolic motion	
	Aa(lateral)	Mitral Valve lateral Late diastolic motion	
	Sa(lateral)	Mitral Valve lateral Systolic motion	
	ARa(lateral)	Mitral Valve lateral Acceleration Rate	
	DRa(lateral)	Mitral Valve lateral Deceleration Rate	
Calculation	/	/	
Study	See below		

6.4 Cardiac Measurement Operations

Tips:
1. See the table in "6.3 Cardiac Measurement Tools" above for measurement tools and methods.
2. For the definitions of measurement, calculation and study, refer to "1.3 Measurement, Calculation and Study".
3. The order of the measurement items is presettable, see "2.4.2 Application Measurement Preset" for details.
4. Measurements of some tools described in this Chapter are to be performed in several imaging modes, please select appropriate imaging modes in measurement.

6.4.1 Measurement Tool Operations

1. Select the item/tool in the measurement menu.
2. Perform the measurement referring to methods in table above.

6.4.2 Calculation Tool Operations

1. Select the item/tool in the measurement menu.

2. The system calculates and displays the results after relating measurement items have been completed.

6.4.3 Study Tool Operations

6.4.3.1 Left Ventricular Function

This group of studies is to estimates the Left Ventricular (LV) diastolic and systolic capabilities by a series of clinical indices measured on B or M image. Except for calculating left ventricular volume and end diastole and end systole, they may calculate the following indices (not all indices are calculated in every study, see Study Results table in each study for reference).

Result	Descriptions	Formulae
SV	Stroke Volume	SV(ml) = EDV(ml)-ESV(ml)
CO	Cardiac Output	CO(l/min) = SV(ml)×HR(bpm)/ 1000
EF	Ejection Fraction	EF(No unit) = SV(ml)/ EDV(ml)
SI	SV Index	SI(No unit) = SV(ml)/ Body Surface Area (m^2)
CI	Cardiac Index	CI(No unit) = CO(l/min)/Body Surface Area (m^2)
FS	Fractional Shortening	FS (No unit) = (LVIDd (cm) – LVIDs [cm]) / LVIDd (cm)
MVCF	Mean Velocity of Circumferential Fiber Shortening	MVCF = (LVIDd(cm) – LVIDs(cm)) / (LVIDd (cm) × ET (s))

NOTE: The HR value inputted manually should be within the range of 1~999.

S-P Ellipse

- Study Items

Tools	Descriptions	Operations
LVLd apical	Left Ventricular Long-axis Length at End-diastole in apical view	Distance in 2D General Measurements
LVAd apical	Left Ventricular Long-axis Area at End-diastole in apical view	Area in 2D General Measurements
LVLs apical	Left Ventricular Long-axis Length at End-systole in apical view	Distance in 2D General Measurements
LVAs apical	Left Ventricular Long-axis Area at end-systole in apical view	Area in 2D General Measurements
HR	Heart Rate	Obtained by ECG or input directly

- Study Results

Tools	Descriptions	Formulae
EDV(SP Ellipse)	End-diastolic Left Ventricular Volume	$\mathrm{EDV(SP\ Ellipse)}(ml)=\frac{8}{3\pi}\times\frac{\mathrm{LVAd\,apical}(cm^2)^2}{\mathrm{LVLd\,apical}(cm)}$

Tools	Descriptions	Formulae
ESV(SP Ellipse)	End-systolic Left Ventricular Volume	$\mathrm{ESV(SP\ Ellipse)}(ml)=\frac{8}{3\pi}\times\frac{\mathrm{LVAs\,apical}(cm^2)^2}{\mathrm{LVLs\,apical}(cm)}$
SV(SP Ellipse)	Stroke Volume	See table in “6.4.3.1 Left Ventricular Function”
CO(SP Ellipse)	Cardiac Output	
EF(SP Ellipse)	Ejection Fraction	
SI(SP Ellipse)	SV Index	
CI(SP Ellipse)	CO Index	

■ Operating Procedures

1. Select [S-P Ellipse] in the measurement menu.
2. In apical long-axis view at end-diastole, measure the following parameters:
   LVLd apical
   LVAd apical
   EDV value is then calculated.
3. In apical long-axis view at end-systole, measure the following parameters:
   LVLs apical
   LVAs apical
   ESV value is then calculated.
   The system calculates SV and EF;
   If height and weight have been input already, SI is calculated.
4. Obtain HR by ECG or input.
   The CO and CI are calculated automatically.

B-P Ellipse

■ Study Items

Tools	Descriptions	Operations
LVIDd	Left Ventricular Internal Diameter at End-diastole	Distance in 2D General Measurements
LVIDs	Left Ventricular Internal Diameter at End-systole	
LVAd sax MV	Left Ventricular Area at Mitral Valve level at End-diastole in Short-axis view	Area in 2D General Measurements
LVAs sax MV	Left Ventricular Area at Mitral Valve level at End-systole in Short-axis view	
LVAd apical	Left Ventricular Long-axis Area at End-diastole in apical view	
LVAs apical	Left Ventricular Long-axis Area at end-systole in apical view	
HR	Heart Rate	Obtained by ECG or input directly

■ Study Results

Tools	Descriptions	Formulae
EDV(BP Ellipse)	End-diastolic Left Ventricular Volume	*1
ESV(BP Ellipse)	End-systolic Left Ventricular Volume	*2
SV(BP Ellipse)	Stroke Volume	See table in "6.4.3.1 Left Ventricular Function"
CO(BP Ellipse)	Cardiac Output	
EF(BP Ellipse)	Ejection Fraction	
SI(BP Ellipse)	SV Index	
CI(BP Ellipse)	CO Index	

*1 means:

$$\mathrm{EDV(BP\ Ellipse)}(ml) = {}^{8}\!/_{3\pi} \times \mathrm{LVAd\ apical}(cm^2) \times \mathrm{LVAd\ sax\ MV}(cm^2) \Big/ LVIDd(cm)$$

*2 means:

$$\mathrm{ESV(BP\ Ellipse)}(ml) = {}^{8}\!/_{3\pi} \times \mathrm{LVAs\ apical}(cm^2) \times \mathrm{LVAs\ sax\ MV}(cm^2) \Big/ LVIDs(cm)$$

■ Operating Procedures

1. Select [B-P Ellipse] in the menu.
2. In left ventricular short-axis view, measure the following parameters:
   At end diastole: LVIDd
   At end systole: LVIDs
3. In short-axis view at mitral valve level, measure the following parameters:
   At end diastole: LVAd sax MV
   At end systole: LVAs sax MV
4. In apical long-axis view, measure the following parameters:
   LVAd apical, the EDV is calculated
   LVAs apical, the ESV is calculated
   The system calculates SV and EF after LVAs apical has been measured;
   If height and weight have been input already, SI is calculated.
5. Obtain HR by ECG or input.
   The CO and CI are calculated automatically.

Bullet

■ Study Items

Tools	Descriptions	Operations
LVLd apical	Left Ventricular Long-axis Length at End-diastole in apical view	Distance in 2D General Measurements
LVLs apical	Left Ventricular Long-axis Length at End-systole in apical view	

Tools	Descriptions	Operations
LVAd sax MV	Left Ventricular Area at Mitral Valve level at End-diastole in Short-axis view	Area in 2D General Measurements
LVAs sax MV	Left Ventricular Area at Mitral Valve level at End-systole in Short-axis view	
HR	Heart Rate	Obtained by ECG or input directly

■ Study Results

Tools	Descriptions	Formulae
EDV(Bullet)	End-diastolic Left Ventricular Volume	EDV(ml)= 5/6×LVLd apical(cm)×LVAd sax MV(cm^2)
ESV(Bullet)	End-systolic Left Ventricular Volume	ESV(ml)= 5/6×LVLs apical(cm)×LVAs sax MV(cm^2)
SV(Bullet)	Stroke Volume	See table in "6.4.3.1 Left Ventricular Function"
CO(Bullet)	Cardiac Output	
EF(Bullet)	Ejection Fraction	
SI(Bullet)	SV Index	
CI(Bullet)	CO Index	

■ Operating Procedures

1. Select [Bullet] in the measurement menu.
2. In apical long-axis view, measure the following parameters:
   At end diastole: LVLd apical
   At end systole: LVLs apical.
3. In short-axis view at mitral valve level, ， measure the following parameters:
   At end diastole: LVAd sax MV, the EDV is calculated
   At end systole: LVAs sax MV, the ESV is calculated
   The system calculates SV and EF; If height and weight have been input already, SI is calculated.
4. Obtain HR by ECG or input.
   The CO and CI are calculated automatically.

Mod.Simpson

■ Study Items

Tools	Descriptions	Operations
LVLd apical	Left Ventricular Long-axis Length at End-diastole in apical view	Distance in 2D General Measurements
LVLs apical	Left Ventricular Long-axis Length at End-systole in apical view	
LVAd sax MV	Left Ventricular Area at Mitral Valve level at End-diastole in Short-axis view	Area in 2D General Measurements

Tools	Descriptions	Operations
LVAs sax MV	Left Ventricular Area at Mitral Valve level at End-systole in Short-axis view	
LVAd sax PM	Left Ventricular Area at Papillary Muscle level at end-diastole in short axis view	
LVAs sax PM	Left Ventricular Area at Papillary Muscle level at end-systole in short axis view	
HR	Heart Rate	Obtained by ECG or input directly

■ Study Results

Tools	Descriptions	Formulae
EDV(Mod.Simpson)	End-diastolic Left Ventricular Volume	*1
ESV(Mod.Simpson)	End-systolic Left Ventricular Volume	*2
SV(Mod.Simpson)	Stroke Volume	See table in "6.4.3.1 Left Ventricular Function"
CO(Mod.Simpson)	Cardiac Output	
EF(Mod.Simpson)	Ejection Fraction	
SI(Mod.Simpson)	SV Index	
CI(Mod.Simpson)	CO Index	

*1 means:

$$EDV[\,mL\,] = \frac{\text{LVLdapical}\,[\,cm\,]}{9} \times \left(\begin{array}{l} 4 \times \text{LVAdsax MV}[\,cm^2\,] + 2 \times \text{LVAd} \\ \text{sax PM}\ [\,cm^2\,] + \sqrt{\text{LVAdsax MV}[\,cm^2\,] \times \text{LVAdsax PM}\,[\,cm^2\,]} \end{array} \right)$$

*2 means:

$$ESV[\,mL\,] = \frac{\text{LVLsapical}\,[\,cm\,]}{9} \times \left(\begin{array}{l} 4 \times \text{LVAssax MV}\,[\,cm^2\,] + 2 \times \text{LVAs} \\ \text{sax PM}\ [\,cm^2\,] + \sqrt{\text{LVAssax MV}[\,cm^2\,] \times \text{LVAssax PM}\,[\,cm^2\,]} \end{array} \right)$$

■ Operating Procedures

1. Select [Mod.Simpson] in the measurement menu.
2. In apical long-axis view, measure the following parameters:
   At end diastole: LVLd apical
   At end systole: LVLs apical
3. In short-axis view at mitral valve level, measure the following parameters:
   At end diastole: LVAd sax MV
   At end systole: LVAs sax MV
4. In short-axis view at papillary muscle level, measure the following parameters:
   At end diastole: LVAd sax PM, the EDV is calculated
   At end systole: LVAs sax PM, the ESV is calculated
   The system calculates SV and EF;
   If height and weight have been input already, SI is calculated.
5. Obtain HR by ECG or input.

The CO and CI are calculated automatically.

Simpson SP

This method includes two studies: Simp SP(A4C) and Simp SP(A2C).

■ Study Items

Tools	Descriptions	Operations
EDV(A2C/A4C)	End-diastolic Left Ventricular Volume (apical 2-chamber/ 4-chamber)	Simpson measurement (Trace/ Spline/ Auto)
ESV(A2C/A4C)	End-systolic Left Ventricular Volume (apical 2-chamber/ 4-chamber)	
HR	Heart Rate	Obtained by ECG or input directly

■ Study Results

Tools	Descriptions	Formulae
EDV(Simp SP)	End-diastolic Left Ventricular Volume	$\mathrm{EDV}(ml)=\pi\times\frac{\mathrm{LVLd\,apical}(cm)}{20}\times\sum_{i=1}^{20}r_i^{\,2}(cm)$ LVLd apical: Left Ventricular Long-axis Length at End-diastole in apical view, i.e. the long-axis length obtained in measurement. r_i : Radiuses obtained from diastolic measurement
ESV(Simp SP)	End-systolic Left Ventricular Volume	$\mathrm{ESV}(ml)=\pi\times\frac{\mathrm{LVLs\,apical}(cm)}{20}\times\sum_{i=1}^{20}r_i^{\,2}(cm)$ LVLs apical: Left Ventricular Long-axis Length at End-systole in apical view, i.e. the long-axis length obtained in measurement. r_i : Radiuses obtained from systolic measurement
SV	Stroke Volume	See table in “6.4.3.1 Left Ventricular Function“
CO	Cardiac Output	
EF	Ejection Fraction	
SI	SV Index	
CI	CO Index	

■ Operating Procedures

1. Select [Simp SP] in the measurement menu.
2. Measure the endocardium.

   Measure the left ventricular endocardium at end-diastolic, and set the long axis, the EDV is obtained;

   Measure the left ventricular endocardium at end-systolic, and set the long axis, the ESV is obtained;

   The system calculates SV and EF;

   If height and weight have been input already, SI is calculated.

3. Obtain HR value by ECG or input.

   The CO and CI are calculated automatically.

■ Measurement Methods

The endocardium can be measured using trace, spline or auto.

- Trace

Trace the endocardium along the edge of the target area using the method similar to the “Trace“ method in 2D Area measurements; and then set the long axis.

- Spline

Set reference points (up to 12) along the edge of the endocardium using the method similar to the “Spline” method in 2D Area measurements; and then set the long axis.

- Auto

(1) Set point A and B using the trackball and <Set> key, where in,

   ➤ A: Left ventricular interventricular septal and mitral valve junction;

   ➤ B: Left ventricular wall and mitral valve junction;

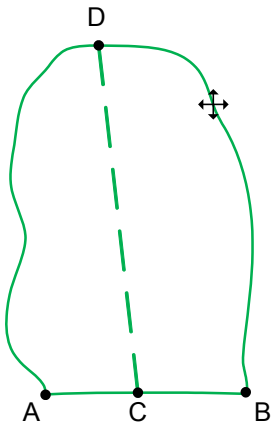
(2) After setting A and B, the cursor positions automatically at point D where is considered as the apical part by system detecting, also the long axis (line segment CD) and the line that traces the endocardium are displayed at the same time. Where in,

   ➤ C: Midpoint of A and B.

   ➤ D: Apical part of left ventricle.

   You can:

- Adjust the long axis
  a) Rotate the trackball to position the cursor on the long axis (which turns yellow), and then press <Set>;
  b) Rotate the trackball, adjust the point D (with point C unchanged) after the cursor changes to ✣.
- Adjust the trace line
  a) Rotate the trackball to position the cursor on the trace line (which turns yellow), and then press <Set>;
  b) Rotate the trackball, move the cursor along the endocardium edge to adjust the line after the cursor changes to ✣(with ABD points unchanged).



(3) Press <Set> outside the line to confirm the adjustment.

Simpson BP

■ Study Items

Tools	Descriptions	Operations
EDV(A2C)	End-diastolic Left Ventricular Volume (apical 2-chamber)	Simpson measurement (Trace/ Spline/ Auto) See “Simpson SP” for endocardium measurement
ESV(A2C)	End-systolic Left Ventricular Volume (apical 2-chamber)	
EDV(A4C)	End-diastolic Left Ventricular Volume (apical 4-chamber)	
ESV(A4C)	End-systolic Left Ventricular Volume (apical 4-chamber)	
HR	Heart Rate	Obtained by ECG or input directly

■ Study Results

Tools	Descriptions	Formulae
EDV(Simpson BP)	End-diastolic Left Ventricular Volume	*1
ESV(Simpson BP)	End-systolic Left Ventricular Volume	*2
SV(Simpson BP)	Stroke Volume	See table in “6.4.3.1 Left Ventricular Function”
CO(Simpson BP)	Cardiac Output	
EF(Simpson BP)	Ejection Fraction	
SI(Simpson BP)	SV Index	
CI(Simpson BP)	CO Index	

*1 means:

$$\mathrm{EDV}(ml)=\pi\times\frac{MAX\{LVLd_{2i}(cm),LVLd_{4i}(cm)\}}{20}\times\sum_{i=1}^{20}(r_{2i}(cm)\times r_{4i}(cm))$$

*2 means:

$$\mathrm{ESV}(ml)=\pi\times\frac{MAX\{LVLs_{2i}(cm),LVLs_{4i}(cm)\}}{20}\times\sum_{i=1}^{20}(r_{2i}(cm)\times r_{4i}(cm))$$

Calculate the LV volume on the apical 2-chamber view image:

$$\mathrm{EDV}\ 2(ml)=\pi\times\frac{LVLd_{2i}(cm)}{20}\times\sum_{i=1}^{20}r_{2i}^{2}(cm)$$

$$\mathrm{ESV}\ 2(ml)=\pi\times\frac{LVLs_{2i}(cm)}{20}\times\sum_{i=1}^{20}r_{2i}^{2}(cm)$$

Calculate the LV volume on the apical 4-chamber view image:

$$\mathrm{EDV}\ 4(ml)=\pi\times\frac{LVLd_{4i}(cm)}{20}\times\sum_{i=1}^{20}r_{4i}^{2}(cm)$$

$$\mathrm{ESV}\ 4(ml)=\pi\times\frac{LVLs_{4i}(cm)}{20}\times\sum_{i=1}^{20}r_{4i}^{2}(cm)$$

Where,

$LVLd_{2i}$ – Left ventricular long-axis length at end diastole at apical two-chamber view, which is the long-axis length obtained by EDV(A2C) measurement

$LVLd_{4i}$ – Left ventricular long-axis length at end diastole at apical four-chamber view, which is the long-axis length obtained by EDV(A4C) measurement

$LVLs_{2i}$ – Left ventricular long-axis length at end systole at apical two-chamber view, which is the long-axis length obtained by ESV(A2C) measurement

$LVLs_{4i}$ – Left ventricular long-axis length at end systole at apical four-chamber view, which is the long-axis length obtained by ESV(A4C) measurement

r_{2i} – Radiuses obtained by EDV(A2C) or ESV(A2C) at apical two-chamber view

r_{4i} – Radiuses obtained by EDV(A4C) or ESV(A4C) at apical four-chamber view

⚠CAUTION: When using Simpson BP to measure LV function, be sure to keep the apical four-chamber view and apical two-chamber view perpendicular. Otherwise the measurement result will be incorrect.

- Operating Procedures

1. Select [Simpson BP] in the measurement menu.
2. In apical two-chamber view, measure the following parameters:
   Left ventricular endocardium at end-diastolic, and set the long axis, the EDV(A2C) is obtained;
   Left ventricular endocardium at end-systolic, and set the long axis, the ESV(A2C) is obtained;
3. In apical four-chamber view, measure the following parameters:
   Left ventricular endocardium at end-diastolic, and set the long axis, the EDV(A4C) is obtained;
   Left ventricular endocardium at end-systolic, and set the long axis, the ESV(A4C) is obtained;
   If height and weight have been input already, SV, EF and SI are calculated.
4. Obtain HR value by ECG or input.
   The CO and CI are calculated automatically.

Cube

- Study Items

Tools	Descriptions	Operations
Diastole	End-diastolic Left Ventricular Measurement	FoldLine in 2D mode Parallel method in M mode
Systole	End-systolic Left Ventricular Measurement	
LVIDd	Left Ventricular Internal Diameter at End-diastole	Distance in 2D/M General Measurements
LVIDs	Left Ventricular Internal Diameter at End-systole	
HR	Heart Rate	Obtained by ECG, input directly or measured manually

■ Study Results

Tools	Descriptions	Formulae
IVSd	Interventricular Septal Thickness at End-diastole	Distance in 2D/M General Measurements
LVIDd	Left Ventricular Internal Diameter at End-diastole	
LVPWd	Left Ventricular Posterior Wall Thickness at End-diastole	
IVSs	Interventricular Septal Thickness at End-systole	
LVIDs	Left Ventricular Internal Diameter at End-systole	
LVPWs	Left Ventricular Posterior Wall Thickness at End-systole	
EDV(Cube)	End-diastolic Left Ventricular Volume	EDV(ml)= LVIDd(cm)^3
ESV(Cube)	End-systolic Left Ventricular Volume	ESV(ml)= LVIDs(cm)^3
SV(Cube)	Stroke Volume	See table in “6.4.3.1 Left Ventricular Function”
CO(Cube)	Cardiac Output	
EF(Cube)	Ejection Fraction	
FS(Cube)	Fractional Shortening	
MVCF(Cube)	Mean Velocity of Circumferential Fiber Shortening	
SI(Cube)	SV Index	
CI(Cube)	CO Index	

■ Operating Procedures

1. Select [Cube] in the measurement menu.
2. Measure Diastole in 2D or M mode.
   The IVSd, LVIDd. LVPWd and EDV are obtained.
3. Measure Systole in 2D or M mode.
   IVSs, LVSs, LVIDs, LVPWs and ESV are obtained.
   The system calculates SV, EF and FS;
4. Measure HR (heart rate) in M mode or obtain HR value by ECG or input.
   If height and weight have been input already, SI, CO and CI are calculated.
   MVCF is calculated if LVET is measured.

Teichholz

■ Study Items

Tools	Descriptions	Operations
Diastole	End-diastolic Left Ventricular Measurement	FoldLine in 2D mode

Tools	Descriptions	Operations
Systole	End-systolic Left Ventricular Measurement	Parallel method in M mode
LVIDd	Left Ventricular Internal Diameter at End-diastole	Distance in 2D/M General Measurements
LVIDs	Left Ventricular Internal Diameter at End-systole	
HR	Heart Rate	Obtained by ECG, input directly or measured manually

■ Study Results

Tools	Descriptions	Formulae
IVSd	Interventricular Septal Thickness at End-diastole	Distance in 2D/M General Measurements
LVIDd	Left Ventricular Internal Diameter at End-diastole	
LVPWd	Left Ventricular Posterior Wall Thickness at End-diastole	
IVSs	Interventricular Septal Thickness at End-systole	
LVIDs	Left Ventricular Internal Diameter at End-systole	
LVPWs	Left Ventricular Posterior Wall Thickness at End-systole	
EDV(Teichholz)	End-diastolic Left Ventricular Volume	$EDV(ml)=(7\times(LVIDd(cm))^3)/(2.4+LVIDd(cm))$
ESV(Teichholz)	End-systolic Left Ventricular Volume	$ESV(ml)=(7\times(LVIDs(cm))^3)/(2.4+LVIDs(cm))$
SV(Teichholz)	Stroke Volume	See table in “6.4.3.1 Left Ventricular Function”
CO(Teichholz)	Cardiac Output	
EF(Teichholz)	Ejection Fraction	
FS(Teichholz)	Fractional Shortening	
MVCF(Teichholz)	Mean Velocity of Circumferential Fiber Shortening	
SI(Teichholz)	SV Index	
CI(Teichholz)	CO Index	

■ Operating Procedures

See table above for methods and formulae of the measurement items.

See section "Cube" for measurement procedures.

Gibson

■ Study Items

Tools	Descriptions	Operations
Diastole	End-diastolic Left Ventricular Measurement	FoldLine in 2D mode Parallel method in M mode
Systole	End-systolic Left Ventricular Measurement	
LVIDd	Left Ventricular Internal Diameter at End-diastole	Distance in 2D/M General Measurements
LVIDs	Left Ventricular Internal Diameter at End-systole	
HR	Heart Rate	Obtained by ECG, input directly or measured manually

■ Study Results

Tools	Descriptions	Formulae
IVSd	Interventricular Septal Thickness at End-diastole	Distance in 2D/M General Measurements
LVIDd	Left Ventricular Internal Diameter at End-diastole	
LVPWd	Left Ventricular Posterior Wall Thickness at End-diastole	
IVSs	Interventricular Septal Thickness at End-systole	
LVIDs	Left Ventricular Internal Diameter at End-systole	
LVPWs	Left Ventricular Posterior Wall Thickness at End-systole	
EDV(Gibson)	End-diastolic Left Ventricular Volume	$\mathrm{EDV}(ml)=\pi/6\times(0.98\times LVIDd(cm)+5.90)\times LVIDd(cm)^2$
ESV(Gibson)	End-systolic Left Ventricular Volume	$\mathrm{ESV}(ml)=\pi/6\times(1.14\times LVIDs(cm)+4.18)\times LVIDs(cm)^2$
SV(Gibson)	Stroke Volume	See table in “6.4.3.1 Left Ventricular Function”
CO(Gibson)	Cardiac Output	
EF(Gibson)	Ejection Fraction	
SI(Gibson)	SV Index	
CI(Gibson)	CO Index	
MVCF(Gibson)	Mean Velocity of Circumferential Fiber Shortening	
FS(Gibson)	Fractional Shortening	

■ Operating Procedures

See table above for methods and formulae of the measurement items.

See section "Cube " for measurement procedures.

6.4.3.2 Left Ventricular Mass (LV Mass)

Estimates the Index of Left Ventricular Mass (LV Mass-I) by calculating the LV Mass.

LV MASS-I (No unit) = LV Mass (g) / Body Surface Area (m^2)

LV Mass (Cube)

■ Study Items

Tools	Descriptions	Operations
IVSd	Interventricular Septal Thickness at End-diastole	Distance in 2D/M General Measurements
LVIDd	Left Ventricular Internal Diameter at End-diastole	
LVPWd	Left Ventricular Posterior Wall Thickness at End-diastole	

■ Study Results

Tools	Descriptions	Formulae
LV Mass (Cube)	Left Ventricular Mass	LV Mass (g) = 1.04 × ((LVPWd(cm) + IVSd(cm) + LVIDd(cm))^3 - LVIDd(cm)^3) - 13.6
LV MASS-I (Cube)	Index of Left Ventricular Mass	See LV Mass-I formula in “Left Ventricular Mass (LV Mass)”

■ Operating Procedures

1. Select [LV Mass (Cube)] in the measurement menu.
2. At end diastole, measure the following parameters:

   IVSd

   LVIDd

   LVPWd

   The LV Mass (Cube) is calculated.

   If height and weight have been input already, LV Mass-I(Cube) is calculated.

LV Mass (A-L)

■ Study Items

Tools	Descriptions	Operations
LVAd sax Epi	Left Ventricular Epicardial Area at Papillary Muscle level at end-diastole in Short-axis view	Area in 2D General Measurements
LVAd sax Endo	Left Ventricular Endocardial Area at Papillary Muscle level at end-diastole in Short-axis view	
LVLd apical	Left Ventricular Long-axis Length at End-diastole in apical view	Distance in 2D General Measurements

■ Study Results

Tools	Descriptions	Formulae
LV Mass (A-L)	Left Ventricular Mass	*1

Tools	Descriptions	Formulae
LV MASS-I (A-L)	Index of Left Ventricular Mass	See LV Mass-I formula in “Left Ventricular Mass (LV Mass)”

*1 means:

$$\text{LV Mass(g)} = 1.05 \times 5/6 \times (\text{LVAd sax Epi}(\text{cm}^2) \times (\text{LVLd apical(cm)} + \text{t(cm)}) - \text{LVAd sax Endo}(\text{cm}^2) \times \text{LVL(cm)})$$

Where,

$$\text{t(cm)} = \sqrt{(\text{LVAdsax Epi}(\text{cm}^2)/\pi)} - \sqrt{(\text{LVAdSax Endo}(\text{cm}^2)/\pi)}$$

■ Operating Procedures

1. Select [LV Mass (A-L)] in the measurement menu.
2. In long-axis view at end diastole, measure LVLd apical；
3. In short-axis view at papillary muscle level at end diastole, measure the following parameters:
   Endocardium area: LVAd sax Endo;
   Epicardium area: LVAd sax Epi

   The LV Mass (A-L) is calculated.

   If height and weight have been input already, LV Mass-I(A-L) is calculated.

LV Mass (T-E)

■ Study Items

Tools	Descriptions	Operations
LVAd sax Epi	Left Ventricular Epicardial Area at Papillary Muscle level at end-diastole in Short-axis view	Area in 2D General Measurements
LVAd sax Endo	Left Ventricular Endocardial Area at Papillary Muscle level at end-diastole in Short-axis view	
a	Semi-major axis from widest minor axis radius to apex	Distance in 2D General Measurements
d	Truncated semi-major axis from widest minor axis radius to mitral annulus plane	

■ Study Results

Except for values in upper table, the following results can be obtained in this study:

Tools	Descriptions	Formulae
LV Mass (T-E)	Left Ventricular Mass	*1
LV MASS-I (T-E)	Index of Left Ventricular Mass	See LV Mass-I formula in “Left Ventricular Mass (LV Mass)”

*1 means:

$$\text{LV Mass(g)} = 1.05\pi \times \{(b+t)^2 \times [\frac{2(a+t)}{3} + d - \frac{d^3}{3(a+t)^2}] - b^2 \times (\frac{2a}{3} + d - \frac{d^3}{3a^2})\}$$

Where, units of a, b, d, t are cm.

a: Semi-major axis from widest minor axis radius to apex

d: Truncated semi-major axis from widest minor axis radius to mitral annulus plane

t: Thickness of the myocardium

$$t\,(cm) = \sqrt{(LVAd\,sax\ Epi(cm^2)/\pi)} - \sqrt{(LVAd\,Sax\ Endo(cm^2)/\pi)}$$

b: Short axis radius, usually measured where the radius is largest.

$$b(cm) = \sqrt{(LVAd\,Sax\ Endo(cm^2)/\pi)}$$

- Operating Procedures

1. Select [LV Mass(T-E)] in the measurement menu.
2. In short-axis view at papillary muscle level at end diastole, measure the following parameters:
   Endocardium area: LVAd sax Endo;
   Epicardium area LVAd sax Epi
3. Measure a and d.
   The LV Mass(T-E) is calculated.
   If height and weight have been input already, LV Mass-I(T-E) is calculated.

6.4.3.3 Mitral Valve Area (MVA)

Mitral Valve Area (MVA) can be calculated by two methods: pressure half time (PHT) or velocity-time integral (VTI).

Tips:	See MVA(PHT) in "6.3.3 Doppler Cardiac Measurement" for calculation formula of the MVA calculated by PHT method.

MVA(VTI)

- Study Items

Tools	Descriptions	Operations
LVOT Diam	Left Ventricular Outflow Tract Diameter	Distance in 2D General Measurements
LVOT VTI	Left Ventricular Outflow Tract Velocity-Time Integral	D trace in General D measurements
MV VTI	Mitral Valve Velocity-Time Integral	

- Study Results

Except for values in upper table, the following results can be obtained in this study:

Tools	Descriptions	Formulae
MVA(VTI)	Mitral Valve Area	$MVA(VTI)(cm^2) = \frac{\pi \times \lvert LVOT\ VTI(cm)\rvert \times LVOT\ Diam(cm^2)^2}{4 \times \lvert MV\ VTI(cm)\rvert}$

- Operating Procedures

See table above for methods and formulae of the measurement items.

6.4.3.4 AVA(VTI)

Aortic Valve Area (AVA) can be calculated by velocity-time integral (VTI). Measurements should be performed on 2D and Doppler image.

■ Study Items

Tools	Descriptions	Operations
LVOT Diam	Left Ventricular Outflow Tract Diameter	Distance in 2D General Measurements
LVOT VTI	Left Ventricular Outflow Tract Velocity-Time Integral	D trace in General D measurements
AV VTI	Aortic Valve Velocity-Time Integral	

■ Study Results

Except for values in upper table, the following results can be obtained in this study:

Tools	Descriptions	Formulae
AVA(VTI)	Aortic Valve Area	$\mathrm{AVA(VTI)(cm^2)} = \frac{\pi \times \left\lvert \mathrm{LVOT\ VTI(cm)} \right\rvert \times \mathrm{LVOT\ Diam(cm^2)^2}}{4 \times \left\lvert \mathrm{AV\ VTI(cm)} \right\rvert}$

■ Operating Procedures

See table above for methods and formulae of the measurement items.

6.4.3.5 LA Vol

LA Vol (Left Atrium Volume) used to estimate the size of left atrium.

LA Vol(A-L)

Estimates Left Atrium Volume using area and length.

■ Study Items

Tools	Descriptions	Operations
LA Diam	Left Atrium Diameter	Distance in 2D General Measurements
LAA(A2C)	Left Atrium Area at apical 2-chamber view	Area in 2D General Measurements
LAA(A4C)	Left Atrium Area at apical 4-chamber view	

■ Study Results

Except for values in upper table, the following results can be obtained in this study:

Tools	Descriptions	Formulae
LA Vol(A-L)	Left Atrium Area	$\mathrm{LA\ Vol(A-L)(ml)} = \frac{8\pi}{3} \mathrm{LAA(A4C)(cm^2)} \times \mathrm{LAA(A2C)(cm^2)} \Big/ \mathrm{LA\ Diam(cm)}$

■ Operating Procedures

See table above for methods and formulae of the measurement items.

LA Vol (Simp)

Estimates the left atrium volume using Simpson method. Performed at apical two-chamber view and apical four-chamber view.

- Study Items and Results

Tools	Descriptions	Operations
LA Vol(A2C)	Left Atrium Volume at apical 2-chamber view	Same as Simpson SP measurement
LA Vol(A4C)	Left Atrium Volume at apical 4-chamber view	

- Operating Procedures

See “Simpson SP” for measurement procedures.

6.4.3.6 RA Vol (Simp)

Estimates right atrium volume using Simpson methods, performed at apical four-chamber view.

- Study Items and Results

Tools	Descriptions	Operations
RA Vol(A4C)	Right Atrium Volume at apical 4-chamber view	Same as Simpson SP measurement

- Operating Procedures

See “Simpson SP” for measurement procedures.

6.4.3.7 LVIMP

LVIMP (Left Ventricular Index of Myocardial Performance) is used to analyze the integrative ventricular diastolic and systolic capabilities.

- Study Items

Tools	Descriptions	Operations
MV C-O dur	Mitral Valve close-open Duration	Time in M/Doppler General Measurements
LVET	Left Ventricular Ejection Time	

- Study Results

Except for values in upper table, the following results can be obtained in this study:

Tools	Descriptions	Formulae
LVIMP	Left Ventricular Index of Myocardial Performance	$\text{LVIMP(No unit)} = \frac{\text{MV C - O dur(s) - LVET(s)}}{\text{LVET(s)}}$

- Operating Procedures

See table above for methods and formulae of the measurement items.

6.4.3.8 RVSP

RVSP measures the right ventricular systolic pressure.

■ Study Items

Tools	Descriptions	Operations
TR Vmax	Tricuspid Valve Regurgitation Maximum Velocity	D Vel in Doppler General Measurements
RAP	Right Atrium Pressure	See below

■ Study Results

Except for values in upper table, the following results can be obtained in this study:

Tools	Descriptions	Formulae
TR PGmax	Tricuspid Valve Regurgitation Pressure Gradient	TR PGmax (mmHg) = 4 × TR Vmax (m/s)^2
RVSP	Right Ventricular Systolic Pressure	$\mathrm{RVSP(mmHg)} = RAP(mmHg) + 4 \times (TR\,V\,\max(m/s))^2$

■ Operating Procedures

1. Select [RVSP] in the measurement menu.
2. Measure TR Vmax in Doppler mode.

   The TR PGmax is calculated.
3. Select [RAP] in the [RVSP] sub-menu, and select (or enter) the pressure in the dialog box popped up. As shown in figure below:

   Range of input values is [0, 50.0mmHg].
4. Click [OK] after selecting (or inputting) the pressure, the RAP is obtained.

   RVSP is calculated.

6.4.3.9 PAEDP

PAEDP measures the pulmonary artery end diastolic pressure.

■ Study Items

Tools	Descriptions	Operations
PR Ved	Pulmonary Valve Regurgitation Velocity at end-Diastole	D Vel in Doppler General Measurements
RAP	Right Atrium Pressure	See RAP measurement in “RVSP”

■ Study Results

Except for values in upper table, the following results can be obtained in this study:

Tools	Descriptions	Formulae
PR PGed	Pulmonary Valve Regurgitation Pressure Gradient at end-Diastole	/
PAEDP	Pulmonary Pressure at end-Diastole	$\mathrm{PAEDP(mmHg)} = RAP(\ mmHg\ ) + 4 \times (\ PR\ Ved\ (\ m / s\ ))^2$

■ Operating Procedures

See table above for methods and formulae of the measurement items.

6.4.3.10 RVIMP

Measurement of RVIMP (Right Ventricular Index of Myocardial Performance) is similar to that of LVIMP.

■ Study Items

Tools	Descriptions	Operations
TV C-O dur	Tricuspid Valve close-open Duration	Time in Doppler General Measurements
RVET	Right Ventricular Ejection Time	

■ Study Results

Except for values in upper table, the following results can be obtained in this study:

Tools	Descriptions	Formulae
RVIMP	Right Ventricular Index of Myocardial Performance	$\mathrm{RVIMP(Nounit)} = \dfrac{\mathrm{TV\ C-O\ dur(s)} - \mathrm{RVET(s)}}{\mathrm{RVET(s)}}$

■ Operating Procedures

See table above for methods and formulae of the measurement items.

6.4.3.11 Qp/Qs

Flow ration of pulmonary circulation and systemic circulation.

■ Study Items

Tools	Descriptions	Operations
RVOT Diam	Right Ventricular Outflow Tract Diameter	Distance in 2D General Measurements
LVOT Diam	Left Ventricular Outflow Tract Diameter	
RVOT VTI	Right Ventricular Outflow Tract Velocity-Time Integral	D Trace in Doppler General Measurements
LVOT VTI	Left Ventricular Outflow Tract Velocity-Time Integral	

■ Study Results

Except for values in upper table, the following results can be obtained in this study:

Tools	Descriptions	Operations
RVOT SI	Right Ventricular Outflow Tract SV Index	Obtained from RVOT VTI measurement

Tools	Descriptions	Operations
RVOT CI	Right Ventricular Outflow Tract CO Index	
RVOT SV	Right Ventricular Outflow Tract Stroke Volume	
RVOT CO	Right Ventricular Outflow Tract Cardiac Output	
LVOT SV	Left Ventricular Outflow Tract Stroke Volume	Obtained from LVOT VTI measurement
LVOT SI	Left Ventricular Outflow Tract SV Index	
LVOT CI	Left Ventricular Outflow Tract CO Index	
LVOT CO	Left Ventricular Outflow Tract Cardiac Output	
Qp/Qs	Flow ration of Pulmonary circulation and Systemic circulation	See below
Qp-Qs	Flow difference of Pulmonary circulation and Systemic circulation	

Where,

$$Qp(ml) = \text{RVOT SV(ml)} = \pi(\text{RVOT Diam(cm)}/2)^2 \times \text{RVOT VTI(cm)}$$

$$Qs(ml) = \text{LVOT SV(ml)} = \pi(\text{LVOT Diam(cm)}/2)^2 \times \text{LVOT VTI(cm)}$$

$$Qp/Qs(Nounit) = \frac{\text{RVOT SV}(ml)}{\text{LVOT SV}(ml)}$$

$$Qp - Qs(Nounit) = \text{RVOT SV}(ml) - \text{LVOT SV}(ml)$$

■ Operating Procedures

See table above for methods and formulae of the measurement items.

6.4.3.12 PISA

PISA (Proximal Isovelocity Surface Area) is used in quantitative analysis of the mitral valve regurgitation (PISA MR), aortic valve regurgitation (PISA AR), tricuspid valve regurgitation (PISA TR), and pulmonary valve regurgitation (PISA PR) in color mode.

The PISA measurement procedures are as follows:

1. Start PISA, move the semicircular caliper by rotating the trackball.
2. Fix the center of the semicircular by pressing <Set>.
3. Adjust the radius length orientation of the semicircular by rotating the trackball.
4. Press <Set> to fix the caliper.

PISA MR

Mitral valve regurgitation (PISA MR) needs to be measured in Color and Doppler mode.

■ Study Items

Tools	Descriptions	Operations
MR Rad	Mitral Valve Stenosis Radius	PISA measurement
MR VTI	Mitral Valve Regurgitation Velocity-Time Integral	D Trace in Doppler General Measurements
MR Als.Vel	Mitral Valve Regurgitation Aliasing Maximum Velocity	You can select to use top aliasing velocity or bottom aliasing velocity or input the value directly.

■ Study Results

Tools	Descriptions	Formulae
MR Vmax	Mitral Regurgitation Maximum Velocity	Obtained from MR VTI measurement
MR Flow	Mitral Regurgitation Flow	$\text{MR Flow(ml)} = \frac{2\pi \text{MR Rad(cm)}^2 \times \text{MR Als.Vel(cm/s)}}{\lvert \text{MR Vmax(cm/s)} \rvert} \times \lvert \text{MR VTI(cm)} \rvert$
MR Flow Rate	Mitral Regurgitation Flow Rate	$\text{MR Flow Rate(ml/s)} = 2\pi \text{MR Rad(cm)}^2 \times \text{MR Als.Vel(cm/s)}$
MR Fraction	Mitral Valve Regurgitation Fraction	$\text{MR Fraction (No unit)} = \frac{\text{MR Flow(ml)}}{\text{MV SV(ml)}} \times 100\ \%$
MR EROA	Mitral Valve Effective Regurgitant Orifice Area	$\text{MR EROA(cm)}^2 = \frac{2\pi \text{MR Rad(cm)}^2 \times \text{MR Als.Vel(cm/s)}}{\lvert \text{MR Vmax(cm/s)} \rvert}$

■ Operating Procedures

1. Enter color mode, adjust the color map until the aliasing appears.
2. Select [PISA MR] in the measurement menu.
3. Measure MR Rad using PISA caliper.
   Input MR Als.Vel.
4. Measure the MR spectrum by D trace to obtain:
   MR Vmax
   MR VTI
   MR Flow, MR Flow Rate and MR EROA are calculated automatically.
   If MV SV is measured, MR Fraction will be calculated automatically.

PISA AR

Aortic valve regurgitation (PISA AR) needs to be measured in Color and Doppler mode.

■ Study Items

Tools	Descriptions	Operations
AR Rad	Aortic Valve Stenosis Radius	PISA measurement
AR VTI	Aortic Valve Regurgitation Velocity-Time Integral	D Trace in Doppler General Measurements
AR Als.Vel	Aortic Valve Regurgitation Aliasing Maximum Velocity	You can select to use top aliasing velocity or bottom aliasing velocity or input the value directly.

■ Study Results

Tools	Descriptions	Formulae
AR Vmax	Aortic Regurgitation Maximum Velocity	Obtained from AR VTI measurement
AR Flow	Aortic Regurgitation Flow	$\text{AR Flow(ml)} = \frac{2\pi\text{AR Rad(cm)}^2 \times \text{AR Als.Vel(cm/s)}}{\lvert\text{ARV max(cm/s)}\rvert} \times \lvert\text{AR VTI(cm)}\rvert$
AR Flow Rate	Aortic Regurgitation Flow Rate	$\text{AR Flow Rate(ml/s)} = 2\pi\text{AR Rad(cm)}^2 \times \text{AR Als.Vel(cm/s)}$
AR Fraction	Aortic Valve Regurgitation Fraction	$\text{AR Fraction (No unit)} = \frac{\text{AR Flow(ml)}}{\text{AV SV(ml)}} \times 100\ \%$
AR EROA	Aortic Valve Effective Regurgitant Orifice Area	$\text{AR EROA(cm)}^2 = \frac{2\pi\text{AR Rad(cm)}^2 \times \text{AR Als.Vel(cm/s)}}{\lvert\text{ARV max(cm/s)}\rvert}$

■ Operating Procedures

Same with the PISA MR measurement.

PISA TR

Tricuspid valve regurgitation (PISA TR) needs to be measured in Color and Doppler mode.

■ Study Items

Tools	Descriptions	Operations
TR Rad	Tricuspid Valve Stenosis Radius	PISA measurement
TR VTI	Tricuspid Valve Regurgitation Velocity-Time Integral	D Trace in Doppler General Measurements
TR Als.Vel	Tricuspid Valve Regurgitation Aliasing Maximum Velocity	You can select to use top aliasing velocity or bottom aliasing velocity or input the value directly.

■ Study Results

Tools	Descriptions	Formulae
TR Vmax	Tricuspid Regurgitation Maximum Velocity	Obtained from TR VTI measurement
TR Flow	Tricuspid Regurgitation Flow	$\text{TR Flow(ml)} = \frac{2\pi\text{TR Rad(cm)}^2 \times \text{TR Als.Vel(cm/s)}}{\lvert\text{TRV max(cm/s)}\rvert} \times \lvert\text{TR VTI(cm)}\rvert$
TR Flow Rate	Tricuspid Regurgitation Flow Rate	$\text{TR Flow Rate(ml/s)} = 2\pi\text{TR Rad(cm)}^2 \times \text{TR Als.Vel(cm/s)}$

Tools	Descriptions	Formulae
TR Fraction	Tricuspid Valve Regurgitation Fraction	$\text{TR Fraction (No unit)} = \frac{\text{TR Flow(ml)}}{\text{TV SV(ml)}} \times 100\ \%$
TR EROA	Tricuspid Valve Effective Regurgitant Orifice Area	$\text{TR EROA(cm)}^2 = \frac{2\pi \text{TR Rad(cm)}^2 \times \text{TR Als.Vel(cm/s)}}{\lvert\text{TRVmax(cm/s)}\rvert}$

■ Operating Procedures

Same with the PISA MR measurement.

PISA PR

Pulmonary valve regurgitation (PISA PR) needs to be measured in Color and Doppler mode.

■ Study Items

Tools	Descriptions	Operations
PR Rad	Pulmonary Valve Stenosis Radius	PISA measurement
PR VTI	Pulmonary Valve Regurgitation Velocity-Time Integral	D Trace in Doppler General Measurements
PR Als.Vel	Pulmonary Valve Regurgitation Aliasing Maximum Velocity	You can select to use top aliasing velocity or bottom aliasing velocity or input the value directly.

■ Study Results

Tools	Descriptions	Formulae
PR Vmax	Pulmonary Regurgitation Maximum Velocity	Obtained from PR VTI measurement
PR Flow	Pulmonary Regurgitation Flow	$\text{PR Flow(ml)} = \frac{2\pi \text{PR Rad(cm)}^2 \times \text{PR Als.Vel(cm/s)}}{\lvert\text{PRV max(cm/s)}\rvert} \times \lvert\text{PR VTI(cm)}\rvert$
PR Flow Rate	Pulmonary Regurgitation Flow Rate	$\text{PR Flow Rate(ml/s)} = 2\pi \text{PR Rad(cm)}^2 \times \text{PR Als.Vel(cm/s)}$
PR Fraction	Pulmonary Valve Regurgitation Fraction	$\text{PR Fraction (No unit)} = \frac{\text{PR Flow(ml)}}{\text{PV SV(ml)}} \times 100\ \%$
PR EROA	Pulmonary Valve Effective Regurgitant Orifice Area	$\text{PR EROA(cm)}^2 = \frac{2\pi \text{PR Rad(cm)}^2 \times \text{PR Als.Vel(cm/s)}}{\lvert\text{PR Vmax(cm/s)}\rvert}$

■ Operating Procedures

Same with the PISA MR measurement.

6.4.3.13 CO(LVOT)

Left Ventricular Outflow Tract Cardiac Output.

■ Study Items

Tools	Descriptions	Operations
LVOT Diam	Left Ventricular Outflow Tract Diameter	Distance in 2D General Measurements
LVOT HR	Left Ventricular Outflow Tract Heart Rate	Obtained by ECG, input directly or measured manually
LVOT VTI	Left Ventricular Outflow Tract Velocity-Time Integral	D Trace in Doppler General Measurements

■ Study Results

Except for values in upper table, the following results can be obtained in this study:

Tools	Descriptions	Operations
LVOT CO	Left Ventricular Outflow Tract Cardiac Output	Obtained from LVOT HR measurement
LVOT CI	Left Ventricular Outflow Tract CO Index	
LVOT SV	Left Ventricular Outflow Tract Stroke Volume	Obtained from LVOT VTI measurement
LVOT SI	Left Ventricular Outflow Tract SV Index	
LVOT CI	Left Ventricular Outflow Tract CO Index	
LVOT CO	Left Ventricular Outflow Tract Cardiac Output	
Qp/Qs	Flow ration of Pulmonary circulation and Systemic circulation	See below
Qp-Qs	Flow difference of Pulmonary circulation and Systemic circulation	

Where,

$$Qp(ml)=\mathrm{RVOT\ \ SV(ml)}=\pi(\mathrm{RVOT\ \ Diam(cm)}/2)^2\times\mathrm{RVOT\ \ VTI(cm)}$$

$$Qs(ml)=\mathrm{LVOT\ \ SV(ml)}=\pi(\mathrm{LVOT\ \ Diam(cm)}/2)^2\times\mathrm{LVOT\ \ VTI(cm)}$$

$$Qp/Qs(Nounit)=\frac{\mathrm{RVOT\ \ SV}(ml)}{\mathrm{LVOT\ \ SV}(ml)}$$

$$Qp-Qs(Nounit)=\mathrm{RVOT\ \ SV}(ml)-\mathrm{LVOT\ \ SV}(ml)$$

■ Operating Procedures

See table above for methods and formulae of the measurement items.

6.4.3.14 CO(RVOT)

Right Ventricular Outflow Tract Cardiac Output.

■ Study Items

Tools	Descriptions	Operations
RVOT Diam	Right Ventricular Outflow Tract Diameter	Distance in 2D General Measurements
RVOT HR	Right Ventricular Outflow Tract Heart Rate	Obtained by ECG, input directly or measured manually
RVOT VTI	Right Ventricular Outflow Tract Velocity-Time Integral	D Trace in Doppler General Measurements

■ Study Results

Except for values in upper table, the following results can be obtained in this study:

Tools	Descriptions	Operations
RVOT CO	Right Ventricular Outflow Tract Cardiac Output	Obtained from RVOT HR measurement
RVOT CI	Right Ventricular Outflow Tract CO Index	
RVOT SV	Right Ventricular Outflow Tract Stroke Volume	Obtained from RVOT VTI measurement
RVOT SI	Right Ventricular Outflow Tract SV Index	
RVOT CI	Right Ventricular Outflow Tract CO Index	
RVOT CO	Right Ventricular Outflow Tract Cardiac Output	
Qp/Qs	Flow ration of Pulmonary circulation and Systemic circulation	See below
Qp-Qs	Flow difference of Pulmonary circulation and Systemic circulation	

Where,

$$Qp(ml) = \text{RVOT SV(ml)} = \pi(\text{RVOT Diam(cm)}/2)^2 \times \text{RVOT VTI(cm)}$$

$$Qs(ml) = \text{LVOT SV(ml)} = \pi(\text{LVOT Diam(cm)}/2)^2 \times \text{LVOT VTI(cm)}$$

$$Qp/Qs(Nounit) = \frac{\text{RVOT SV}(ml)}{\text{LVOT SV}(ml)}$$

$$Qp - Qs(Nounit) = \text{RVOT SV}(ml) - \text{LVOT SV}(ml)$$

■ Operating Procedures

See table above for methods and formulae of the measurement items.

6.4.3.15 TDI

If reflects the motive capabilities of the cardiac muscle.

■ Study Items

Tools	Descriptions	Operations
Sa(medial)	Mitral Valve medial Systolic motion	D Vel in Doppler General Measurements
Ea(medial)	Mitral Valve medial Early diastolic motion	
Aa(medial)	Mitral Valve medial Late diastolic motion	
ARa(medial)	Mitral Valve medial Acceleration Rate	Acceleration in Doppler General Measurements
DRa(medial)	Mitral Valve medial Deceleration Rate	
Sa(lateral)	Mitral Valve lateral Systolic motion	D Vel in Doppler General Measurements
Ea(lateral)	Mitral Valve lateral Early diastolic motion	
Aa(lateral)	Mitral Valve lateral Late diastolic motion	
ARa(lateral)	Mitral Valve lateral Acceleration Rate	Acceleration in Doppler General Measurements
DRa(lateral)	Mitral Valve lateral Deceleration Rate	

■ Study Results

Tools	Descriptions	Formulae
Ea/Aa(medial)	MV medial E-Vel/ A-Vel	$\mathrm{Ea/Aa(medial)(Nounit)} = \frac{\mathrm{Ea(medial)}}{\mathrm{Aa(medial)}}$
ATa(medial)	MV medial E-wave Acceleration Time	Obtained from ARa(medial) measurement
DTa(medial)	MV medial E-wave Deceleration Time	Obtained from DRa(medial) measurement
Ea/Aa(lateral)	MV lateral E-Vel/ A-Vel	$\mathrm{Ea/Aa(lateral)(Nounit)} = \frac{\mathrm{Ea(lateral)}}{\mathrm{Aa(lateral)}}$
ATa(lateral)	MV lateral E-wave Acceleration Time	Obtained from ARa(lateral) measurement
DTa(lateral)	MV lateral E-wave Deceleration Time	Obtained from DRa(lateral) measurement

■ Operating Procedures

See table above for methods and formulae of the measurement items.

NOTE: The MV E/Ea will be calculated automatically after MV E Vel is measured as well as Ea(medial) value, and the MV E/Ea result should be selected in item property presetting. For how to preset item property, see “2.4.1 General Measurement Preset”.

6.5 Cardiac Exam Report

During or after a measurement, press <Report> on the Control Panel to browse the report.

For details about report browsing, printing and exporting etc, see "1.7 Report".

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ESV(B-P Ellipse):

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7 Vascular

7.1 Vascular Exam Preparations

Make the following preparations before measurement:

1. Confirm that the current probe is appropriate.
2. Check if the current date of the system is correct.
3. Press <Patient>, input patient information in [Patient Info] -> [VAS] page.

   For more details, refer to "Exam Preparation -> Patient Information" in the Operator's Manual [Basic Volume].
4. Switch to the correct exam mode.

7.2 Basic Vascular Measurement Procedures

1. Press <Patient>, input patient information in [Patient Info] -> [VAS] page.
2. Press <Measure> to enter the Application Measurement.

   If the current menu is not the one having Vascular Measurement tools, move the cursor to the menu title and select the package having Vascular Measurement tools.
3. Select measurement tool in the menu to start the measurement.

   See table in "7.3 Vascular Measurement Tools" below for measurement tools.

   See section "7.4 Vascular Measurement Operations" and steps in "3 General Measurement" for measurement methods.
4. Press <Report> to view the exam report, see "7.5 Vascular Exam Report" for details.

7.3 Vascular Measurement Tools

Vascular measurements are mainly used for carotid, cerebral, upper and lower extremities vessels.

The system supports the following 2D and Doppler vascular measurements.

NOTE: Measurement tools mentioned below are configured in the system. The application measurement packages provided in this system are generally different combinations of measurement tools. For more information about package preset, see "2.4.2.2 Application Measurement Preset".

2D Vascular Measurements

Types	Tools	Descriptions	Methods or formulae
Measurement	Normal(D)	Vessel Diameter	Distance in 2D General Measurements
	Resid(D)	Residual Diameter	
	Normal(A)	Vessel Area	Area in 2D General Measurements
	Resid(A)	Residual Area	

Types	Tools	Descriptions	Methods or formulae
	CCA IMT	Common Carotid Artery IMT	ROI measurement in IMT
	Bulb IMT	Bulbillate IMT	
	ICA IMT	Internal Carotid Artery IMT	
	ECA IMT	External Carotid Artery IMT	
Calculation	Stenosis D	Stenosis Diameter	Stenosis D (No unit) = (Normal Diam(cm) – Resid Diam (cm)) / Normal Diam (cm) × 100%
	Stenosis A	Stenosis Area	Stenosis A (No unit) = (Normal Area(cm^2) – Resid Area (cm^2)) / Normal Area (cm^2) × 100%
Study	Stenosis	/	
	IMT	Intima-Media Thickness	

Doppler Vascular Measurements

Types	Tools	Descriptions	Methods or formulae
Measurement	CCA	Common Carotid Artery	D trace in General D measurements
	Bulb	Bulbillate	
	ICA	Internal Carotid Artery	
	ECA	External Carotid Artery	
	Vert A	Vertebral Artery	
	Innom A	Innominate Artery	
	Subclav A	Subclavian Artery	
	Axill A	Axillary Artery	D trace in General D measurements
	Brachial A	Brachial Artery	
	Ulnar A	Ulnar Artery	
	Radial A	Radial Artery	
	Subclav V	Subclavian Vein	
	Axill V	Axillary Vein	
	Cephalic V	Cephalic Vein	D trace in General D measurements
	Basilic V	Basilic Vein	
	Ulnar V	Ulnar Vein	
	Radial V	Radial Vein	
	C.Iliac A	Common Iliac Artery	
	Ex.Iliac A	External Iliac Artery	
	CFA	Common Femoral Artery	

Types	Tools	Descriptions	Methods or formulae
	SFA	Superficial Femoral Artery	
	Pop A	Popliteal Artery	
	TP Trunk A	Tibial Peroneal Trunk Artery	
	Peroneal A	Peroneal Artery	
	P.Tib A	Posterior Tibial Artery	
	A.Tib A	Anterior Tibial Artery	
	Dors.Ped A	Dorsalis Pedis Artery	
	C.Iliac V	Common Iliac Vein	
	Ex.Iliac V	External Iliac Vein	
	Femoral V	Femoral Vein	
	Saph V	Great Saphenous Vein	
	Pop V	Popliteal Vein	
	TP Trunk V	Tibial Peroneal Trunk Vein	D trace in General D measurements
	Sural V	Sural Vein	
	Soleal V	Soleal Vein	
	Peroneal V	Peroneal Vein	
	P.Tib V	Posterior Tibial Vein	
	A.Tib V	Anterior Tibial Vein	
	ACA	Anterior Cerebral Artery	
	MCA	Middle Cerebral Artery	
	PCA	Posterior Cerebral Artery	
	AComA	Ant.communicating br.	
	PComA	Post.communicating br.	
	BA	Basilar Artery	
	IIA	Internal Iliac Artery	D trace in General D measurements
	PFA	Deep Femoral Artery	
	Ba V	Basilar Vein	
	Brachial V	Brachial Vein	
	IIV	Internal Iliac Vein	
	CFV	Common Femoral Vein	
	SFV	Superficial Femoral Vein	
	PFV	Deep Femoral Vein	
	SSV	Small Saphenous Vein	

Types	Tools	Descriptions	Methods or formulae
	ASP	Ankle Systolic Pressure	Type in
	BSP	Brachial Systolic Pressure	
Calculation	ICA/CCA	/	See below
Study	ABI	Ankle Brachial Index	

7.4 Vascular Measurement Operations

Tips:

1. See the table in "7.3 Vascular Measurement Tools" above for measurement tools and methods.
2. For the definitions of measurement, calculation and study, refer to "1.3 Measurement, Calculation and Study".
3. The order of the measurement items is presettable, see "2.4.2 Application Measurement Preset" for details.
4. Measurements of some tools described in this Chapter are to be performed in several imaging modes, please select appropriate imaging modes in measurement.

7.4.1 Measurement Tool Operations

1. Select the item/tool in the measurement menu.
2. Perform the measurement referring to methods in table above.

7.4.2 Calculation Tool Operations

Stenosis D

Function: Measures Normal Diam and Resid Diam, calculates Stenosis D.

1. Select [Stenosis D] in the measurement menu.
2. Use the method of Distance measurement of 2D General Measurements to measure Normal(D) and Resid(D).

   Stenosis D is calculated automatically.

Stenosis A

Function: Measures Normal Area and Resid Area, calculates Stenosis A.

1. Select [Stenosis A] in the measurement menu.
2. Use the method of Area measurement of 2D General Measurements to measure Normal(A) and Resid(A).

   Stenosis A is calculated automatically.

ICA/CCA (PS)

Function: measures the flow velocity ratio between ICA and CCA to calculate the stenosis.

1. Select [ICA/CCA (PS)] in the measure menu.
2. Measure PS value of ICA and CCA distal using 2 PT method in D trace, and the system calculates the stenosis. Where, ICA value adopts the maximum PS value of proximal, middle and distal.

7.4.3 Study Tool Operations

Stenosis

Function: measures and calculates stenosis diameter and stenosis area.

1. Select [Stenosis] in the measurement menu.
2. Use the method of Distance measurement of 2D General Measurements to measure Normal(D) and Resid(D). Stenosis D is calculated automatically.
3. Use the method of Area measurement of 2D General Measurements to measure Normal(A) and Resid(A). Stenosis A is calculated automatically.

IMT

NOTE:	1.	The IMT function is unavailable on the product not configured with IMT.
	2.	IMT measurement is available on frozen (or history) linear array image only.

Function: IMT (Intima-Media Thickness) measures the distance between LI (Lumen-Intima) and MA (Media-Adventia).

The IMT values at 4 positions: CCA (common Carotid Artery), ICA (Internal Carotid Artery), ECA (External Carotid Artery) and Bulb (Bulbillate) need to be measured here.

1. Enter IMT exam mode, scan and freeze the image (or review a history image).
2. Select [IMT] in the measurement menu and enters the IMT measurement.
3. Select the side (Left/ Right), angle and vessel wall (Near/ Far).
4. Select an item such as [ICC IMT], the ROI box displays on screen.

   It appears as  when Near is selected;

   It appears as  when Far is selected;

Tips	1.	Make sure that you select the right vessel wall (Near/ Far) before IMT measurement; otherwise the intima may be recognized incorrectly due to different algorithm that applied in near/ far wall recognition.
	2.	Enter [Setup]-> [Measure Preset], and the Angle and ROI Width of an IMT item can be preset in the property dialog box of the measurement item.

5. Move ROI box to the desired position, press <Set>. Two auto trace lines appear in the box.

   The ROI box is green while you can:

   - Adjust the size of the ROI box.
   - Erase the trace lines inside the box by pressing <Clear>. (Long press <Clear>: to clear all measurement calipers on the screen.)
   - Trace manually
     a) Move the cursor to a trace line. The trace line turns yellow. Press <Set>.
     b) Move the cursor along the interface of vessel. Press <Set> to confirm the trace after re-adjusting.
6. Press <Set> outside the box to confirm the adjustment result after the manual-trace is completed. The results are recorded in IMT report.

   The system calculates:

   - IMT Max
   - IMT Min
   - IMT Mean

- IMT SD
- IMT ROI Length
- IMT Measure Length
- IMT Quality Index

Quality Index indicates the reliability of one measurement, the manual trace or re-scan an image with clear endocardium edges are recommended if the Quality Index value is small.

Tips: To achieve a good tracing result, try to place the ROI box parallel with vessel and adjust the box size to reduce unwanted interferences.

For multiple measurements in the same side, vessel and angle, the system calculates the following parameters in report:

- Average Mean IMT
- Average Max IMT
- Standard deviation

Also it provides Composite Mean IMT, which is an overall mean value of all IMT mean values derived from the measured items.

ABI

Function: Calculates Ankle Brachial Index (ABI) by measuring Ankle Systolic Pressure (ASP) and Brachial Systolic Pressure (BSP) on Doppler image.

ABI = ASP/BSP

NOTE: Need to be measured in left and right side respectively.

Select [ABI] in the measurement menu.

1. Click [ASP] from the [ABI] menu and type in the value.
2. Click [BSP] from the [ABI] menu and type in the value.

   The ABI is calculated by the system automatically.

7.5 Vascular Exam Report

During or after a measurement, press <Report> on the Control Panel to browse the report.

For details about report browsing, printing and exporting etc, see "1.7 Report".

An IMT report is applied to record results in IMT measurements, where selecting the patient conditions (smoker or not, diabetic or not etc.) and modifying the result data are available.

7.6 References

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8 Gynecology

8.1 Gynecology Exam Preparations

Make the following preparations before measurement:

1. Confirm that the current probe is appropriate.
2. Check if the current date of the system is correct.
3. Register patient information in [Patient Info] -> [GYN] dialog box.

   For more details, refer to "Exam Preparation -> Patient Information" in the Operator's Manual [Basic Volume].
4. Switch to the correct exam mode.

8.2 Basic Gynecology Measurement Procedures

1. Register patient information in [Patient Info] -> [GYN] dialog box.
2. Press <Measure> to enter the Application Measurement.

   If the current menu is not the one having Gynecology Measurement tools, move the cursor to the menu title and select the package having Gynecology Measurement tools.
3. Select measurement tool in the menu to start the measurement.

   See table in "8.3 Gynecology Measurement Tools" below for measurement tools.

   See section "8.4 Gynecology Measurement Operations" and steps in "3 General Measurement" for measurement methods.
4. Press <Report> to view the exam report, see "8.5 Gynecology Exam Report" for details.

8.3 Gynecology Measurement Tools

The system supports the following gynecology measurements.

NOTE:	Measurement tools mentioned below are configured in the system. The application measurement packages provided in this system are generally different combinations of measurement tools. For more information about package preset, see "2.4.2.2 Application Measurement Preset".

Modes	Types	Tools	Descriptions	Methods or formulae
2D	Measurement	UT L	Uterine Length	Same as Distance measurement in 2D General Measurements
		UT H	Uterine Height	
		UT W	Uterine Width	
		Cervix L	Uterine Cervix Length	

Modes	Types	Tools	Descriptions	Methods or formulae
		Cervix H	Uterine Cervix Height	
		Cervix W	Uterine Cervix Width	
		Endo	Endometrium Thickness	
		Ovary L	Ovary Length	Same as Distance measurement in 2D General Measurements
		Ovary H	Ovary Height	
		Ovary W	Ovary Width	
		Follicle1~16 L	Follicle 1~16 Length	
		Follicle1~16 W	Follicle 1~16 Width	
		Follicle1~16 H	Follicle1~16 Height	
	Calculation	Ovary Vol	Ovary Volume	See below
		UT Vol	UT Volume	
		Uterus Body	/	
		UT-L/ CX-L	/	
		Follicle 1-16	/	
	Study	Uterus	/	Length, height and width of uterus, endometrium thickness
		Uterine Cervix	/	Length, height and width of uterine cervix
		Ovary	/	Length, height and width of ovary
		Follicle 1~16	/	Length, height and width of follicle 1~16
M	/		/	
Doppler	/		/	

8.4 Gynecology Measurement Operations

Tips:

1. See the table in "8.3 Gynecology Measurement Tools" above for measurement tools and methods.
2. For the definitions of measurement, calculation and study, refer to "1.3 Measurement, Calculation and Study".
3. The order of the measurement items is presettable, see "2.4.2 Application Measurement Preset" for details.

8.4.1 Measurement Tool Operations

The following procedure takes UT L measurement as an example. Measurements of other items are similar.

1. Select [UT L] in the measurement menu.
2. Use the Distance method in 2D General Measurements to measure uterine length.

8.4.2 Calculation Tool Operations

Ovary Vol

Function: measures Ovary L, Ovary H and Ovary W, calculates Ovary Vol.

NOTE: Need to be measured in left and right side respectively.

1. Select [Ovary Vol] in the measurement menu.
2. Use the Distance method in 2D General Measurements to measure Ovary L, Ovary H and Ovary W. The Ovary Vol is calculated automatically.

UT Vol

Function: measures UT L, UT H and UT W, calculates UT Vol and Uterus Body.

1. Select [UT Vol] in the measurement menu.
2. Use the Distance method in 2D General Measurements to measure UT L, UT H and UT W. UT Vol and Uterus Body are calculated automatically.

Uterus Body

Function: measures UT L, UT H and UT W, calculates UT Vol and Uterus Body.

Uterus Body (cm) = UT L (cm) + UT H (cm) + UT W (cm)

1. Select [Uterus Body] in the measurement menu.
2. Use the Distance method in 2D General Measurements to measure UT L, UT H and UT W. UT Vol and Uterus Body are calculated automatically.

UT-L/ CX-L

Function: measures UT L and Cervix L, calculates their ratio UT-L/CX-L.

UT-L/CX-L (No unit) = UT L (cm) / Cervix L (cm)

1. Select [UT-L/CX-L] in the measurement menu.
2. Use the Distance method in 2D General Measurements to measure UT L and Cervix L. The system calculates UT-L/CX-L.

8.4.3 Study Tool Operations

Uterus

Function: measures UT L, UT H, UT W and Endo, calculates UT Vol, Uterine Body and UT-L/CX-L.

1. Select [Uterus] in the measurement menu.
2. Use the Distance method in 2D General Measurements to measure UT L, UT H, UT W and Endo.

   UT Vol and Uterus Body are calculated automatically.

   If Cervix L has been measured, the system also calculates UT-L/CX-L.

Uterine Cervix

Function: measures Cervix L, Cervix H and Cervix W, calculates UT-L/CX-L.

1. Select [Uterine Cervix] in the measurement menu.
2. Use the Distance method in 2D General Measurements to measure Cervix L, Cervix H and Cervix W.

Ovary

Function: measures Ovary L, Ovary H and Ovary W, calculates Ovary Vol.

NOTE: Need to be measured in left and right side respectively.

1. Select [Ovary] in the measurement menu.
2. Use the Distance method in 2D General Measurements to measure Ovary L, Ovary H and Ovary W. The Ovary Vol is calculated automatically.

Follicle

Function: Measures the length, width and height of follicle using method Distance and calculates the average of length, width and height as well as the follicle volume.

Results	Method	Formulae
Average Diameter	2-distance	$\text{Average Diam} = (Length + Width)/2$
	3-distance	$\text{Average Diam} = (Length + Width + Height)/3$
Follicle Volume	1-distance	$\text{Vol} = \frac{\pi}{6}(Length)^3$
	2-distance	$\text{Vol} = \frac{\pi}{6}(Length)^2 \times Width$
	3-distance	$\text{Vol} = \frac{\pi}{6} length \times Width \times Height$

Up to 16 follicles can be measured. Specify the serial numbers of the follicles before measuring a follicle.

NOTE: Need to be measured in left and right side respectively.

Takes Follicle1 as an example. Measurements of other items are similar.

1. Select [Follicle1] in the measurement menu.
2. Use the method of Distance measurement of 2D General Measurements to measure Follicle1 L, Follicle1 W and Follicle1 H.

   The system automatically calculates the average value of Follicle1 L, Follicle1 W and Follicle1 H as well as the volume of Follicle1.

NOTE:	The calculation method of the volume of the follicle can be preset via [Setup]-> [System Preset]-> [Meas].

8.5 Gynecology Exam Report

During or after a measurement, press <Report> on the Control Panel to browse the report.

For details about report browsing, printing and exporting etc, see "1.7 Report".

8.6 References

Uterus Body: Feng Kui, Sun Yanling, Li Hezhou. Ultrasonic diagnosis of adenomyosis. Journal of Henan Medical University, 1995; 30 (2).

UT-L/ CX-L: Ji Jindi, et al. Ultrasonographic study of the intersex problems and the internal genitalia abnormalities. Journal of China medical ultrasound. 1996, Volume 12, No8 P40.

9 Urology

9.1 Urology Exam Preparations

Make the following preparations before performing a urology exam:

1. Confirm that the current probe is appropriate.
2. Check if the current date of the system is correct.
3. Press <Patient>, register the patient information in [Patient Info] -> [URO] dialog box.

   For more details, refer to "Exam Preparation -> Patient Information" in the Operator's Manual [Basic Volume].
4. Switch to the correct exam mode.

9.2 Basic Urology Measurement Procedures

1. Press <Patient>, register the patient information in [Patient Info] -> [URO] dialog box.
2. Press <Measure> to enter the Application Measurements.

   If the current menu is not the one having Urology Measurement tools, move the cursor to the menu title and select the package having Urology Measurement tools.
3. Select measurement tool in the menu to start the measurement.

   See table in "9.3 Urology Measurement Tools" below for measurement tools.

   See section "9.4 Urology Measurement Operations" and steps in "3 General Measurement" for measurement methods.
4. Press <Report> to view the exam report, see "9.5 Urology Exam Report" for details.

9.3 Urology Measurement Tools

NOTE:	Measurement tools mentioned below are configured in the system. The application measurement packages provided in this system are generally different combinations of measurement tools. For more information about package preset, see "2.4.2.2 Application Measurement Preset".

The system supports the following 2D measurements (no measurement tools in M/Doppler mode).

Types	Tools	Descriptions	Methods or formulae
Measurement	Renal L	Renal Length	Distance in 2D General Measurements
	Renal H	Renal Height	
	Renal W	Renal Width	
	Cortex	Renal Cortical Thickness	
	Adrenal L	Adrenal Length	
	Adrenal H	Adrenal Height	
	Adrenal W	Adrenal Width	

Types	Tools	Descriptions	Methods or formulae
Measurement	Prostate L	Prostate Length	
	Prostate H	Prostate Height	Distance in 2D General Measurements
	Prostate W	Prostate Width	
	Seminal L	Seminal Vesicle Length	
	Seminal H	Seminal Vesicle Height	
	Seminal W	Seminal Vesicle Width	
	Testis L	Testicular Length	
	Testis H	Testicular Height	
	Testis W	Testicular Width	
	Ureter	/	
	Pre-BL L	Pre-void Bladder Length	
	Pre-BL H	Pre-void Bladder Height	Distance in 2D General Measurements
	Pre-BL W	Pre-void Bladder Width	
	Post-BL L	Post-void Bladder Length	
	Post-BL H	Post-void Bladder Height	
	Post-BL W	Post-void Bladder Width	
Calculation	Renal Vol	Renal Volume	See below
	Prostate Vol	Prostate Volume	
	Testis Vol	Testicular Volume	
	Pre-BL Vol	Pre-void Bladder Volume	
	Post-BL Vol	Post-void Bladder Volume	
	Mictur.Vol	Micturated Volume	
Study	Kidney	/	See below
	Adrenal	/	
	Prostate	/	
	Seminal Vesicle	/	
	Testis	/	
	Bladder	/	

9.4 Urology Measurement Operations

Tips:

1. See the table in "9.3 Urology Measurement Tools" above for measurement tools and methods.
2. For the definitions of measurement, calculation and study, refer to "1.3 Measurement, Calculation and Study".
3. The order of the measurement items is presettable, see "2.4.2 Application Measurement Preset" for details.

9.4.1 Measurement Tool Operations

Operations of all Urology measurement tools are the same as Distance measurement of 2D General Measurements.

The following tools need to measure Left or Right side respectively:

Seminal L	Seminal H	Seminal W	Renal L
Renal H	Renal W	Cortex	Adrenal L
Adrenal H	Adrenal W	Testis L	Testis H
Testis W			

The measurement procedures are as follows taking Prostate L measurement as an example:

1. Select [Prostate L] in the measurement menu.
2. Use the Distance of 2D General Measurements to measure Prostate L.

9.4.2 Calculation Tool Operations

Renal Vol

Function: measures Renal L, Renal H and Renal W, calculates Renal Vol.

NOTE: Need to be measured in left and right side respectively.

1. Select [Renal Vol] in the measurement menu.
2. Use the method of Distance measurement of 2D General Measurements to measure Renal L, Renal H and Renal W. The Renal Vol is calculated automatically.

Prostate Vol

Function: measures Prostate L, Prostate H and Prostate W, calculates Prostate Vol and PPSA. If [Serum PSA] in [Patient Info] -> [URO] has been input, PSAD (Prostate Special Antigen Density) will also be calculated.

$$\text{PPSA (ng/ml)} = \text{PPSA Coefficient (ng/ml}^2\text{)} \times \text{Prostate Vol (ml)}$$

$$\text{PSAD (ng/ml}^2\text{)} = \text{Serum PSA (ng/ml)} / \text{Prostate Vol (ml)}$$

Here, PPSA Coefficient and Serum PSA are input in [Patient Info] -> [URO] dialog box. The default value of PPSA Coefficient is 0.12.

1. Select [Prostate Vol] in the measurement menu.
2. Use the Distance method in 2D General Measurements to measure Prostate L, Prostate H and Prostate W.

   The system calculates Prostate Vol and PPSA.

   The PSAD displays in the report if the PSA value is input.

Testis Vol

Function: measures Testis L, Testis H and Testis W, calculates Testis Vol.

NOTE: Need to be measured in left and right side respectively.

1. Select [Testis Vol] in the measurement menu.
2. Use the method of Distance measurement of 2D General Measurements to measure Testis L, Testis H and Testis W. The Testis Vol is calculated automatically.

Pre-BL Vol

Function: measures the Pre-BL L, Pre-BL H and Pre-BL W, calculates the Pre-BL Vol.

1. Select [Pre-BL Vol] in the measurement menu.
2. Use the Distance method in 2D General Measurements to measure Pre-BL L, Pre-BL H and Pre-BL W. The Pre-BL Vol is calculated automatically. The Mictur.Vol is displayed in the report if the Post-BL Vol is measured.

Post-BL Vol

Function: measures the Post-BL L, Post-BL H and Post-BL W, calculates the Post-BL Vol.

1. Select [Post-BL Vol] in the measurement menu.
2. Use the Distance method in 2D General Measurements to measure Post-BL L, Post-BL H and Post-BL W. The Post-BL Vol is calculated automatically. The Mictur.Vol is displayed in the report if the Pre-BL Vol is measured.

Mictur.Vol

Function: measures the Pre-BL Vol and Post-BL Vol, calculates the Mictur.Vol.

1. Select [Mictur.Vol] in the measurement menu.
2. Use the Distance method in 2D General Measurements to measure Pre-BL L, Pre-BL H and Pre-BL W. The Pre-BL Vol is calculated automatically.
3. Use the Distance method in 2D General Measurements to measure Post-BL L, Post-BL H and Post-BL W. The Post-BL Vol and Mictur.Vol are calculated automatically.

9.4.3 Study Tool Operations

Kidney

Function: measures Renal L, Renal H and Renal W, calculates Renal Vol.

NOTE: Need to be measured in left and right side respectively.

1. Select the [Kidney] in the measurement menu.
2. Use the method of Distance measurement of 2D General Measurements to measure Renal L, Renal H and Renal W. The Renal Vol is calculated automatically.
3. Use the method of Distance measurement of 2D General Measurements to measure Cortex.

Adrenal

Function: measures Adrenal L, Adrenal H and Adrenal W.

NOTE: Need to be measured in left and right side respectively.

1. Select the [Adrenal] in the measurement menu.
2. Use the method of Distance measurement of 2D General Measurements to measure Adrenal L, Adrenal H and Adrenal W.

Prostate

Function: measures Prostate L, Prostate H and Prostate W, calculates Prostate Vol and PPSA. If [Serum PSA] in [Patient Info] -> [URO] has been input, PSAD (Prostate Special Antigen Density) will also be calculated.

$$\text{PPSA (ng/ml)} = \text{PPSA Coefficient (ng/ml}^2\text{)} \times \text{Prostate Vol (ml)}$$

$$\text{PSAD (ng/ml}^2\text{)} = \text{Serum PSA (ng/ml)} / \text{Prostate Vol (ml)}$$

Here, PPSA Coefficient and Serum PSA are input in [Patient Info] -> [URO] dialog box. The default value of PPSA Coefficient is 0.12.

1. Select the [Prostate] in the measurement menu.

2. Use the Distance method in 2D General Measurements to measure Prostate L, Prostate H and Prostate W.

   The system calculates Prostate Vol and PPSA.

   The PSAD displays in the report if the PSA value is input.

Seminal Vesicle

Function: measures Seminal L, Seminal H and Seminal W.

NOTE: Need to be measured in left and right side respectively.

1. Select the [Seminal Vesicle] in the measurement menu.
2. Use the method of Distance measurement of 2D General Measurements to measure Seminal L, Seminal H and Seminal W.

Testis

Function: measures Testis L, Testis H and Testis W, calculates Testis Vol.

NOTE: Need to be measured in left and right side respectively.

1. Select the [Testis] in the measurement menu.
2. Use the method of Distance measurement of 2D General Measurements to measure Testis L, Testis H and Testis W. The Testis Vol is calculated automatically.

Bladder

Function: measures Pre-BL L, Pre-BL H, Pre-BL W, Post-BL L, Post-BL H and Post-BL W, calculates Pre-BL Vol, Post-BL Vol and Mictur.Vol.

1. Select the [Bladder] in the measurement menu.
2. Use the Distance method in 2D General Measurements to measure Pre-BL L, Pre-BL H and Pre-BL W. The Pre-BL Vol is calculated automatically.
3. Use the Distance method in 2D General Measurements to measure Post-BL L, Post-BL H and Post-BL W. The Post-BL Vol and Mictur.Vol is calculated automatically.

9.5 Urology Exam Report

During or after a measurement, press <Report> on the Control Panel to browse the report.

For details about report browsing, printing and exporting etc, see "1.7 Report".

9.6 References

PPSA: Peter J. Littrup MD, Fed LeE. MD, Curtis Mettin. PD.Prostate Cancer Screening: Current Trends and Future Implications. CA-A CANCER JOURNAL FOR CLINICIANS, Jul/Aug 1992, Vol.42, No.4.

PSAD: MITCHELL C. BENSON, IHN SEONG, CARL A. OLSSON, J, McMahon, WILLIAM H.COONER. The Use of Prostate Specific Antigen Density to Enhance the Predictive Value of the Intermediate Levels of Serum Prostate Specific Antigen. THE JOURNAL OF UROLOGY, 1992, Vol.147, p817-821

10 Small Parts

10.1 Small Parts Exam Preparations

Make the following preparations before measurement:

1. Confirm that the current probe is appropriate.
2. Check if the current date of the system is correct.
3. Press <Patient>, register the patient information in [Patient Info] -> [SMP] dialog box.

   For more details, refer to "Exam Preparation -> Patient Information" in the Operator's Manual [Basic Volume].
4. Switch to the correct exam mode.

10.2 Basic Small Parts Measurement Procedures

1. Press <Patient>, register the patient information in [Patient Info] -> [SMP] dialog box.
2. Press <Measure> to enter the Application Measurements.

   If the current menu is not the one having Small Parts Measurement tools, move the cursor to the menu title and select the package having Small Parts Measurement tools.
3. Select measurement tool in the menu to start the measurement.

   See table in "10.3 Small Parts Measurement Tools" below for measurement tools.

   See section "10.4 Small Parts Measurement Operations" and steps in "3 General Measurement" for measurement methods.
4. Press <Report> to view the exam report, see "10.5 Small Parts Exam Report" for details.

10.3 Small Parts Measurement Tools

The system supports the following small parts measurements.

NOTE: Measurement tools mentioned below are configured in the system. The application measurement packages provided in this system are generally different combinations of measurement tools. For more information about package preset, see "2.4.2.2 Application Measurement Preset".

Modes	Types	Tools	Descriptions	Methods or formulae
2D	Measurement	Thyroid L	Thyroid Length	Distance in 2D General Measurements
		Thyroid H	Thyroid Height	
		Thyroid W	Thyroid Width	
		Isthmus H	Isthmus height	
		Testis L	Testicular Length	
		Testis H	Testicular Height	

Modes	Types	Tools	Descriptions	Methods or formulae
		Testis W	Testicular Width	
		Mass1 D1~3	/	Distance in 2D General Measurements
		Mass2 D1~3	/	
		Mass3 D1~3	/	
	Calculation	Thyroid Vol	Thyroid Volume	Thyroid Vol (cm^3) = k × Thyroid L (cm) × Thyroid H (cm) × Thyroid W (cm) Where in, k= 0.479 or 0.523
	Study	Thyroid	/	Same formulae as in Thyroid Vol calculation
		Testis	/	See “Testis”.
		Mass1~3	/	Volume (3 Dist) in 2D General Measurements
M	/	/	/	/
Doppler	Measurement	STA	Superior Thyroid Artery	D trace in General D measurements
		ITA	Inferior Thyroid Artery	
	Calculation	/	/	/
	Study	/	/	/

10.4 Small Parts Measurement Operations

Tips:	1.	See table "10.3 Small Parts Measurement Tools" above for measurement tools and methods.
	2.	For the definitions of measurement, calculation and study, refer to "1.3 Measurement, Calculation and Study".
	3.	The order of the measurement items is presettable, see "2.4.2 Application Measurement Preset" for details.

10.4.1 Measurement Tool Operations

Take measurement "Thyroid L" for example; the measurement procedures are as follows:

1. Select [Thyroid L] in the measurement menu.
2. Use the Distance of 2D General Measurements to measure Thyroid L. The value displays in the result window and exam report.

10.4.2 Calculation Tool Operations

Thyroid Vol

Function: measures Thyroid L, Thyroid H and Thyroid W respectively, and calculates Thyroid Vol.

Tips:	Need to be measured in left and right side respectively.

1. Select [Thyroid Vol] in the measurement menu.
2. Use the Distance of 2D General Measurements to measure Thyroid L, Thyroid H and Thyroid W.

   Two Thyroid Vols are calculated automatically.

10.4.3 Study Tool Operations

Thyroid

Function: measures Thyroid L, Thyroid H and Thyroid W respectively, and calculates Thyroid Vol. See “10.3 Small Parts Measurement Tools” for calculation formulae.

Tips:	Need to be measured in left and right side respectively.

1. Select the [Thyroid] in the measurement menu.
2. Use the Distance tool in 2D General Measurements to measure Thyroid L, Thyroid H and Thyroid W. The Thyroid Vol is calculated automatically.

Mass

Function: measures Mass D1, Mass D2 and Mass D3 to calculate the Mass Volume. Up to 3 masses can be measured.

Take Mass1 as an example, the procedures are as follows:

1. Select [Mass1] in the measurement menu.
2. Use the Distance tool in the 2D General Measurement to measure Mass1 D1, Mass1 D2 and Mass1 D3.

   The measurements and the calculated Mass Volume are recorded in the report.

Testis

The same as “Testis” in “Urology”.

10.5 Small Parts Exam Report

During or after a measurement, press <Report> on the Control Panel to browse the report.

For details about report browsing, printing and exporting etc, see "1.7 Report".

10.6 References

Thyroid Vol: (k= 0.479) Volumetrie der Schilddruesenlappn mittels Realtime-Sonographie; J Brunn, U. Block, G. Ruf, et al.; Dtsch.med. Wschr.106 (1981), 1338-1340.)

Thyroid Vol: (k=0.523) Gomez JM, Gomea N, et al. Determinants of thyroid volume as measured by ultrasonography in healthy adults randomly selected. Clin Endocrinol(Oxf), 2000;53:629-634)

11 Orthopedics

HIP (Hip Joint Angle) measurement is used in pediatric orthopedics. Such measurement provides early diagnosis for infant hip joint dislocation.

11.1 Orthopedics Exam Preparations

Make the following preparations before measurement:

1. Confirm that the current probe is appropriate.
2. Check if the current date of the system is correct.
3. Register patient information in [Patient Info] -> [PED] dialog box.

   For more details, refer to "Exam Preparation -> Patient Information" in the Operator's Manual [Basic Volume].
4. Switch to the correct exam mode.

11.2 Basic Orthopedics Measurement Procedures

1. Register patient information in [Patient Info] -> [PED] dialog box.
2. Press <Measure> to enter the Application Measurements.

   If the current menu is not the one having HIP Measurement tools, move the cursor to the menu title and select the package having HIP Measurement tools.
3. Select measurement tool in the menu to start the measurement.
4. See table in "11.3 Orthopedics Measurement Tools" below for measurement tools.
5. See section "11.4 HIP Measurement Operations" and steps in "3 General Measurement" for measurement methods.
6. Press <Report> to view the exam report, see "11.5 Orthopedics Exam Report" for details.

11.3 Orthopedics Measurement Tools

NOTE:	Measurement tools mentioned below are configured in the system. The application measurement packages provided in this system are generally different combinations of measurement tools. For more information about package preset, see "2.4.2.2 Application Measurement Preset".

HIP

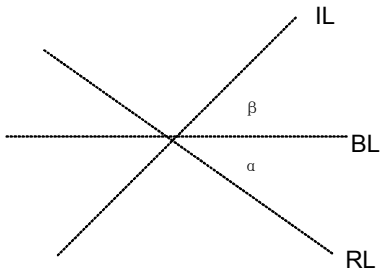
The HIP calculation assists in assessing the development of the infant hip. In this calculation, three straight lines are superimposed on the image and aligned with the anatomical features. The two angles are calculated and displayed.

The three lines are:

- The baseline (BL), connecting the osseous acetabular convexity to the point where the joint capsule and the perichondrium unite with the ilium.
- The roof line (RL), connecting the lower edge of the ilium to the osseous acetabular convexity.
- The inclination line (IL), connecting the osseous acetabular convexity to the labrum acetabular.

The angles are:

- α: the angle between BL and RL.
- β: the angle between BL and IL



Dislocation type can be determined through Graf method, as described in the following table.

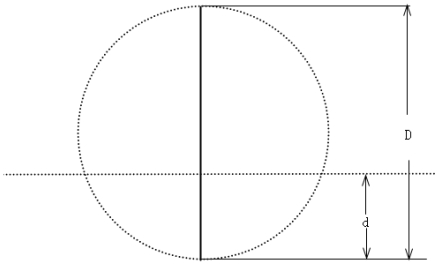
DISLOCATION TYPE	CRITERIA			RESULT
	α	β	Patient	
I	α≥60°	β<77°	All ages	I
II	50°≤α≤59°		Younger than three months of age	IIa
	50°≤α≤59°	β<55°	Three months of age or older than three months	IIb
	43°≤α≤49°	β≤77°	All ages	IIc
	43°≤α≤49°	β>77°	All ages	IId
III	α<43°	β>77°	All ages	III
IV	Quantitative angle measurement cannot be performed.		All ages	All
	Others	Others	All ages	?????

HIP-Graf

The measurement items, results and procedures are the same with “HIP”.

d/D

Measures distance between baseline and bottom line of the osseous acetabular and maximum width of hip to estimate the hip osseous acetabular coverage.



1. Click [d/D] in the measure menu.
2. Use the Distance tool in the 2D General Measurement to measure maximum width of hip (D), and distance between osseous acetabular roof and bottom (d).The system calculates d/D.

11.4 HIP Measurement Operations

Tips:	For the definitions of measurement, calculation and study, refer to "1.3 Measurement, Calculation and Study".

1. In B mode, select [HIP] from the measurement menu.

   A line appears, and there is a fulcrum on the line.
2. Use the trackball to move the line to the position of the hip joint. Then rotate the Multifunctional Knob to fix the baseline.
3. Press <Set> to confirm and the second line displays.
4. Use the method for adjusting the first line to anchor the RL and press <Set> to fix the RL.
5. Use the same method to fix the third line IL. The angles of α and β come out.

   If patient age is entered, dislocation type is also displayed.

   Measure angles of α and β separately: click [HIP (α)] or [HIP (β)] to measure.

11.5 Orthopedics Exam Report

During or after a measurement, press <Report> on the Control Panel to browse the report.

For details about report browsing, printing and exporting etc, see "1.7 Report".

11.6 References

Graf R., “Sonographic diagnosis of hip dysplasia. Principles, sources of error and consequences” Ultraschall Med. 1987 Feb;8(1):2-8

Schuler P., “Principles of sonographic examination of the hip” Ultraschall Med. 1987 Feb;8(1):9-1

Graf, R. “Fundamentals of Sonographic Diagnosis of Infant Hop Dysplasia.” Journal Pediatric Orthopedics, Vol. 4, No. 6:735-740,1984.

Graf, R. Guide to Sonography of the Infant Hip. Georg Thieme Verlag, Stuttgart and New York, 1987.

Morin, C., Harcke, H., MacEwen, G. “The Infant Hip: Real-Time US Assessment of Acetabular Development.” Radiology, 177:673-677, December 1985.

12 Emergency

The following optional emergency exam modes are available in current system:

- EM ABD
- EM FAST
- EM OB
- EM Vascular
- EM Superficial

12.1 Basic Measurement Procedures

1. Press <Patient>, register patient information in proper page under [Patient Info] screen.
2. Scan the desired ultrasonic views and save image(s).
3. Press <Measure> to enter the Application Measurements.

   If the current menu doesn't contain the desired measurement tools, move the cursor to the menu title and select the proper package.
4. Select the item/tool to start the measurement.
5. Press <Report> to view and output measurement report.

12.2 EM Measurement Tools

Mode	Type	Item	Item	Method or formulae
2D	Measurement	Renal L	Renal Length	Distance in 2D General Measurements
		Renal H	Renal Height	
		Renal W	Renal Width	
		CBD	Common bile duct	
		Portal V Diam	Portal Vein Diameter	
		CHD	Common hepatic duct	
		GB wall th	Gallbladder wall thickness	
		Aorta Diam	Aorta Diameter	
		Aorta Bif	/	
		Ureter	/	
		Pre-BL L	Pre-Animal Bladder Length	
		Pre-BL H	Pre-Animal Bladder Height	
		Pre-BL W	Pre-void Bladder Width	

Mode	Type	Item	Item	Method or formulae
		Post-BL L	Post-void Bladder Length	
	Measurement	Post-BL H	Post-void Bladder Height	
		Post-BL W	Post-void Bladder Width	
		GS	Gestational Sac Diameter	
		YS	Yolk Sac	
		BPD	Biparietal Diameter	
		CRL	Crown Rump Length	Line (same as Distance in 2D General Measurements), Trace, Spline
		UT L	Uterine Length	Distance in 2D General Measurements
		UT H	Uterine Height	
		UT W	Uterine Width	
		Endo	Endometrium Thickness	
		Ovary L	Ovary Length	
		Ovary H	Ovary Height	
		Ovary W	Ovary Width	
	Calculation	Renal Vol	Renal Volume	Refer to “9.4.2 Renal Vol”
		Pre-BL Vol	Pre-void Bladder Volume	Refer to “9.4.2 Pre-BL Vol”
		Post-BL Vol	Post-void Bladder Volume	Refer to “9.4.2 Post-BL Vol”
		Mictur.Vol	Micturated Volume	Refer to “9.4.2 Mictur. Vol”
		Ovary Vol	Ovary Volume	Refer to “8.4.2 Ovary Vol”
		UT Vol	UT Volume	Refer to “8.4.2 UT Vol”
		Uterus Body	/	Refer to “8.4.2 Uterus Body”
	Study	Uterus	/	Refer to “8.4.3 Uterus”
		Ovary	/	Refer to “8.4.3 Ovary”
		Kidney	/	Refer to “Kidney”
		Bladder	/	Refer to “9.4.3 Bladder”
M/D Mode	Measurement	FHR	Fetal Heart Rate	Heart Rate in M General Measurements

NOTE: 1. Measurement tools in each EM package depend on the specific measurement data preset for each ultrasound system.

2. For more information about package preset, see "2.4.2.2 Application Measurement Preset".

12.3 EM Exam Report

During or after a measurement, press <Report> on the Control Panel to browse the report.

Each EM exam mode has its corresponding EM report. Similar to other reports, the following functions are available in the EM report:

- Selecting anatomic diagnosis
- Editing report data and adding remarks
- Adding/ deleting ultrasound image(s)
- Changing report template
- Printing/ previewing the report
- Exporting Report

For details about report browsing, printing and exporting etc, see "1.7 Report".

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