

DC-8/DC-8 PRO/DC-8 CV/DC-8S
Diagnostic Ultrasound System
Operator's Manual

[Advanced Volume]

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Preface

This manual details the procedures for operating the DC-8/DC-8 PRO/DC-8 CV/DC-8S 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 depend on the specific system you purchased.

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


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
	Caution!

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) depends 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. When the result of auto trace 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 or touch screen. 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 etc., see "2 Measure Preset" for details.
5. Press <Measure> or <Caliper> to start measurement.
6. Select an item from the measurement menu or touch screen to start.
For general and application measurement items (tools), see chapter "3 General Measurement" of specified application measurements for details.
7. Press <Report> to view the exam report.
For report editing and browsing, see "1.7 Report".

Button Functions

Keys	Basic Operations
Measure	To enter/exit the application measurement.
Caliper	To enter/exit the general measurement.
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. In iWorks status, press to enter measurement according to the prompt.

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

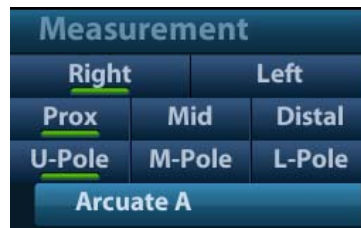
Menus of General and Application measurement are different. For more information on measurement menu, refer to "3 General Measurement" and the specified application measurement chapter.

Measurement menu and the corresponding touch screen are as follows:





1.2.1 Measurement Location



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

- Side (Left/Right): belong to the item (e.g. kidney) that contains measurement of left/ right side parameters respectively.
- Location (Prox/Mid/Dist): belong to the item (e.g. vascular) that contains measurement of Proximal, Middle or Distal parameters.
- Pole (U/M/L): belong to the item (e.g. some abdomen vessels) that contains measurement of upper, middle or lower 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.

Also, you can rotate the knob under the “Location” or “Side” on the touch screen (shown in figure below) on touch screen to switch the location.



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

1.2.2 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

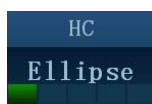
The procedures are as follows:

1. Select the tool:
 - Move the cursor to the item on the menu and press <Set>.
 - Touch an item on the touch screen.
2. Perform the measurement according to the actual situation.
3. After finishing the measurement, perform operations if necessary.


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 (or touch screen).
2. Turn the knob under the adjusting item on the touch screen to select the method, as shown in the following figure.



Other Features

Features	Descriptions
Current measurement tool/item	Highlighted.
Measured item	Performed application item/tool is 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.)
Page up/down	Use the ▲/▼ on the menu, or  on the touch screen.
Unavailable item	Greyed out. Need switch to the proper imaging mode to enable it.
Result window	To show/hide the result window by touching [Result] on the touch screen.

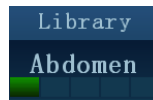
1.2.3 Mode Switching

You can always use the mode tabs on touch screen to switch to other measurement menu available for other modes, as shown in figure below.



1.2.4 Measurement Library Switching


During application measurement, rotate the knob under [Library] on the touch screen, to select among the available measurement libraries under the current probe of the current exam mode.



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 “” in preset screen. E.g. "Distance" in the 2D general measurement; or "HC" in the OB measurement.



On the touch screen, measurement tools are displayed using square button as

Calculation


Results of calculations are automatically derived by the system, using other measured or calculated values as parameters, they are indicated by “” in preset screen. 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.

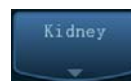


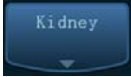
On the touch screen, calculation tools are displayed using square button as

Study

A group of measurements and / or calculations for a specific clinical application, they are indicated by “” in preset screen. E.g. AFI in the OB measurement.

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



On the touch screen, study items are displayed as , with an arrow indicating the tools to be selected.

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

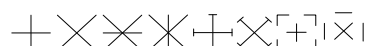
The ends of calipers can be active or fixed. The active end is called a Cursor.

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] -> [Application], see "2.2 Measurement Parameters Preset" for more information.

1.5 Result Window

Measurement window displays the conducted measurement's result and the engaging measurement in real time.

1.5.1 Result Display

Select [Show Result] on the touch screen 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.

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.

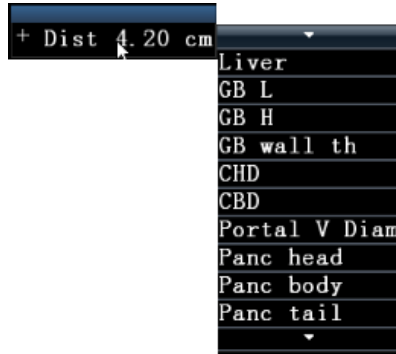
1.5.3 Result Window Assignment

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:

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

Application items in the Obstetric measurement that use the "Distance" 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 the 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 (or touch screen). The selected application item also has to meet the matching rules in step 1.
3. If the application item(s) is/are included 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

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.

For details about auto spectrum calculation, please refer to “3.4.5 D Trace”.

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

1.6 Cross-window Measurement

For linear probe, 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 automatically saved by the system after each measurement.

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

Formula	Value	1	2	3	Method	GA	Range
AC	Hadlock	14.03cm	14.03		Avg	19w3d	✓
HUM	Jeanty	2.66cm	2.66		Avg	19w3d	
NF	29.2mm	27.1	31.4		Avg		
AFI							
AP1	2.54cm	2.54			Last		
AP2	0.14cm	0.14			Last		
AP3	3.06cm	3.06			Last		

- Each measurement contains three latest values and a final value.
- The report only displays results of the tools that are default to be displayed 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 displays 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 (or touch screen) to clear all measurement data.

Entering Ultrasound Remarks

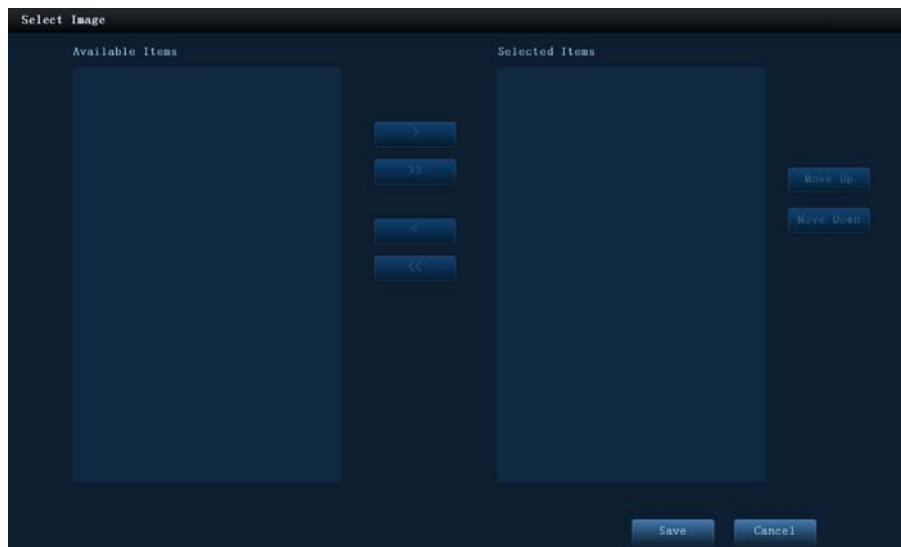
In [Comments] box, you can input corresponding information.

Also you can save or load the comments.

Selecting Images

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

1. Click [Add Picture] 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.

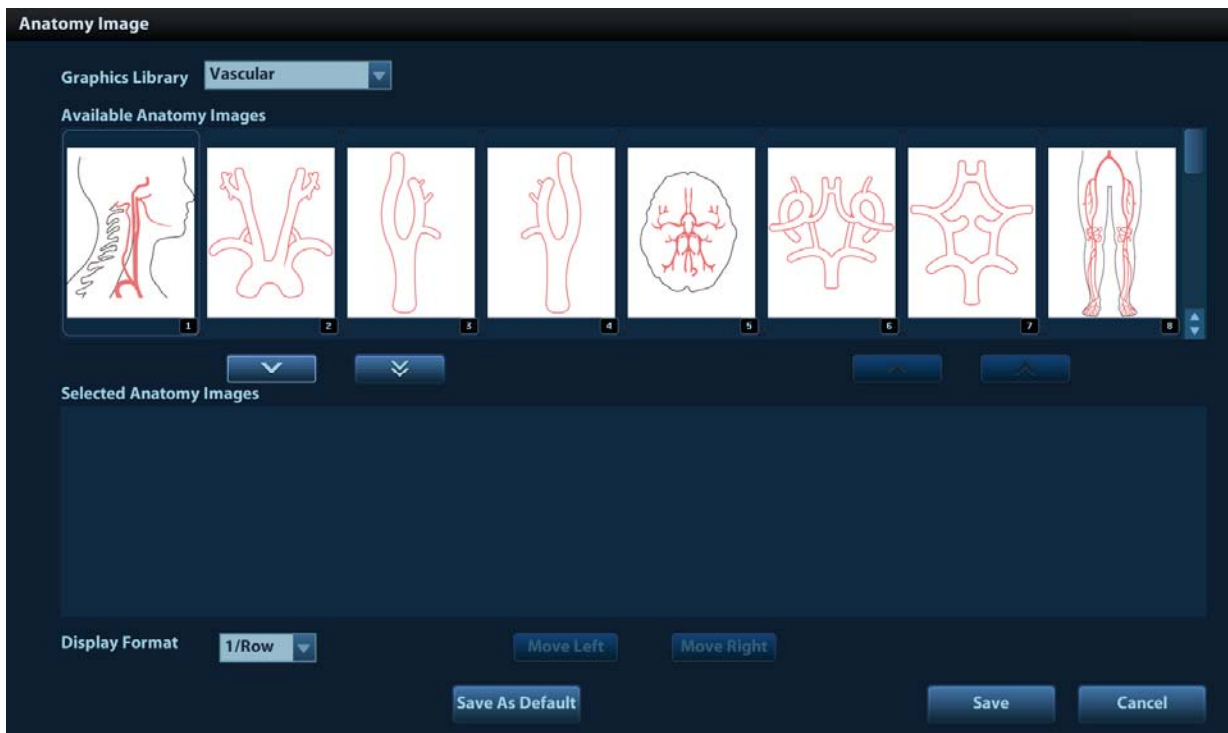
Select an image in the right column and click [Move Up] or [Move Down] to adjust the image sequence, in which the images are arranged in the report.

3. Click [Save] to confirm.

Add Anatomical Picture

You may add anatomical graphics for illustration. OB, EM OB, Stress Echo and LV analysis reports do not support this function.

1. Click [Anatomical Graphic] on the report page. The dialog box appears.







Available items: the graphic saved in the current exam can be added to the report.

Selected items: the selected graphic will be added to the report.

2. Select the graphic

a) Adding/ Removing the image with:

-  Adding the selected graphic.
-  Adding all optional graphics to the selected items.
-  Removing the selected single graphic.
-  Removing all added graphics.

b) Adjusting the graphic's sequence.

Select a graphic from the selected items. Click [Move Left] or [Move Right] to adjust the graphic sequence in the list.

The sequence of the graphic in the bottom column is that of the graphics in the report.

3. Click [Save] to confirm the setting.

You may edit the select anatomic graphic on the touch screen by drawing.

Save/Load/Export Report

■ Save/Load report

After the report template is edited, the history report archived in the system will change at the same time. The user may print or export the current report to make a copy in advance.

NOTE: This function is not available for anonymous patient.

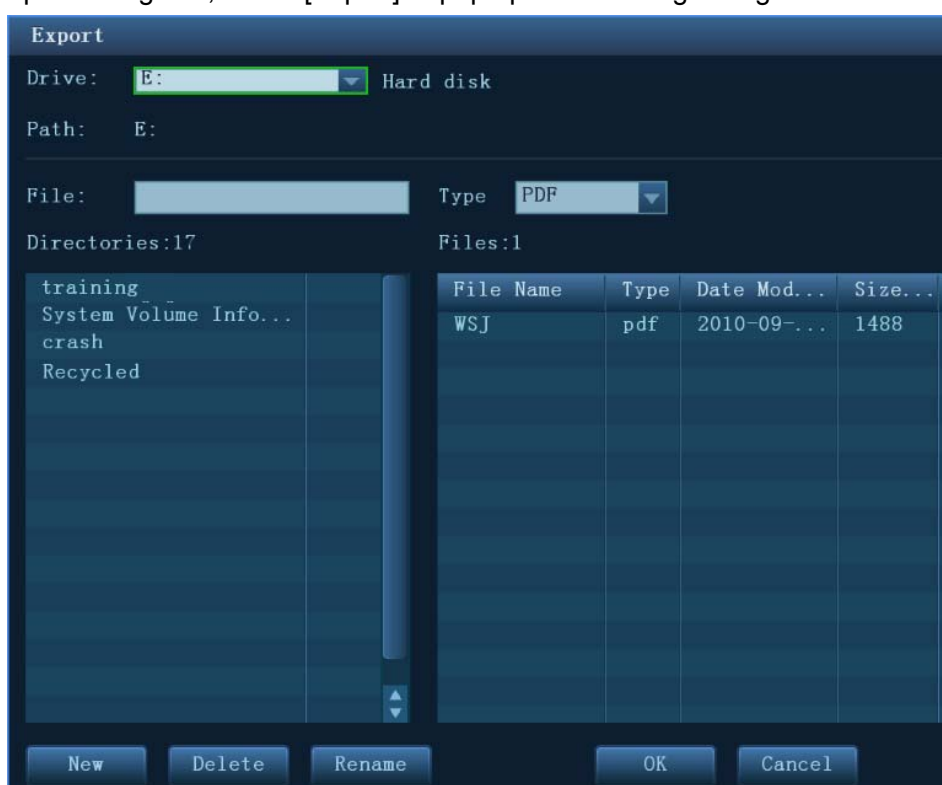
Click [Save Report], and the report is saved in PDF file.

Click [Load Report], you can preview the saved report, export or print the report.

■ Export report

The reports can be exported in RTF or PDF 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.

Analyzing Report Data

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

1. Click [Analyze].
2. Select or type in anatomy descriptions.

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

Use the [Prev Page]/ [Next] to turn the pages.

3. Click [OK] to confirm. Analysis information displays following the measurement values in the report.

⚠ CAUTION: Input appropriate data when editing the measurement values, otherwise misdiagnosis 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]. |
| Preset Image Layout | Click [Image Layout] to set the number of images displayed in a row in the report. |
| 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 Report Setting

Click [Setting] in the bottom-left part of the Report screen to generally change the report display.

Type	Description	
Print information and layout	Choose the item (s) to be displayed on the report: ultrasound image, anatomical graphic, analysis and comments. Set the layout for ultrasound image and anatomical graphic for printing.	
	Ultrasound Image	Select the ultrasound image to be printed. Then, set the image layout for printing.
	Anatomical Graphic	Select the anatomical graphic to be printed. Then, set the graphic layout for printing.
	Analyze	Select to print the added analysis.
	Comments	Select to print the comment column.
Measurement	Show all measurement results	Display all measurement results of each item for printing.
	Show all fetus data in one report	After clicking it, the report chooses and prints the multi-fetus data simultaneously.
Fetal Growth	Fetal growth	Select to print fetal growth result. Then set the layout in the report.
	Fetal growth compare	Select the result of fetal growth comparison to be printed.

1.7.6 Fetal Growth Curve

If [Obstetric] in the [Patient Info] is selected in the report template (see "5.7.4 Fetal Growth Curve"), you can view the fetal growth curve by clicking the [Growth] button in the report page. See "5.7.4 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
- Report Preset

2.1 Basic Preset Procedures

The basic measure preset procedures are as follows:

1. Press <F10> to enter the Preset:
2. Preset the measurement parameters.
Enter [Setup] -> [System Preset] -> [Application] to preset the Measure ruler, 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 and items. See "2.4 Measure Preset" for details.
5. Return from the setup to make the settings taking effect.
Select [Save] on the [Setup] menu (or touch screen) to return from the setup.

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

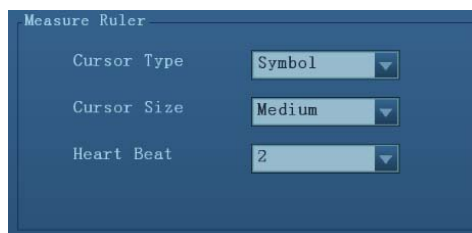
2.2 Measurement Parameters Preset

Basic operation steps are as follows:

1. Press <F10> to show the [Setup] menu.
2. Select [Setup] -> [System Preset] -> [Application] to preset the following parameters:
 - Measurement Ruler
 - Left ventricular study
 - Follicle
 - Comment
 - Clear results while deleting calliper
 - PW velocity display in absolute value
3. Click [Save] to confirm.

The following are function descriptions of the parameters.

Measurement Ruler



You can preset:

Tools	Descriptions
Cursor Type	Types of cursor displays on the measurement caliper and result window. Value options: <ul style="list-style-type: none"> ■ 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.)

Left Ventricle function study tool setting

Set the tools used in Cube/Teichholz/Gibson study.

Follicle

Set the method to calculate the follicle. Value options:

Follicle 3 distances/ 2 distances/ 1 distance

Comment

You can preset:

- Whether clear the comments while unfreezing image or changing probe/exam
- Whether clear Bodymark when unfreezing
- Whether enable the voice comment

2.3 Obstetric Preset

Basic procedures:

1. Press <F10> 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 [Save] to exit the page.

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".
 3. You can add user-defined formulae for items (obstetric tools) that are not included in the GA and FG table below. See "2.3.2.2 User-defined OB Formulae".

GA and FG formulae are shown in table below:

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

Tools	GA	FG
EFW	Tokyo Hadlock	Hadlock Shepard Hansmann Tokyo Brenner William
EFW2	Tokyo Hadlock	Hadlock Shepard Hansmann Tokyo Brenner William
GS	Tokyo Rempen Hansmann China	Rempen Tokyo Hansmann Hellman
CRL	Hadlock Tokyo Jeanty Nelson Robinson Rempen Hansmann China ASUM RobinsonBMUS	Hadlock Tokyo Robinson Rempen Hansmann ASUM

Tools	GA	FG
BPD	Hadlock Tokyo Jeanty Kurtz Hansmann Merz Rempen ChittyOI Osaka China Nicolaides ASUM CFEF	Hadlock Tokyo Jeanty Kurtz Sabbagha Hansmann Merz Rempen ChittyOI Osaka Nicolaides ASUM CFEF
HC	Hadlock Jeanty Hansmann ChittyDer ChittyPL Nicolaides ASUM CFEF	Hadlock Merz Jeanty Hansmann ChittyPL ChittyDer Nicolaides ASUM CFEF
AC	Hadlock Jeanty Merz ChittyPL Nicolaides ASUM CFEF Hansmann	Hadlock Jeanty Merz ChittyPL ChittyDer Nicolaides ASUM CFEF Hansman

Tools	GA	FG
FL	Hadlock Tokyo Jeanty Hohler Merz Hansmann Warda Chitty Osaka China Nicolaidis ASUM CFEF	Hadlock Tokyo Jeanty Merz Hansmann O'Brien Warda Chitty Osaka Nicolaidis ASUM CFEF
OFD	Hansmann Nicolaidis ASUM	Hansmann Merz Nicolaidis ASUM Jeanty
APAD	/	Merz
TAD	CFEF	Merz CFEF
FTA	Osaka	Osaka
THD	Hansmann	Hansmann
APTD	/	/
YS	/	/
TTD	/	/
HUM	Jeanty ASUM	Jeanty Merz ASUM
Ulna	Jeanty	Merz Jeanty
Tibia	Jeanty	Merz Jeanty
RAD	/	Merz Jeanty
FIB	/	Merz Jeanty
CLAV	Yarkoni	Yarkoni

Tools	GA	FG
TCD	Hill Nicolaides	Hill Goldstein Nicolaides
OOD	Jeanty	/
Vertebrae	/	/
NT	/	/
Cist Magna	/	Nicolaides
Mean Sac Diam	Daya	/
MCA PI	/	JSUM
MCA RI	/	JSUM
Umb A PI	/	JSUM
Umb A RI	/	JSUM
AFI	/	Moore
FL/HC (Hadlock)	/	Hadlock
HC/AC(Campbell)	/	Campbell

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 EFW and EFW2 of GA/ FG are different from those in the [Fetal Weight] page.
	<ul style="list-style-type: none"> ■ 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)	$EFW = 10^{(1.304 + (0.05281 \cdot AC) + (0.1938 \cdot FL) - (0.004 \cdot AC \cdot FL))}$	g	cm
	$SD = 0.154 \cdot EFW$ SD Type = $\pm 2SD$	g	g
Hadlock (AC, FL, BPD)	$EFW = 10^{(1.335 - (0.0034 \cdot AC \cdot FL) + (0.0316 \cdot BPD) + (0.0457 \cdot AC) + (0.1623 \cdot FL))}$	g	cm
	$SD = 0.146 \cdot EFW$ SD Type = $\pm 2SD$	g	g
Hadlock (AC, FL, HC)	$EFW = 10^{(1.326 - (0.00326 \cdot AC \cdot FL) + (0.0107 \cdot HC) + (0.0438 \cdot AC) + (0.158 \cdot FL))}$	g	cm
	$SD = 0.148 \cdot EFW$ SD Type = $\pm 2SD$	g	g

Formulae	Descriptions	Units	
Hadlock (AC, FL, HC, BPD)	$EFW = 10^{(1.3596 - (0.00386 \cdot AC \cdot FL) + (0.0064 \cdot HC) + (0.00061 \cdot BPD \cdot AC) + (0.0424 \cdot AC) + (0.174 \cdot FL))}$	g	cm
	SD=0.146*EFW SD Type=±2SD	g	g
Shepard	$EFW = 10^{(-1.7492 + (0.166 \cdot BPD) + (0.046 \cdot AC) - (2.646 \cdot AC \cdot BPD / 1000))}$	g	cm
	SD=0.202*EFW SD Type=±2SD	g	g
Merz1	$EFW = -3200.40479 + (157.07186 \cdot AC) + (15.90391 \cdot (BPD^2))$	g	cm
Merz2	$EFW = 0.1 \cdot (AC^3)$	g	cm
Hansmann	$EFW = (-1.05775 \cdot BPD) + (0.0930707 \cdot (BPD^2) + (0.649145 \cdot THD) - (0.020562 \cdot (THD^2) + 0.515263)$	g	cm
Tokyo	$EFW = (1.07 \cdot (BPD^3)) + (3.42 \cdot APTD \cdot TTD \cdot FL)$	g	cm
Osaka	$EFW = (1.25674 \cdot (BPD^3)) + (3.50665 \cdot FTA \cdot FL) + 6.3$	g	cm
Campbell	$EFW = EXP(-4.564 + (0.282 \cdot AC) - (0.00331 \cdot (AC^2)))$	g	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, EDD and DOC;
- UP(Calc Method)(Formula) **%: Where Calc Method may be AUA, CUA.

■ 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.

$$\text{average EFW} \times 1.25 > EFW > \text{average EFW} \times 0.75$$

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.

E.g. 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 \surd .

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

In [Fetal Gestational Age] page, you can select whether to display EFW derived GA in the report.

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) Select the calculating formula and display format of the weight percentile.

Select the formula from the drop-down list of [EFW-GP] and you can select to display the percentile calculated by LMP or CUA/AUA or both from [Type].

4. Click [Save] to confirm.

Import/Export an OB GA Table or Formula

1. Select [Import] or [Export] in the Fetal Gestational Age or Fetal Growth page.
2. The system pops up the [Load Data] dialog box.
3. Select the drive and file path the data located.
4. Select the data file to load or export.
5. Click [OK] to confirm.

Tips: only user-defined table that is imported can be exported.

The imported user-defined table of FG and GA has to be *.csv file. The format of the *.csv file is described as follows:

■ FG table

Table Type	Author Name	SD Type	Meas Value Unit	SD Unit
FG	The author name	Value of standard deviation	Unit of the measurement value	Unit of the standard deviation
Row Num	Row number (N) of the table			
No.	GA	Min	Meas Value	Max
1	GA value	Minimum value	Measurement value	Maximum value
2	...	...	...	...
...
N	...	...	...	...

NOTE:

- You should fill in the table according to actual clinical value except those cells with words in bold.
- Value of standard deviation:
Select from one of the following:
 - None
 - $\pm 1SD$
 - $\pm 2SD$
 - 3%~97%
 - 5%~95%
 - 10%~90%
- Unit of the measurement value: according to the table to import, select from mm, cm, g, kg, cm² or mm².
- Row number (N) of the table: the maximum row number N in the column of "No."
- The third row is empty.
- GA value, Minimum value, Measurement value, Maximum value: input the number of days without the unit.

■ GA table

Table Type	Author Name	SD Type	Meas Value Unit	
GA	The author name	Value of standard deviation	Unit of the standard deviation	
Row Num	Row number (N) of the table			
No.	Meas Value	SD(-)	GA	SD(+)
1	Measurement value	Standard deviation (-)	GA value	Standard deviation (+)
2	...	...	...	...
...
N	...	...	...	...

NOTE:

- You should fill in the table according to actual clinical value except for those cells with words in bold.
- Value of standard deviation:
Select from one of the following:
 - None
 - $\pm 1SD$
 - $\pm 2SD$
 - 3%~97%
 - 5%~95%
 - 10%~90%
- Unit of the measurement value: according to the table to import, select from mm, cm, g, kg, cm² or mm².
- Row number (N) of the table: the maximum row number N in the column of "No."
- The third row is empty.
- Measurement value, Standard deviation (-), GA value, Standard deviation (+): input the number of days without the unit.

2.3.2.2 User-defined OB Formulae

NOTE: The calculation results of the user-defined OB formulae are used for reference rather than clinic diagnosis.

You can add user-defined formulae for items (obstetric tools) that are not included in the GA and FG table in section 2.3.1.

1. Select [More OB Item] in the GA or FG tab sheet.
2. Select an item and click [OK].
New item appears in the left column.
3. Select the *.csv file (formula file) for the item.
Or, you can add a formula for the new item by clicking [Load].

2.4 Measure Preset

Basic Procedures:

1. Press <F10> to show the [Setup] menu.
2. Select [Measure Preset] in the [Setup] menu.
3. Preset the general measurement and application measurement.
For details, refer to "2.4.1 General Measurement Preset" and "2.4.2 Application Measurement Preset".
4. Click [Save] to confirm.

2.4.1 General Measurement Preset

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

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



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.

2. 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.
3. 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.
4. 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.
5. Adjust the item position.
 Select an item in the right column and click [Up]/ [Down] to adjust the sequence in which the items are arranged in the corresponding general measurement menu (and touch screen).
6. Modify the property of measurement item.
 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.

Property			
Item Name D Trace			
Item Name	Result	Unit	CalcMethod
PS	<input checked="" type="checkbox"/>	cm/s	Last
ED	<input checked="" type="checkbox"/>	cm/s	Last
TAMAX	<input checked="" type="checkbox"/>	cm/s	Last
TAMEAN	<input checked="" type="checkbox"/>	cm/s	Last
PI	<input checked="" type="checkbox"/>		Calc after Mean
RI	<input checked="" type="checkbox"/>		Calc after Mean
S/D	<input checked="" type="checkbox"/>		Calc after Mean
HR	<input checked="" type="checkbox"/>	Bpm	Last
Vel	<input type="checkbox"/>	cm/s	Last
PV	<input type="checkbox"/>	cm/s	Last
MD	<input type="checkbox"/>	cm/s	Last
PPG	<input type="checkbox"/>	mmHg	Calc after Mean

Descriptions of the attributes are shown in the following table.

Attributes	Descriptions
Item Name & Result	<p>Results obtained from D trace are listed. The selected items will be displayed in the result window.</p> <ul style="list-style-type: none"> ■ 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. <ul style="list-style-type: none"> ● 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.
Unit	Select the measurement unit.
Meas Method	Select the measurement method for the tool.

c) Click [OK] to confirm the setting.

7. 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.

8. Click [Save] 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.

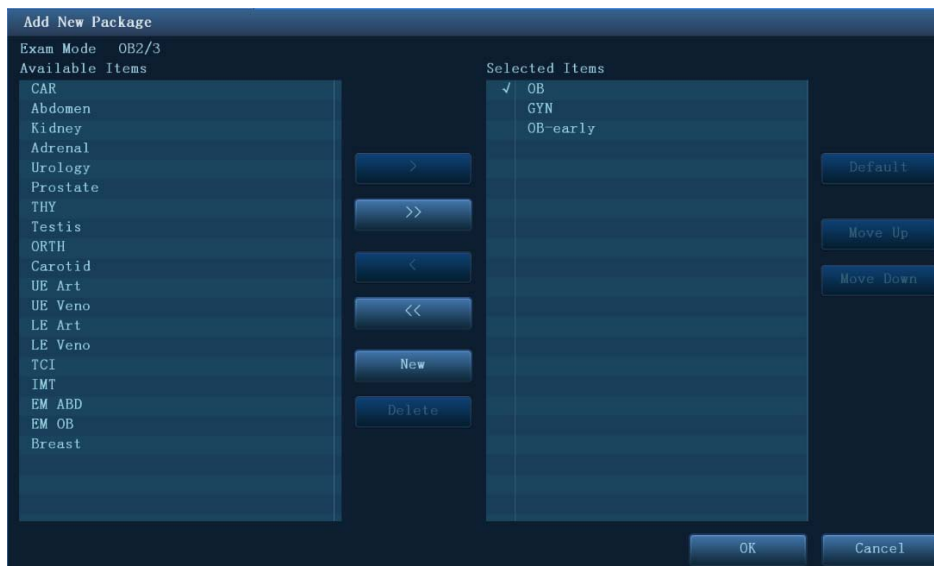


2. Select the 2D, M or Doppler scanning mode.
3. Choose or edit the Measurement Package.
 Generally, the corresponding package appears in the [Measure Package] when the [Exam Mode] is selected.
 - If no package appears, you can input the package name directly in the [Measure Package] text box then add items to edit the current package.
 - Or, click [Advanced] to add or select a package.
 For details about creating, deleting and setting default package, see “2.4.2.2 Measurement Package Preset”.
4. Select an application region from the drop-down list under [Available Items].
5. 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".
6. Preset the measurement menu.
 For details on adding, creating and setting default item, see “2.4.2.3 Preset of Measurement Menu”.
 For details on measurement tool property setting, see “2.4.1 General Measurement Preset”.
7. 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.
8. Click [Save] to confirm.

2.4.2.2 Measurement Package Preset

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

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.

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 displays 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 \surd .

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

The following operations are available.

- Adding/ Removing Item
- Setting Default Item
- Adjusting Item Position
- User-defined Study Item

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 as well as on touch screen.

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.

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 from the [Menu] list.
2. Click [Default], and the defaulted item is marked with a \surd .

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 [Up]/ [Down].

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

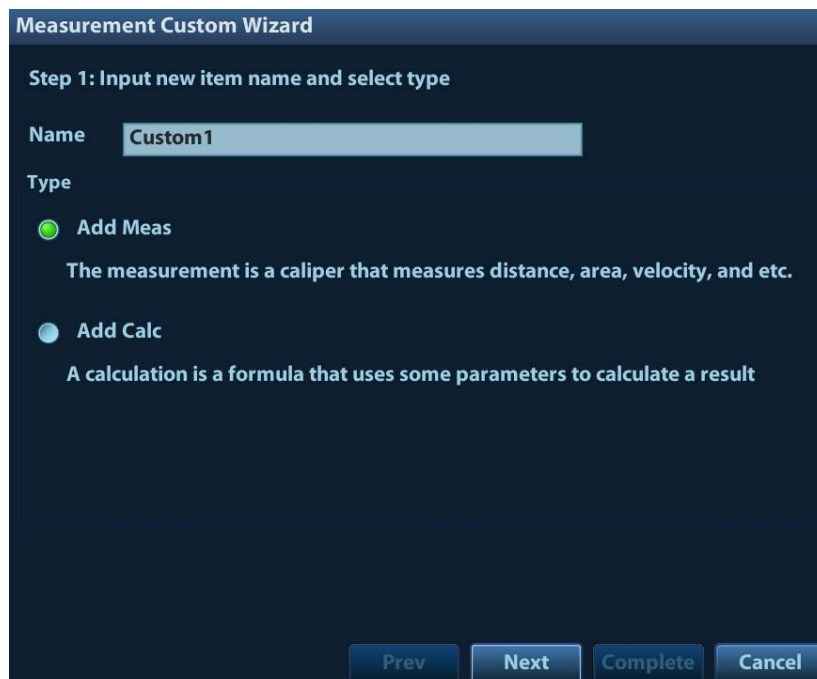
2.4.2.4 User-defined Measurement/Calculation/Study

NOTE: Please guarantee the correctness and validity of the formula defined, otherwise Mindray will not be liable for damage caused by improper definition of the formula.

User-defined Measurement

1. Enter [Measure Preset] -> [Measure] page.
2. Click [New].

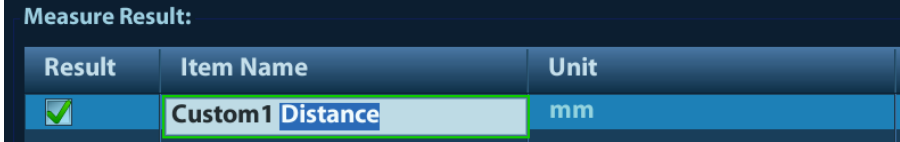
The "Measurement Custom Wizard" dialog box pops up, as shown in the following figure.



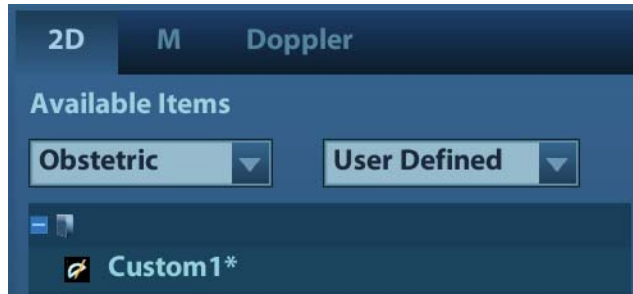
3. Input Name in the "Measurement Custom Wizard" dialog box, and click [Next].
4. Select the [Tool Type], [App Region] and the Measure Result.



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 Dist if you want to add a new item to measure the distance.
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	<p>Choose the result(s) to be displayed in the result window. The result name is changeable.</p> <p>Move the cursor onto an item and press <Set>, then input the name in the text box.</p> 

- Click [Complete] to finish the setting. The user-defined measurement item lists in the “Selected Items” menu and in the “User-defined” category of “Available Items”. An asterisk appears posterior to the user-defined item for identification.

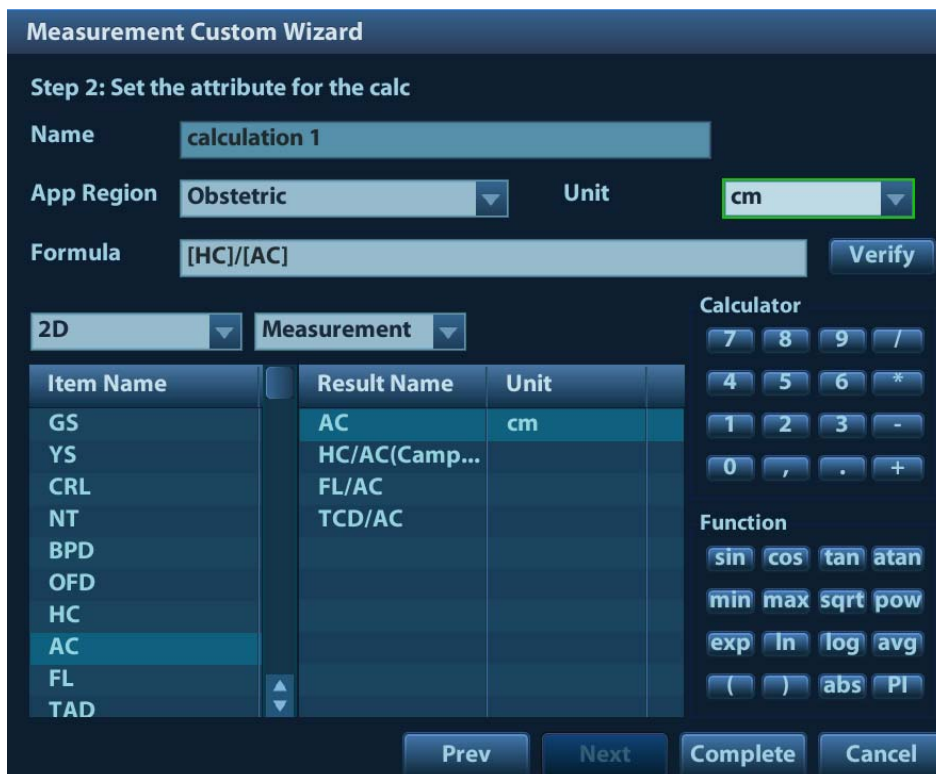


In the meantime, the user-defined measurement item will be added automatically to the “Selected Items” in the Report template. If the item is completed in an exam, the result will be displayed in the report. For detailed information of Report template, please refer to “2.4.3 Report Preset”.

User-defined Calculation

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

1. Enter [Measure Preset] -> [Measure] page.
2. Click [New].
3. Input Name in the "Measurement Custom Wizard" dialog box, choose [Add Calc] and click [Next].
4. Select the [App Region] and 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 if the formula is valid.

Attributes	Descriptions
Measurement Item	All available measurement items of the application region selected in the previous step. You can select from measurement/calculation/study items in 2D/M/Doppler mode.
Calculator/ Function	Used to input numbers and functions in the formula.
Unit	Used to set the Unit of result.

For example, to create a user-defined measurement item (HC/AC).

- a) Enter name for the item, like “calculation 1”.
 - b) Select Region to be “Obstetric”, select measurement tool source to be “2D” and “Measurement”.
 - c) Find HC in the “Item Name” list, click to select it, and then double-click HC in the Result Name box on the right side, and then the index goes into the formula.
 - d) Click to select Calculator to be “/” and it goes into the formula.
 - e) Find AC in the “Item Name” list, click to select it, and then double-click AC in Result Name box on the right side, and then the index goes into the formula.
5. Verify the formula and select the unit of the result, then click [Complete]. The user-defined calculation item lists in the “User-defined” category of “Available Items”.

In the meantime, the user-defined calculation item will be added automatically to the “Selected Items” in the Report template. If the item is completed in an exam, the result will be displayed in the report. For detailed information of Report template, please refer to “2.4.3 Report Preset”.

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

User-defined Study Item

You can add or remove user-defined study in the [Selected Items] column.

1. Enter [Measure Preset] -> [Measure] page.
2. Click [Add Study] on the right.
3. Input the study name in the popped up dialogue box.
4. Click [OK] and the item will be added to the “Selected Items”.
5. Select a measurement/calculation item from the “Available Items” and click [>] to add the item to the user-defined study.
6. Repeat last step to add more items if necessary.
7. Move the cursor to click the study, and click [Property] on the right to edit sequence.

Edit User-defined Item

1. Select “User-defined” in the “Available Items”;
2. Select the target item, and click [Edit] on the right.

Remove User-defined Item

■ Remove Measurement/Calculation

1. Select "User-defined" in the "Available Items", select the desired item.
2. Click [Delete] on the right.

■ Remove Study

Select an user-defined study, click [<].

NOTE:

1. Adding B-Hist or B-Profile to the study is not supported.
2. The button of [Add Study] is available in the root directory only.
3. Click [Export XML] in the measure preset window to export the user-defined measurement, which is used to help parsing the user-defined data by the PACS system.

2.4.3 Report Preset

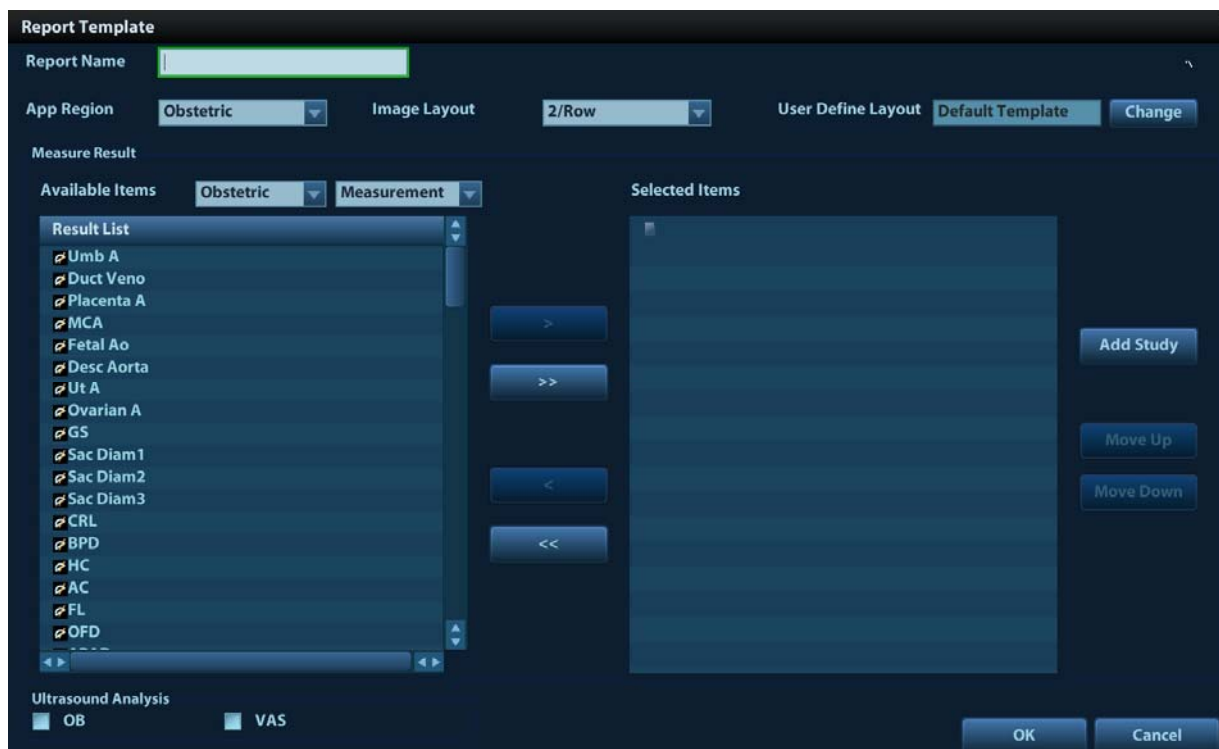
NOTE: Deleting is not supported by IVF, IMT and EM reports.

Basic procedures:

1. Select [Report] in the [Measure Preset] page.
2. Manage the report template. Available operations:
 - Adding new Report Template
 - Deleting Report Template
 - Editing Report Template
 - Setting default Report Template
3. Click [Print Blank Comment] to set whether print the comment when no
4. Continue other presets; or click [Save] on the [Setup] menu to make the settings take effect.

2.4.3.1 Creating Report Template

1. Enter [Measure Preset] -> [Report] page.
2. Click [New] to pop up the following dialog box.



Descriptions of items and functions are shown in table below.

Item	Description
Report Name	Name of the report template.
Application Region	Select the application region. Patient information items displays in the report are different for each category.
Image Layout	Select numbers and arrangement of images display in the report.
User Define Layout	Select the template for the user-defined layout.
Measure Result	Set the measurement items displayed in the report.
Ultrasound Analysis	Whether to display the anatomy information. The corresponding anatomy options will appear when clicking the [Anatomy] button in the report.

3. Select an application category 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 items to the [Selected Item] list.
Only tools appear in the right column and are completed in the ultrasound exam can be displayed in the report.
For details, refer to "Add/ Remove the item" in section "2.4.1 General Measurement Preset".
6. Add the study.
Click [Add Study] and enter the study name in the dialog box popped up and click [OK].
New added study appears in the [Selected Item] list.

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

7. Adjusting the item position.

Select an item in the [Selected Item] 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.

2.4.3.2 Deleting Report Template

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

2.4.3.3 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 “2.4.3.1 Creating Report Template” for editing the template.
4. Click [OK] in the [Report] tab sheet to confirm the settings.

2.4.3.4 Setting Default Template

1. Enter [Measure Preset] -> [Report] page.
2. Select a report template in the list.
3. Click [Default].
4. Click [Save] to confirm.

2.5 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 operator’s manual [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. Start the exam.
2. Select the imaging mode (B/M/Doppler), then scan the image.
3. Press <Caliper> to enter the 2D/M/Doppler general measurement menu.
4. Select an item from the general measurement menu (or touch screen) to start the measurement.

- | |
|--|
| <p>Tips:</p> <ol style="list-style-type: none">1. The order of the measurement items is presettable, see "2.4.1 General Measurement Preset" for details.2. A measurement tool can be activated by clicking the item either in the measurement menu or touch screen menu, it is described as "Select/Click ...(certain item) in the measurement menu" in the following procedures.3. Under B+M or B+PW mode, when moving the cursor to the B image, the system will start B mode distance measurement automatically. |
|--|

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.

<p>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.</p>

1. Click [Depth] in the measurement menu, and the cursor appears on the screen.
2. Use the trackball to move the cursor to the desired point.
3. 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 & Circumference

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] 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] in the measurement menu. The cursor appears on the screen (touch 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 <Angle> 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] 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] 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:

■ 3 Dist

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:

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

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:

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

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

■ **Ellipse Dist.**

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:

Volume (3 Dist)

1. Select [Volume (3 Dist)] from 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.

Volume (Ellipse)

1. Select [Volume (Ellipse)] from 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.

Volume (Ellipse Dist.)

1. Select [Volume (Ellipse Dist.)] from 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 Double Dist

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

1. Click [Double Dist] 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 <Angle> 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 Curve Length

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

Trace

1. Select [Trace Len (Trace)] 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 <Angle> 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.

See "Trace" in "3.2.4 Area" for trace performed on the touch screen.

Spline

1. Select [Trace Len (Spline)] 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, Cross, Spline.

1. Select [Ratio (A)] (tools including Ratio (Area Ellipse), Ratio (Area Spline), Ratio (Area Cross)) 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.

Tips: The following operations are performed on Freeze images by default.

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).

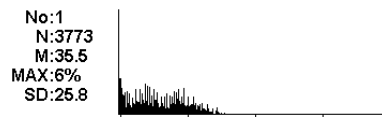
Tips: The following operations are performed on Freeze images by default.

Rectangle

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

1. Click [B-Hist (Rectangle)] 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/ $N \times 100\%$

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:**
1. This measurement item is meant for a general estimation, not for accurate measurement.
 2. The following operations are performed on Freeze images by default.

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 <Angle> 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 IMT

Tips: The IMT should be performed on Freeze images by default.

IMT (Intima-Media Thickness) measures the distance between LI (Lumen-Intima) and MA (Media-Adventia). For details, please refer to “7.4.3 Study Tool Operations IMT”.

3.2.16 Strain Ratio

Function: measures strain ratio in the image, $\text{strain ratio} = \frac{\text{strain (normal tissue)}}{\text{strain (lesion)}}$.

Tips: only elastography imaging supports this function, and for details please refer to [Basic Volume].

In the image, region selected from lesions is defined as A, and region selected from normal tissue is defined as B; while A' is the region extended from lesions, and shell thick refers to the thickness of the mass shell.

Tissue strain is related to forces on the probe and tissue depth, we recommend using regions of same depth and same area for comparison.

1. Click [Strain Ratio (Ellipse)] or [Strain Ratio (Trace)] in the measurement menu.
2. Set the shell thick and select if to turn on the shadow function.
 - In B+E dual display mode, rotate the knob under [Shadow] on the touch screen to be On, measurements on any of the window will be displayed on the other window.
 - Rotate the knob under [Shell Thick] on the touch screen to set the mass shell size.
3. Perform measurements, you can select between ellipse or trace method, for details, please refer to “3.2.10 Ratio (A)”.
4. After the strain ratio is measured, select the [Shell Thick] to be more than 0mm, the system extends from lesion A automatically according to the shell thick value. Result window will display the results: B/A', B/Shell, A/Shell.

3.2.17 Strain-Hist

Function: displays strain ratio using the histogram, $\text{strain ratio} = \frac{\text{strain (normal tissue)}}{\text{strain (lesion)}}$.

1. Click [Strain-Hist (Ellipse)] or [Strain-Hist (Trace)] in the measurement menu.
2. Set the shell thick and select if to turn on the shadow function.
 - In B+E dual display mode, rotate the knob under [Shadow] on the touch screen to be On, measurements on any of the window will be displayed on the other window.
 - Rotate the knob under [Shell Thick] on the touch screen to set the mass shell size.
3. Perform measurements, you can select between ellipse or trace method, for details, please refer to “3.2.12 B-Hist”.

After the Strain-Hist is measured, select the [Shell Thick] to be more than 0mm, the histogram will display data of A as well as A'.

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 ($n \leq 8$) 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] -> [Application] 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.

HR 76(2) Bpm

Number of Cardiac Cycles

Heart Rate

3.4 Doppler General Measurements

The measurement accuracy of Time is within $\pm 2\%$;

The measurement accuracy of Heart Rate is within $\pm 4\%$;

The measurement accuracy of D velocity is within $\pm 5\%$.

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 ($n \leq 8$) 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.

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.

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

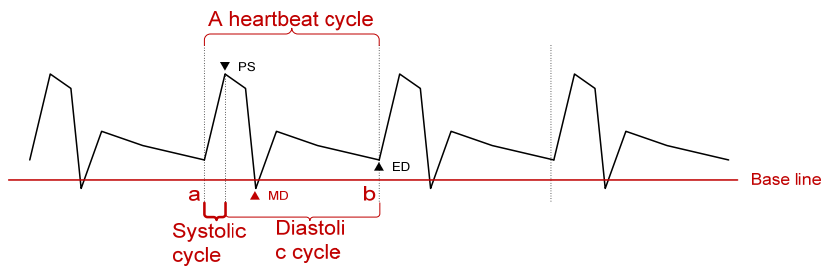
Function: Measures the velocities of two points and their time interval on the Doppler image, and calculates the acceleration, pressure gradient, velocity difference and correction angle.

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.

3.4.5 D Trace

Function: measures clinical indices through tracing Doppler spectrum. Measurement methods available are Trace, 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 diastolic ending time as end point. That is, by tracing the Doppler spectrum from systolic to diastolic to calculate indices.

■ Operations:

1. Click [D Trace] in the measurement menu, and the cursor appears on the screen.
2. Move the cursor to the starting point to be measured and press the [Set] key 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 <Angle> anticlockwise to correct the trace line already drawn.
4. Trace the end point to be measured and press <Set> to fix the point.

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	/	<p>The average flow velocity in the whole traced Doppler spectrum.</p> <p>■ TAMAX (Time Averaged Maximum Velocity):</p> $TAMAX(cm / s) = \int_{T_a}^{T_b} V(t) dt / (T_b - T_a)$ <p>Where V(t) is the maximum velocity</p> <p>■ TAMEAN (Time Averaged Mean Velocity): Obtained by auto spectrum calculation.</p> $TAMEAN(cm / s) = \int_{T_a}^{T_b} V(t) dt / (T_b - T_a)$ <p>Where V(t) is the mean velocity.</p>
PPG	Peak Pressure Gradient	It is the corresponding pressure gradient of the peak systolic velocity. PPG (mmHg) = $4 \times PS (m/s)^2$

Parameters	Descriptions	
Average Pressure Gradient	/	<p>Average pressure gradient in the whole traced Doppler spectrum.</p> <ul style="list-style-type: none"> ■ MPG: Maximum Pressure Gradient. $\text{MPG}(mmHg) = \int_{T_a}^{T_b} 4(V(t))^2 dt / (T_b - T_a)$ <p>Where V(t) is the peak systolic velocity.</p> <ul style="list-style-type: none"> ■ MMPG: Mean velocity Mean Pressure Gradient. (Obtained during auto-spectrum calculation.) $\text{MMPG}(mmHg) = \int_{T_a}^{T_b} 4(V(t))^2 dt / (T_b - T_a)$ <ul style="list-style-type: none"> ■ Where V(t) is the mean systolic velocity.
VTI	Velocity-Time Integral	<p>Velocity-time Integral. It is the integral of the product of Doppler instantaneous velocity and the total time interval.</p> $\text{VTI}(m) = \int_{T_a}^{T_b} V(t) dt$
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)
D/S	/	ED/PS. D/S (No unit) = ED (m/s) / PS (m/s)
PI	Pulsatility Index	Pulsatility 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 is 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

The measurement method varies by the result selected, where,

■ 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

Function: measures the velocity, pressure gradient and correction angle between two points on the Doppler spectrum.

1. Select items using [2 PT] method 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.

■ Spline

1. Select items using [Spline] method from 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 Spectrum Calculation

You can also acquire above results by auto calculation, which calculates the recently cardiac cycles.

- Click [Auto Calc] on the PW image menu to be on, the system traces automatically and displays the results on the upper right part of the screen.
- Click [Auto Calc Param] on the PW image menu, you can select the parameters to be calculated.
- Click [Auto Cardiac Cycle] on the PW image menu, you can select the cycle number to be calculated.

3.4.6 PS/ED

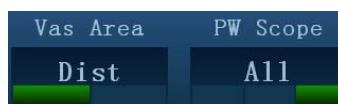
Function: measures the Peak Systolic (PS) velocity and End Diastolic (ED) velocity on the Doppler spectrum, and calculates their resistance index (RI), S/D and correction angle.

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.

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. Click [Vas Area] in the submenu on the touch screen, selections of vas area and PW scope will be displayed on the bottom of the touch screen:



- Rotate the knob under [Vas Area] to select the method for calculating the area: dist or trace.
 - Rotate the knob under [PW Scope] to select the scope to be traced.
3. Measure the vascular area.
 4. Click [TAMEAN] or [TAMAX] to calculation the volume flow.

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

$$Vel\ Ratio(Nounit) = |Vel1(cm / s) / Vel2(cm / s)|$$

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,

$$VTI\ Ratio(Nounit) = |VTI1(cm) / VTI2(cm)|$$

3.5 References

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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.
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 (or touch screen) 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.

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	
	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	
	Panc duct	Pancreatic duct	
Panc head	Pancreatic head		
Panc body	Pancreatic body		
Panc tail	Pancreatic tail		
measurement	Spleen	/	Distance in 2D General Measurements
	Aorta Diam	Aorta Diameter	
	Aorta Bif	Aorta Bifurcation	
	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	

Types	Tools	Descriptions	Methods or formulae
	Post-BL H	Post-void Bladder Height	
	Post-BL W	Post-void Bladder Width	
Calculation	Renal Vol	Renal Volume	See "Renal Vol"
	Pre-BL Vol	Pre-void Bladder Volume	See "Pre-BL Vol"
	Post-BL Vol	Post-void Bladder Volume	See "Post-BL Vol"
	Mictur.Vol	Micturated Volume	See "Mictur.Vol"
Study	Kidney	/	See "Kidney"
	Adrenal	/	See "Adrenal"
	Bladder	/	See "Bladder"

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		

Types	Tools	Descriptions	Methods or formulae
	SMV	Superior Mesenteric Vein	
Calculation	RAR	Ratio of Renal Artery PS the Abdominal Aorta PS	$RAR \text{ (no unit)} = \frac{\text{Renal A PS (cm/s)}}{\text{Aorta PS (cm/s)}}$
	SMA/Ao	Ratio of Superior Mesenteric Artery PS and Abdominal Aorta PS	$SMA/Ao \text{ (no unit)} = \frac{\text{SMA PS (cm/s)}}{\text{Aorta PS (cm/s)}}$
	CA/Ao	Ratio of Celiac Axis PS and Abdominal Aorta PS	$CA/Ao \text{ (no unit)} = \frac{\text{Celiac Axis PS (cm/s)}}{\text{Aorta PS (cm/s)}}$
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.
 4. A measurement tool can be activated by clicking the item either in the measurement menu or touch screen menu.

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

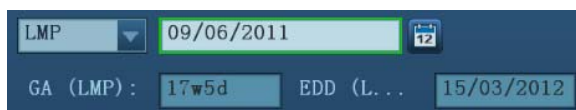
1. Press <Patient>, register the patient information in [Patient Info] -> [OB] dialog box.
The clinical GA is calculated when the corresponding data input in this page, see "5.3.1 Clinical GA" for details.
2. Press <Measure> to enter the Application Measurements.
3. Select measurement tool in the menu (or touch screen) 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 screenshot shows a digital form with a dark blue background. At the top, there is a dropdown menu labeled 'LMP' with a downward arrow, followed by a text input field containing '09/06/2011' and a calendar icon. Below this, there are two rows of input fields: 'GA (LMP):' with the value '17w5d' and 'EDD (L...)' with the value '15/03/2012'.

The calculating methods are listed as follows:

- LMP: input the LMP, the system will calculate the GA and EDD.
- DOC: input the DOC, 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 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].

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.

Name: OB	DOB:	Operator: Admin
ID: 20130815-092927-9C15	Age:	Ref.Physician: Fetus A
LMP: 22/04/2013	GA: 16w3d	EDD(LMP): 27/01/2014
		AUA 16w3d EDD(AUA): 27/01/2014

	Formula	Value	1	2	3	Method	GA	Range
2D Measurements								
HC	Hadlock	12.88cm	45.22%	12.97	12.78	Avg	16w4d	15w3d-17w5d
AC	Hadlock	10.46cm	50.00%	10.46		Avg	16w3d	14w5d-18w1d
FL	Hadlock	2.11cm	40.13%	2.11		Avg	16w3d	15w0d-17w6d

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:	<ol style="list-style-type: none"> 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 Smart NT must be used with convex-wide probe and good image quality. If an evident inaccurate recognition exists, please confirm the target profile manually and adjust the result. 3. 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**".
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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 (Support Smart NT method if the Smart NT function is configured)*
	HC ¹	Head Circumference	Area in 2D General Measurements (Support Smart OB method if the Smart OB function is configured)
	AC	Abdominal Circumference	
	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	

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
Measurement	TAD	Abdominal Transversal Diameter	Distance in 2D General Measurements
	APAD	Anteroposterior Abdominal Diameter	
	TCD	Cerebellum Diameter	
	Cist Magna	Cist Magna	
	LVW	Lateral Ventricle Width	
	HW	Hemisphere Width	
	OOD	Outer Orbital Diameter	
	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		
PL Thickness	Placental Thickness	Distance in 2D General Measurements	

Types	Tools	Descriptions	Methods or formulae
	Sac Diam1	Gestational Sac Diameter 1	
	Sac Diam2	Gestational Sac Diameter 2	
	Sac Diam3	Gestational Sac Diameter 3	
	AF1	Amniotic Fluid 1	
	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	
Measurement	RVIDs	Right Ventricular Internal Diameter at End-systole	Distance in 2D General Measurements
	RV Diam	Right Ventricular Diameter	
	RA Diam	Right Atrium Diameter	
	IVSd	Interventricular Septal Thickness at End-diastole	
	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		
	Facial Angle	Angle of the two lines: one from fetus nasal base to forehead, and the other one from nasal base to ear base.	Angle in 2D General Measurements

Types	Tools	Descriptions	Methods or formulae
	HrtA	Heart area	Area in 2D General Measurements
	MV Diam	Mitral Valve diameter	Distance in 2D General Measurements
	PV Diam	Pulmonary valve Diameter	
	Ao Asc Diam	Ascending Aorta Diameter	
	Ao Desc Diam	Descending Aorta Diameter	
	Duct Art Diam	Ductus Arteriosus Diameter	
	TV Diam	Tricuspid valve Diameter	
	LPA Diam	Left pulmonary Artery Diameter	
	RPA Diam	Right pulmonary Artery Diameter	
	AV Diam	Aorta Valve Diameter	
	IVC Diam	Inferior vena cava Diameter	
	UT L	Uterine Length		Distance, Trace and Spline in 2D General Measurements
	UT H	Uterine Height	Distance in 2D General Measurements
	UT W	Uterine Width	
	Endo	Endometrium Thickness	
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 1	EFW is calculated by the default EFW formulae, based on multiple measured parameters, See "2.3.1 Obstetric Formula". The formulae can be reselected in the OB report.
	EFW2	Estimated Fetal Weight 2	
	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

Types	Tools	Descriptions	Methods or formulae
	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
	UT Vol	UT Volume	See “UT Vol” in 8.4.2
	UT Sum	/	See “UT ” in 8.4.2
	UT-L/ CX-L	/	See “UT-L/ CX-L” in 8.4.2
Study	AFI	/	Measures AF1, AF2, AF3, AF4, calculates AFI
	Uterus	/	See “Uterus” in 8.4.3

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
	Duct Ven	Ductus Venosus	
	Placenta A	Placenta Artery	
	MCA	Middle Cerebral Artery	
	Fetal Ao	Fetal Aorta	
	Desc Aorta	Descending Aorta	
	Ut A	Uterine Artery	
	Ovarian A	Ovarian Artery	
	FHR	Fetal Heart Rate	HR in General D measurements
	Asc Aorta	Ascending Aorta	D trace in General D measurements
	RVOT	Right Ventricle Outflow Tract	
LVOT	Left Ventricle Outflow Tract		
Calculation	/	/	
Study	/	/	

5.5 Obstetric Measurement Operations

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

Tips:	<ol style="list-style-type: none"> 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. 4. A measurement tool can be activated by clicking the item either in the measurement menu or touch screen menu, it is described as "Select/Click ... (certain item) in the measurement menu" in the following procedures.
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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 EDD or not in [System Preset] -> [OB] -> [Fetal Gestational Age].

For more details about GA, see "5.3 GA".

■ Auto OB Measurement (Smart OB)

There is an auto measurement method for commonly-used OB measurement items. The procedures are 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 track ball to modify the caliper if the result of 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.
2. Measure the maximum AFs of the four amniotic fluid pockets of pregnant woman, and AFI is calculated automatically.

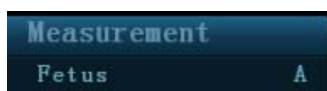
5.6 Multi-fetus Exam

The system allows multi-fetus (4 at most) examination.

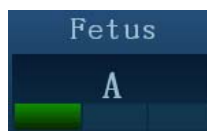
NOTE: Ensure that the Fetus displayed in the multi-fetus measurement menu is the one on which you are intended to perform the measurements.

Similar to the OB measurement,

1. Set the number of fetuses in [Gestations] via [Patient Info] -> [OB].
If the [Gestations] is set to be more than 1, the [Fetus] widget displays in the OB measurement menu (and touch screen), as shown in the figure below.



(on menu)



(on touch screen)

You can switch among [Fetus A], [Fetus B], [Fetus C] or [Fetus D] via the widget (or the [Fetus] button on touch screen).

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

1	HC(A)	10.64 cm	35.9 %
	GA	15w0d ±1w1d	
2	HC(B)	10.89 cm	45.6 %
	GA	15w2d ±1w1d	

- In the Obstetric report, select [Fetus A], [Fetus B], or [Fetus C] to switch among results of different fetuses.
 - Click [Fetus Compare] in report page to see a visualized comparison result.
 - 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 : Different 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.
- Tips: you can select whether to print multi-fetus data in one report via <Setup> -> [System Preset] -> [OB].

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.

- Click [Analyze] in the OB report page, the fetus Score is listed after the fetal analysis.

Fetus Score		
FHR	2	Reactive FHR ≥15bpm, duration ≥15s, ≥2 times
FM	2	FM ≥3 times (Continuous movement is deemed to 1 time)
FBM	2	FBM ≥1 times, duration ≥30s
FT	2	Limbs and spine stretch-bend ≥1 times
AF	2	One or more AF volume ≥2x2cm
Total Score	10	Normal, chronic asphyxia risk low

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:

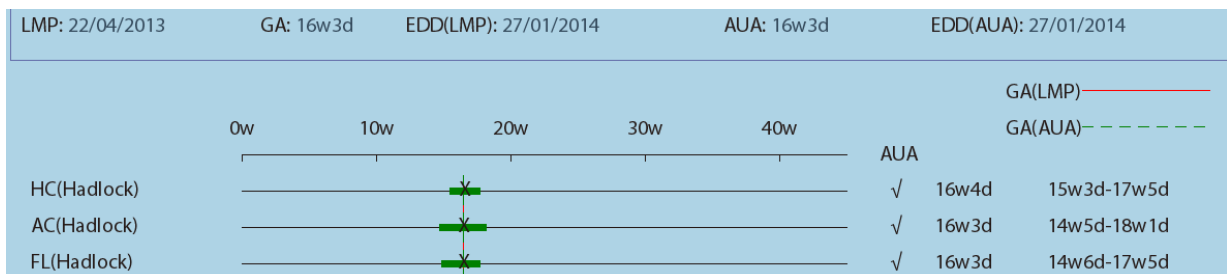
Total scores	Growth condition
8-10 scores	Normal, chronic asphyxia risk low
4-6 scores	Chronic asphyxia risk suspicious
0-2 scores	Chronic asphyxia risk high

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

5.7.2 Compare Bar

This function compares the clinical GA, ultrasound GA obtained from OB measurements and AUA (CUA).

1. Enter patient basic information and obstetric information in the [Patient Info] -> [OB] dialog box.
2. Perform one or more tools of GA related parameters.
3. In the report dialog box, select [Compare Bar] to pop up the following figure.



- Click the [Print] check box to determine whether to include the bar in the printed report or not.

5.7.3 Z-Score

As FL, BPD and GA is most relevant to fetus cardiac structure, and Z-Score regression equation is related to natural logarithm value of FL, BPD and GA variables, Z-Score of cardiac structures can be obtained by looking in the Z-Score table, which is important in fetus cardiac growth evaluation and intrauterine interventional therapy.

$$\ln(\text{predicted cardiac dimension})=m*\ln(\text{FL, GA or BPD})+c$$

$$\text{Z-Score}=(\ln(\text{actual})-\ln(\text{predicted cardiac dimension}))/\text{root MSE}$$

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 patient basic information and obstetric information in the [Patient Info] -> [OB] dialog box.
2. Measure BPD and FL.
3. Select Z-Score parameters (with Z-Score tag in the name) from measurement menu or touch screen to measure.
4. Open the report to check the Z-Score result.

Tips: Z-Score study is effective for fetus of 15~40 weeks.

5.7.4 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. Enter patient information and obstetric information in [Patient Info] -> [OB] dialog box.
2. Perform one or more tools of fetal growth parameters.
3. 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.
 - Different 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.
4. 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.
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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.
3. Select measurement tool in the menu (or touch screen) 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:	<ol style="list-style-type: none"> 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 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. 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).
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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		

Types	Tools	Descriptions	Methods or formulae	
	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		
Measurement	IVSs	Interventricular Septal thickness at end-systole	Distance in 2D General Measurements	
	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			

Types	Tools	Descriptions	Methods or formulae
	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	
	EPSS	Distance between point E and Interventricular Septum when mitral valve is fully open	Distance in 2D General Measurements
	TV Diam	Tricuspid valve Diameter	
	TVA	Tricuspid Valve Area	Area in 2D General Measurements
	IVC Diam(Insp)	Inferior vena cava inspiration Diameter	
	IVC Diam(Expir)	Inferior vena cava expiration Diameter	
Measurement	SVC Diam(Insp)	Superior vena cava inspiration Diameter	Distance in 2D General Measurements
	SVC Diam(Expir)	Superior vena cava expiration Diameter	
	LCA	Left Coronary Artery	
	RCA	Right Coronary Artery	
	VSD Diam	Ventricular Septal defect Diameter	
	ASD Diam	Atrial Septal defect Diameter	
	PDA Diam	Patent ductus Arteriosus Diameter	Distance in 2D General Measurements
	PFO Diam	Patent Oval Foramen Diameter	
	PEd	Pericardial Effusion at diastole	
	PEs	Pericardial Effusion at systole	
	HR	Heart Rate	Heart Rate in M General Measurements
	Diastole	End-diastolic Left Ventricular Measurement	FoldLine in 2D mode
	Systole	End-systolic Left Ventricular Measurement	
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)

Types	Tools	Descriptions	Methods or formulae
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	
	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		

Types	Tools	Descriptions	Methods or formulae
	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	
	HR	Heart Rate	Heart Rate in M General Measurements
	Diastole	End-diastolic Left Ventricular Measurement	Parallel method in M mode
	Systole	End-systolic Left Ventricular Measurement	
	TAPSE	Tricuspid Annular Plane Systolic Excursion	Distance 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	

Types	Tools	Descriptions	Methods or formulae
	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	Mitral Valve Isovolumic Relaxation Time	Time in Doppler General Measurements
	IVCT	Mitral Valve Isovolumic Contraction Time	
	MV E Dur	Mitral Valve E-wave Duration	
	MV A Dur	Mitral Valve A-wave Duration	
	LVOT Vmax	Left Ventricular Outflow Tract Maximum 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	Acceleration in Doppler General Measurements
	AAo Vmax	Ascending Aorta Maximum Velocity	D Vel in Doppler General Measurements
	DAo Vmax	Descending Aorta Maximum Velocity	
	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

Types	Tools	Descriptions	Methods or formulae
	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	
	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

Types	Tools	Descriptions	Methods or formulae
	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	
	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	
	VSD Vmax	Ventricular Septal Defect Maximum Velocity	D Vel in Doppler General Measurements
	ASD Vmax	Atrial Septal Defect Maximum Velocity	

Types	Tools	Descriptions	Methods or formulae
	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	
	HR	Heart Rate	
	RAP	Right Atrium Pressure	Select from the pop-up dialog box or input a value manually. See RAP measurement in "RVSP"
	Hepatic V S Vel	Hepatic Vein Systolic Peak Velocity	D Vel in Doppler General Measurements
	Hepatic V D Vel	Hepatic Vein Diastolic Peak Velocity	
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	
	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	MV Ea(medial)	Mitral Valve medial Early diastolic motion	D Vel in Doppler General Measurements
	MV Aa(medial)	Mitral Valve medial Late diastolic motion	
	MV Sa(medial)	Mitral Valve medial Systolic motion	
	MV ARA(medial)	Mitral Valve medial Acceleration Rate	
	MV DRa(medial)	Mitral Valve medial Deceleration Rate	D Vel in Doppler General Measurements
	MV Ea(lateral)	Mitral Valve lateral Early diastolic motion	
	MV Aa(lateral)	Mitral Valve lateral Late diastolic motion	
	MV Sa(lateral)	Mitral Valve lateral Systolic motion	
	MV ARA(lateral)	Mitral Valve lateral Acceleration Rate	
	MV DRa(lateral)	Mitral Valve lateral Deceleration Rate	

Types	Tools	Descriptions	Methods or formulae
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. A measurement tool can be activated by clicking the item either in the measurement menu or touch screen menu, it is described as "Select/Click ...(certain item) in the measurement menu" in the following procedures.
 5. Measurements of some tools described in this Chapter are to be performed in several imaging modes, please select appropriate imaging modes before 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 estimate 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	$CO(l/min) = SV(ml) \times HR(bpm) / 1000$
EF	Ejection Fraction	$EF(\text{No unit}) = SV(ml) / EDV(ml)$
SI	SV Index	$SI(\text{No unit}) = SV(ml) / \text{Body Surface Area (m}^2\text{)}$
CI	Cardiac output	$CI(\text{No unit}) = CO(l/min) / \text{Body Surface Area (m}^2\text{)}$
FS	Fractional Shortening	$FS(\text{No unit}) = (LVIDd (cm) - LVIDs [cm]) / LVIDd (cm)$

Result	Descriptions	Formulae
MVCF	Mean Velocity of Circumferential Fiber Shortening	$MVCF = (LVIDd(cm) - LVIDs(cm)) / (LVIDd (cm) \times ET (s))$

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
LVAAs 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	$EDV(SP Ellipse)(ml) = \frac{8}{3\pi} \times \frac{LVAd apical(cm^2)^2}{LVLd apical(cm)}$
ESV(SP Ellipse)	End-systolic Left Ventricular Volume	$ESV(SP Ellipse)(ml) = \frac{8}{3\pi} \times \frac{LVAAs apical(cm^2)^2}{LVLs apical(cm)}$
EDV Index(SP Ellipse)	End-diastolic Left Ventricular Volume Index	EDV Index=EDV/BSA
ESV Index(SP Ellipse)	End-systolic Left Ventricular Volume Index	ESV Index=ESV/BSA
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
 - LVA_d apical
 EDV value is then calculated.
3. In apical long-axis view at end-systole, measure the following parameters:
 - LVLs apical
 - LVA_s apical
 ESV value is then calculated.
 The system calculates SV and EF;
 If height and weight have been input already, SI, EDV Index and ESV Index are calculated.
4. Using touch screen knob to select HR source: 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	
LVA _d sax MV	Left Ventricular Area at Mitral Valve level at End-diastole in Short-axis view	Area in 2D General Measurements
LVA _s sax MV	Left Ventricular Area at Mitral Valve level at End-systole in Short-axis view	
LVA _d apical	Left Ventricular Long-axis Area at End-diastole in apical view	
LVA _s 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
EDV Index(BP Ellipse)	End-diastolic Left Ventricular Volume Index	EDV Index=EDV/BSA
ESV Index(BP Ellipse)	End-systolic Left Ventricular Volume Index	ESV Index=ESV/BSA
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:

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

*2 means:

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

■ 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, EDV Index and ESV index are calculated.
5. Using touch screen knob to select HR source: 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	
LVAAd sax MV	Left Ventricular Area at Mitral Valve level at End-diastole in Short-axis view	Area in 2D General Measurements
LVAAs 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	$EDV(ml) = 5/6 \times LVLd \text{ apical}(cm) \times LVAAd \text{ sax MV}(cm^2)$
ESV(Bullet)	End-systolic Left Ventricular Volume	$ESV(ml) = 5/6 \times LVLs \text{ apical}(cm) \times LVAAs \text{ sax MV}(cm^2)$
EDV Index(Bullet)	End-diastolic Left Ventricular Volume Index	$EDV \text{ Index} = EDV/BSA$
ESV Index(Bullet)	End-systolic Left Ventricular Volume Index	$ESV \text{ Index} = ESV/BSA$
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.

In apical long-axis view, measure the following parameters:

At end diastole: LVLd apical

At end systole: LVLs apical.

2. In short-axis view at mitral valve level, , measure the following parameters:

At end diastole: LVAAd sax MV, the EDV is calculated

At end systole: LVAAs sax MV, the ESV is calculated

The system calculates SV and EF; If height and weight have been input already, SI, EDV Index and ESV Index are calculated.

3. Using touch screen knob to select HR source: 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
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
EDV Index(Mod.Simpson)	End-diastolic Left Ventricular Volume Index	EDV Index=EDV/BSA
ESV Index(Mod.Simpson)	End-systolic Left Ventricular Volume Index	ESV Index=ESV/BSA
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:

$$EDV[mL] = \frac{LVLd_{apical} [cm]}{9} \times \left(4 \times LVAd_{sax\ MV} [cm^2] + 2 \times LVAd_{sax\ PM} [cm^2] + \sqrt{LVAd_{sax\ MV} [cm^2] \times LVAd_{sax\ PM} [cm^2]} \right)$$

*2 means:

$$ESV[mL] = \frac{LVLs_{apical} [cm]}{9} \times \left(4 \times LVAs_{sax\ MV} [cm^2] + 2 \times LVAs_{sax\ PM} [cm^2] + \sqrt{LVAs_{sax\ MV} [cm^2] \times LVAs_{sax\ PM} [cm^2]} \right)$$

■ 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, EDV Index and ESV Index are calculated.
5. Using touch screen knob to select HR source: 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	$EDV(ml) = \pi \times \frac{LVLd\ apical(cm)}{20} \times \sum_{i=1}^{20} r_i^2 (cm)$ <p>LVLd apical: Left Ventricular Long-axis Length at End-diastole in apical view, i.e. the long-axis length obtained in measurement.</p> <p>r_i : Radiuses obtained from diastolic measurement</p>
ESV(Simp SP)	End-systolic Left Ventricular Volume	$ESV(ml) = \pi \times \frac{LVLs\ apical(cm)}{20} \times \sum_{i=1}^{20} r_i^2 (cm)$ <p>LVLs apical: Left Ventricular Long-axis Length at End-systole in apical view, i.e. the long-axis length obtained in measurement.</p> <p>r_i : Radiuses obtained from systolic measurement</p>

Tools	Descriptions	Formulae
EDV Index(Simp SP)	End-diastolic Left Ventricular Volume Index	EDV Index=EDV/BSA
ESV Index(Simp SP)	End-systolic Left Ventricular Volume Index	ESV Index=ESV/BSA
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, EDV Index and ESV Index are calculated.

3. Using touch screen knob to select HR source: ECG or input.

The CO and CI are calculated automatically.

■ Measurement Methods

The endocardium can be measured using trace, spline or auto, rotate the knob under [EDV] or [ESV] on the touch screen to select the method.

● 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,

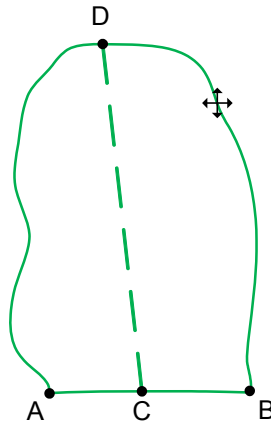
➤ C: Midpoint of A and B.

➤ 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 \updownarrow .
- 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 \updownarrow (with ABC 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
EDV Index(Simp BP)	End-diastolic Left Ventricular Volume	EDV Index=EDV/BSA
ESV Index(Simp BP)	End-systolic Left Ventricular Volume	ESV Index=ESV/BSA

Tools	Descriptions	Formulae
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:

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

*2 means:

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

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

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

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

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

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

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

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;
4. If height and weight have been input already, SV, EF, SI, EDV Index and ESV Index are calculated.
5. Using touch screen knob to select HR source: 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 measure manually

■ Study Results

Tools	Descriptions	Formulae
IVSd	Interventricular Septal Thickness at End-diastole	Distance in 2D/M General Measurements
LVPWd	Left Ventricular Posterior Wall Thickness at End-diastole	
IVSs	Interventricular Septal Thickness 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	$ESV(ml) = LVIDs(cm)^3$
EDV Index(Cube)	End-diastolic Left Ventricular Volume	$EDV\ Index = EDV/BSA$
ESV Index(Cube)	End-systolic Left Ventricular Volume	$ESV\ Index = ESV/BSA$
SV(Cube)	Stroke Volume	See table in "6.4.3.1 Left Ventricular Function"
CO(Cube)	Cardiac Output	

Tools	Descriptions	Formulae
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 (take the method using LVIDd, LVIDs, HR as an example)

1. Select [Cube] in the measurement menu.
2. Measure LVIDd in 2D or M mode.
The LVIDd and EDV are obtained.
3. Measure LVIDs in 2D or M mode.
LVIDs and ESV are obtained.
The system calculates SV, EF and FS;
4. Measure HR (heart rate) in M mode, or using touch screen knob to select HR source: ECG or input.
If height and weight have been input already, SI, CO, CI, EDV Index and ESV Index are calculated.
MVCF is calculated if LVET is measured.

In [Preset]-[System Preset]-[Application] screen, you can set the method for Cube/Teichholz/HR study.

Teichholz

■ 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 measure manually

■ Study Results

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

Tools	Descriptions	Formulae
IVSs	Interventricular Septal Thickness 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	$ESV(ml) = (7 \times (LVIDs(cm))^3) / (2.4 + LVIDs(cm))$
EDV Index(Teich)	End-diastolic Left Ventricular Volume	EDV Index=EDV/BSA
ESV Index(Teich)	End-systolic Left Ventricular Volume	ESV Index=ESV/BSA
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.

In [Preset]-[System Preset]-[Application] screen, you can set the method for Cube/Teichholz/HR study.

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 measure manually

■ Study Results

Tools	Descriptions	Formulae
IVSd	Interventricular Septal Thickness at End-diastole	Distance in 2D/M General Measurements
LVPWd	Left Ventricular Posterior Wall Thickness at End-diastole	
IVSs	Interventricular Septal Thickness at End-systole	
LVPWs	Left Ventricular Posterior Wall Thickness at End-systole	
EDV(Gibson)	End-diastolic Left Ventricular Volume	$EDV(ml) = \frac{\pi}{6} \times (0.98 \times LVIDd(cm) + 5.90) \times LVIDd(cm)^2$
ESV(Gibson)	End-systolic Left Ventricular Volume	$ESV(ml) = \frac{\pi}{6} \times (1.14 \times LVIDs(cm) + 4.18) \times LVIDs(cm)^2$
EDV Index(Gibson)	End-diastolic Left Ventricular Volume	EDV Index=EDV/BSA
ESV Index(Gibson)	End-systolic Left Ventricular Volume	ESV Index=ESV/BSA
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.

$$LV \text{ MASS-I (No unit) } = LV \text{ Mass (g) } / \text{ Body Surface Area (m}^2\text{)}$$

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	$LV\ Mass\ (g) = 1.04 \times ((LVPWd(cm) + IVSd(cm) + LVIDd(cm))^3 - LVIDd(cm)^3) - 13.6$
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
LVA _d sax Epi	Left Ventricular Epicardial Area at Papillary Muscle level at end-diastole in Short-axis view	Area in 2D General Measurements
LVA _d sax Endo	Left Ventricular Endocardial Area at Papillary Muscle level at end-diastole in Short-axis view	
LVL _d 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
LV MASS-I (A-L)	Index of Left Ventricular Mass	See LV Mass-I formula in “Left Ventricular Mass (LV Mass)”

*1 means:

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

Where,

$$t(cm) = \sqrt{(LVA_{d\ sax\ Epi}(cm^2) / \pi)} - \sqrt{(LVA_{d\ sax\ Endo}(cm^2) / \pi)}$$

■ Operating Procedures

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

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

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

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

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

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

■ 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: MVA Calculation by PHT method should be performed in CW mode, See MVA(PHT) in “6.3.3 Doppler Cardiac Measurement” for formula of 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	$MVA(VTI)(cm^2) = \frac{\pi \times |LVOT VTI(cm)| \times LVOT Diam(cm)^2}{4 \times |MV VTI(cm)|}$

■ 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	$AVA(VTI)(cm^2) = \frac{\pi \times |LVOT VTI(cm)| \times LVOT Diam(cm)^2}{4 \times |AV VTI(cm)|}$

■ 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	$LA\ Vol(A-L)(ml) = \frac{8\pi}{3} LAA(A4C)(cm^2) \times LAA(A2C)(cm^2) / LA\ Diam(cm)$
LA Vol Index (A-L)	Left Atrium Area	LA Vol Index= LA Vol/ BSA

■ 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	
LA Vol Index (A2C/A4C)	Left Atrium Volume Index	LA Vol Index= LA Vol/ BSA

■ 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
RA Vol Index (A4C)	Right Atrium Volume Index	RA Vol Index= RA Vol/ BSA

■ Operating Procedures

See “Simpson SP” for measurement procedures.

6.4.3.7 LV TEI (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	$LVIMP(\text{Nounit}) = \frac{MV\ C - O\ dur(s) - LVET(s)}{LVET(s)}$

■ 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

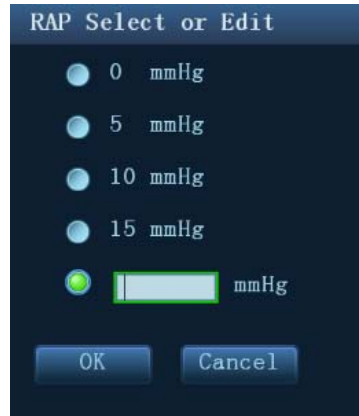
■ Study Results

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	$TR\ PGmax\ (mmHg) = 4 \times TR\ Vmax\ (m/s)^2$
RVSP	Right Ventricular Systolic Pressure	$RVSP(mmHg) = RAP(mmHg) + 4 \times (TR\ V\ max(m/s))^2$

■ 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	$PAEDP(mmHg) = RAP(mmHg) + 4 \times (PR Ved(m/s))^2$

■ Operating Procedures

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

6.4.3.10 RV TEI (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	$RVIMP(Nounit) = \frac{TV\ C-O\ dur(s) - RVET(s)}{RVET(s)}$

■ 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:

Item	Description	Operations
RVOT HR	Right ventricular outflow tract heart rate	Obtained from RVOT VTI measurement
RVOT SV	Right ventricular outflow tract stroke volume	
RVOT CO	Right ventricular outflow tract cardiac output	
RVOT SI	Right ventricular outflow tract SV index	
RVOT CI	Right ventricular output tract CO index	
LVOT HR	Left ventricular outflow tract heart rate	Obtained from LVOT VTI measurement
LVOT SV	Left ventricular outflow tract stroke volume	
LVOT SI	Left ventricular outflow tract SV index	
LVOT CO	Left ventricular outflow tract cardiac output	
LVOT CI	Left ventricular output tract CO index	

Item	Description	Operations
Qp/Qs	Flow ration of Pulmonary circulation and Systemic circulation	See below
Qp-Qs	Flow difference of Pulmonary circulation and Systemic circulation	

Where,

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

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

$$Q_p / Q_s(\text{Nounit}) = \frac{RVOT \text{ SV}(ml)}{LVOT \text{ SV}(ml)}$$

$$Q_p - Q_s(\text{Nounit}) = RVOT \text{ SV}(ml) - LVOT \text{ SV}(ml)$$

■ 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	$MR \text{ Flow}(ml) = \frac{2\pi MR \text{ Rad}(cm)^2 \times MR \text{ Als.Vel}(cm/s)}{|MR V \text{ max}(cm/s)|} \times |MR \text{ VTI}(cm)|$

Tools	Descriptions	Formulae
MR Flow Rate	Mitral Regurgitation Flow Rate	$MR \text{ Flow Rate(ml/s)} = 2\pi MR \text{ Rad(cm)}^2 \times MR \text{ Als.Vel(cm/s)}$
MR Fraction	Mitral Valve Regurgitation Fraction	$MR \text{ Fraction (Nounit)} = \frac{MR \text{ Flow(ml)}}{MV \text{ SV(ml)}} \times 100 \%$
MR EROA	Mitral Valve Effective Regurgitant Orifice Area	$MR \text{ EROA(cm)}^2 = \frac{2\pi MR \text{ Rad(cm)}^2 \times MR \text{ Als.Vel(cm/s)}}{|MR V_{max}(cm/s)|}$

■ 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	$AR \text{ Flow(ml)} = \frac{2\pi AR \text{ Rad(cm)}^2 \times AR \text{ Als.Vel(cm/s)}}{|AR V_{max}(cm/s)|} \times |AR \text{ VTI(cm)}|$
AR Flow Rate	Aortic Regurgitation Flow Rate	$AR \text{ Flow Rate(ml/s)} = 2\pi AR \text{ Rad(cm)}^2 \times AR \text{ Als.Vel(cm/s)}$
AR Fraction	Aortic Valve Regurgitation Fraction	$AR \text{ Fraction (Nounit)} = \frac{AR \text{ Flow(ml)}}{AV \text{ SV(ml)}} \times 100 \%$

Tools	Descriptions	Formulae
AR EROA	Aortic Valve Effective Regurgitant Orifice Area	$AREROA(cm)^2 = \frac{2\pi AR Rad(cm)^2 \times AR Als.Vel(cm/s)}{|ARVmax(cm/s)|}$

■ 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	$TR Flow(ml) = \frac{2\pi TR Rad(cm)^2 \times TR Als.Vel(cm/s)}{|TRV max(cm/s)|} \times |TR VTI(cm)|$
TR Flow Rate	Tricuspid Regurgitation Flow Rate	$TR Flow Rate(ml/s) = 2\pi TR Rad(cm)^2 \times TR Als.Vel(cm/s)$
TR Fraction	Tricuspid Valve Regurgitation Fraction	$TR Fraction (Nounit) = \frac{TR Flow(ml)}{TV SV(ml)} \times 100 \%$
TR EROA	Tricuspid Valve Effective Regurgitant Orifice Area	$TREROA(cm)^2 = \frac{2\pi TR Rad(cm)^2 \times TR Als.Vel(cm/s)}{|TRVmax(cm/s)|}$

■ 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	$\text{PR Flow(ml)} = \frac{2\pi \text{PR Rad(cm)}^2 \times \text{PR Als.Vel(cm/s)}}{|\text{PR V max(cm/s)}|} \times |\text{PR VTI(cm)}|$
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	$\text{PR Fraction (Nounit)} = \frac{\text{PR Flow(ml)}}{\text{PV SV(ml)}} \times 100 \%$
PR EROA	Pulmonary Valve Effective Regurgitant Orifice Area	$\text{PR EROA(cm)}^2 = \frac{2\pi \text{PR Rad(cm)}^2 \times \text{PR Als.Vel(cm/s)}}{|\text{PR Vmax(cm/s)}|}$

■ Operating Procedures

Same with the PISA MR measurement.

6.4.3.13 TDI

■ Study Items

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

■ Study Results

Tools	Descriptions	Formulae
Ea/Aa(medial)	MV medial E-Vel/ A-Vel	$Ea/Aa(medial)(Nounit) = \frac{Ea(medial)}{Aa(medial)}$
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	$Ea/Aa(lateral)(Nounit) = \frac{Ea(lateral)}{Aa(lateral)}$
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
MV E/Ea(medial)	Used to estimate the diastolic function of left ventricular	Calculate after measuring MV E Vel and MV Ea(medial): $MV E/Ea(medial)(Nounit) = \frac{MV E Vel}{MV Ea(medial)}$
MV E/Ea(lateral)		Calculate after measuring MV E Vel and MV Ea(lateral): $MV E/Ea(lateral)(Nounit) = \frac{MV E Vel}{MV Ea(lateral)}$

Tools	Descriptions	Formulae
MV E/Ea(medial+lateral)		Calculate after measuring MV E Vel, MV Ea(medial) and MV Ea(lateral) $E / Ea(\text{medial} + \text{lateral})(\text{Nounit}) = \frac{\text{MV E Vel}(cm / s)}{(\text{MVEa}(\text{medial})(cm / s) + \text{MVEa}(\text{lateral})(cm / s))/2}$

■ Operating Procedures

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

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".

6.6 References

Body Surface Are (BSA):

- DuBois, D., DuBois, E.F., "A Formula to Estimate the Approximate Surface Area if Height and Weight Be Known," Nutrition, Sept-Oct 1989, Vol. 5, No. 5, pp. 303-313.

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Stroke Volume (SV):

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- Roelandt, Joseph, Practical Echocardiology, vol. 1 of Ultrasound in Medicine Series, ed. Denis White, Research Studies Press, 1977, p. 124.

Ejection Fraction (EF):

- Pombo, J.F., "Left Ventricular Volumes and Ejection by Echocardiography," Circulation, 1971, Vol. 43, pp. 480-490.

Stroke Volume Index (SI):

- Gorge, G., et al., "High Resolution Two-dimensional Echocardiography Improves the Quantification of Left Ventricular Function", Journal of the American Society of Echocardiography, 1992, 5: 125-34.
- Roelandt, Joseph, Practical Echocardiology, vol. 1 of Ultrasound in Medicine Series, ed. Denis White, Research Studies Press, 1977, p. 124.

Cardiac Output (CO):

- Belenkie, Israel, et al., "Assessment of Left Ventricular Dimensions and Function by Echocardiography," American Journal of Cardiology, June 1973, Vol. 31

Cardiac output Index (CI):

- The Merck Manual of Diagnosis and Therapy, ed. 15, Robert Berkon, ed., Merck and Co., Rahway, NJ, 1987, p. 378.
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EDV(B-P Ellipse):

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ESV(B-P Ellipse):

- Folland, E.D., et al., "Assessment of Left Ventricular Ejection Fraction and Volumes by Real-Time, Two-Dimensional Echocardiography," Circulation, October 1979, Vol. 60, No.4, pp. 760-766

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- Weyman, Arthur E., Cross-Sectional Echocardiography, Lea & Febiger, 1985, p. 295. Folland, E.D., et al., "Assessment of Left Ventricular Ejection Fraction and Volumes by Real-Time, Two-Dimensional Echocardiography," Circulation, October 1979, Vol. 60, No.4, pp. 760-766

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ESV (Cube):

- Dodge, H.T., Sandler, D.W., et al., "The Use of Biplane Angiography for the Measurement of Left Ventricular Volume in Man," American Heart Journal, 1960, Vol. 60, pp. 762-776.
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- John H. Phillips, "Practical Quantitative Doppler Echocardiography", CRC Press, 1991, .Page 96.

LA/Ao:

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- Schiller, N.B., et al., "Recommendations for Quantification of the LV by Two-Dimensional Echocardiography," J Am Soc Echo, Sept-Oct, 1989, Vol. 2, No. 5, p. 364.

MV CA/CE:

- Maron, Barry J., et al., "Noninvasive Assessment of Left Ventricular Diastolic Function by Pulsed Doppler Echocardiography in Patients with Hypertrophic Cardiomyopathy, J Am Coll Cardio, 1987, Vol. 10, pp. 733-742.

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- Stamm, R. Brad, et al., "Quantification of Pressure Gradients Across Stenotic Valves by Doppler Ultrasound," J Am Coll Cardiol, 1983, Vol. 2, No. 4, pp. 707-718.

Right Ventricular Systolic Pressure:

- Stevenson, J.G., "Comparison of Several Noninvasive Methods for Estimation of Pulmonary Artery Pressure," Journal of the American Society of Echocardiography, June 1989, Vol. 2, pp. 157-171.
- Yock, Paul G. and Popp, Richard L., "Noninvasive Estimation of Right Ventricular Systolic Pressure by Doppler Ultrasound in Patients with Tricuspid Regurgitation," Circulation, 1984, Vol. 70, No. 4, pp. 657-662.

MV E/Ea

- Recommendations for the Evaluation of Left Ventricular Diastolic Function by Echocardiography" 2009 Published by Elsevier Inc. on behalf of the American Society of Echocardiography. P11

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.
3. Select measurement tool in the menu (or touch screen) 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.

2D Vascular Measurements

Types	Tools	Descriptions	Methods or formulae
Measurement	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	$\text{Stenosis D (No unit)} = \frac{\text{Normal Diam(cm)} - \text{Resid Diam (cm)}}{\text{Normal Diam (cm)}} \times 100\%$ $\text{Stenosis D (No unit)} = \left| \frac{D1-D2}{\text{MAX}(D1, D2)} \right| * 100\%$ <p>Where, D1 and D2 refers to the measured vascular diameter, and MAX (D1, D2) represents the larger value of the two.</p>
	Stenosis A	Stenosis Area	$\text{Stenosis A (No unit)} = \left| \frac{A1-A2}{\text{MAX}(A1, A2)} \right| * 100\%$ <p>Where, A1 and A2 refers to the measured vascular area, and MAX (D1, D2) represents the larger value of the two.</p>
Study	IMT	Intima-Media Thickness	See below

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	

Types	Tools	Descriptions	Methods or formulae
	Subclav A	Subclavian Artery	D trace in General D measurements
	Axill A	Axillary Artery	
	Brachial A	Brachial Artery	
	Ulnar A	Ulnar Artery	
	Radial A	Radial Artery	
	Subclav A	Subclavian Artery	
	Axill V	Axillary Vein	
Measurement	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	
	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	
	Measurement	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	

Types	Tools	Descriptions	Methods or formulae
	MCA	Middle Cerebral Artery	
	PCA	Posterior Cerebral Artery	
	AComA	Ant.communicating br.	
	PComA	Post.communicating br.	
	BA	Basilar Artery	
Measurement	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	
		ASP	Ankle Systolic Pressure	Type in
	BSP	Brachial Systolic Pressure	
Calculation	ICA/CCA(PS)	/	See below
Study	ABI	Ankle Brachial Index	See below

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. A measurement tool can be activated by clicking the item either in the measurement menu or touch screen menu, it is described as "Select/Click ...(certain item) in the measurement menu" in the following procedures.
 5. 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

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

1. Select [ICA/CCA] in the measure menu.
2. Measure PS value of ICA and CCA using 2 PT method in D trace, and the system calculates the stenosis. Where, ICA value can be measured in proximal, middle and distal end where CCA adopts the distal PS value by default.

7.4.3 Study Tool Operations


IMT

- | | |
|--------------|--|
| NOTE: | <ol style="list-style-type: none">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 | 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. |
|-------------|---|

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.

$$\text{ABI} = \text{ASP}/\text{BSP}$$

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

Stenosis D: Honda, Nobuo, et al., "Echo-Doppler Velocimeter in the Diagnosis of Hypertensive Patients: The Renal Artery Doppler Technique," *Ultrasound in Medicine and Biology*, 1986, Vol. 12(12), pp. 945-952.

Stenosis A: Jacobs, Norman M., et al., "Duplex Carotid Sonography: Criteria for Stenosis, Accuracy, and Pitfalls," *Radiology*, 1985, 154:385-391.

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.
3. Select measurement tool in the menu (or touch screen) 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
		UT H	Uterine Height	Same as Distance measurement in 2D General Measurements
		UT W	Uterine Width	
		UT L	Uterine Length	
		Cervix L	Uterine Cervix Length	Same as Distance, Trace and Spline measurement in 2D General Measurements
		Cervix H	Uterine Cervix Height	
		Cervix W	Uterine Cervix Width	Same as Distance measurement in 2D General Measurements
		Endo	Endometrium Thickness	
		Ovary L	Ovary Length	
		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 Sum		/		
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.
 4. A measurement tool can be activated by clicking the item either in the measurement menu or touch screen menu, it is described as "Select/Click ...(certain item) in the measurement menu" in the following procedures.

8.4.1 Measurement Tool Operations

All items are measured by Distance method except for UT L and Cervix L which support the Distance, Trance and Spline methods.

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.

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 is calculated automatically.

UT Sum

Function: measures UT L, UT H and UT W, calculates UT Sum.

$$\text{Uterus Sum (cm)} = \text{UT L (cm)} + \text{UT H (cm)} + \text{UT W (cm)}$$

1. Select [UT Sum] in the measurement menu.
2. Use the Distance method in 2D General Measurements to measure UT L, UT H and UT W. UT Sum is calculated automatically.

UT-L/ CX-L

Function: measures UT L and Cervix L, calculates their ratio UT-L/CX-L.

$$\text{UT-L/CX-L (No unit)} = \text{UT L (cm)} / \text{Cervix L (cm)}$$

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 Sum 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	Average Diam = $\frac{(Length + Width)}{2}$
	3-distance	Average Diam = $\frac{(Length + Width + Height)}{3}$
Follicle Volume	1-distance	Vol = $\frac{\pi}{6} (Length)^3$
	2-distance	Vol = $\frac{\pi}{6} (Length)^2 \times Width$
	3-distance	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.

Wherein the calculation methods of the follicle diameter and volume can be preset via [Setup]-> [System Preset]-> [Application].

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 Sum: 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.
3. Select measurement tool in the menu (or touch screen) 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 measurements (no measurement tools in M mode).

Modes	Types	Tools	Descriptions	Methods or formulae
2D	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	
		Prostate L	Prostate Length	
		Prostate H	Prostate Height	
		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	
		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			

Modes	Types	Tools	Descriptions	Methods or formulae
2D	Measurement	Prostate Mass1 d1-3	/	Distance in 2D General Measurements
		Prostate Mass2 d1-3	/	
		Prostate Mass3 d1-3	/	
		Testis Mass1 d1-3	/	
		Testis Mass2 d1-3	/	
		Testis Mass3 d1-3	/	
		Epididymis L	Epididymis Length	
		Epididymis W	Epididymis Width	
		Epididymis H	Epididymis Height	
		Scrotal Wall Thickness	/	
	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		/		
Mass1-10		/		
Epididymis		/		
Doppler	Measurement	Testis A	Testis Aorta	Distance in 2D General Measurements
		Testis V	Testis Vein	
		Epididymis A	Epididymis Aorta	
		Epididymis V	Epididymis Vein	

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.
 4. A measurement tool can be activated by clicking the item either in the measurement menu or touch screen menu; it is described as "Select/Click ... (certain item) in the measurement menu" in the following procedures.

9.4.1 Measurement Tool Operations

Operations of all Urology measurement tools are the same as Distance measurement of 2D General Measurements.

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.

Mass

Function: measures 3 distances in the mass.

Take Mass1 as an example, the procedures are as follows:

1. Select [Mass1] in the measurement menu.
Rotate the knob under [Position] on the touch screen to record the mass position.
2. Use the Distance tool in the 2D General Measurement to measure Mass1 d1, Mass1 d2 and Mass1 d3.

Epididymis

Function: measures Epididymis L, Epididymis H and Epididymis W.

NOTE: Need to be measured in left and right side respectively.

1. Select the [Epididymis] in the measurement menu.
2. Use the method of Distance measurement of 2D General Measurements to measure Epididymis L, Epididymis H and Epididymis W.

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.
3. Select measurement tool in the menu (or touch screen) 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		
		Testis W	Testicular Width		
		Epididymis L	Epididymis Length		
		Epididymis W	Epididymis Width		
		Epididymis H	Epididymis Height		
		Scrotal Wall Thickness	/		
		Mass1~10 L	Mass Length		Distance in 2D General Measurements
		Mass1~10 W	Mass Width		
	Mass1~10 H	Mass Height			
	Nip.-Mass 1~10 Dist.	Distance between nipple and mass			
	Skin-Mass 1~10 Dist.	Distance between skin and mass			
	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".		
	Mass1~10	/	Volume (3 Dist) in 2D General Measurements		
M	/	/	/	/	

Modes	Types	Tools	Descriptions	Methods or formulae
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.
 4. A measurement tool can be activated by clicking the item either in the measurement menu or touch screen menu, it is described as "Select/Click ... (certain item) in the measurement menu" in the following procedures.

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 L, Mass W and Mass H to calculate the Mass Volume, as well as measures the Nip.-Mass Dist and Skin-Mass Dist. Up to 10 masses can be measured.

Take Mass1 as an example, the procedures are as follows:

1. Select [Mass1] in the measurement menu.

Rotate the knob under [Position] on the touch screen to record the mass position.

Rotate the knob under [Side] on the touch screen to record the mass side.

2. Use the Distance tool in the 2D General Measurement to measure Mass1 L, Mass1 W and Mass1 H.
3. Use the Distance tool in the 2D General Measurement to measure Nip.-Mass Dist and Skin-Mass Dist.

The measurements and the calculated Mass Volume are recorded in the report.

Testis

The same as "Testis" in "9 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: Volumetrie der Schilddruesenlappn mittels Realtime-Sonographie; J Brunn, U. Block, G. Ruf, et al.; Dtsch.med. Wschr.106 (1981), 1338-1340.)
(k= 0.479)

Thyroid Vol: 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)
(k=0.523)

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.
3. Select measurement tool in the menu (or touch screen) 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

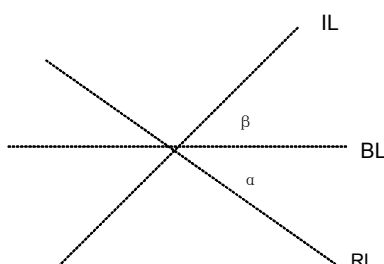
The HIP calculation assists in assessing the development of the infant hip. In this calculation, three straight lines are superimposed on the image and aligned with the anatomical features. The two angles are calculated and displayed.

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.

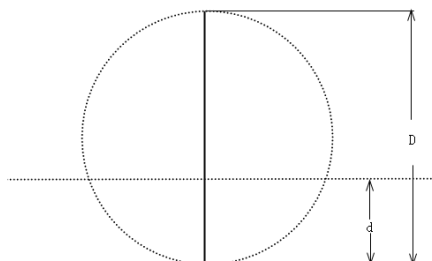
DISLOCATION TYPE	CRITERIA			RESULT
	α	β	Patient	
I	$\alpha \geq 60^\circ$	$\beta < 77^\circ$	All ages	I
II	$50^\circ \leq \alpha \leq 59^\circ$		Younger than three months of age	IIa
	$50^\circ \leq \alpha \leq 59^\circ$	$\beta < 55^\circ$	Three months of age or older than three months	IIb
	$43^\circ \leq \alpha \leq 49^\circ$	$\beta \leq 77^\circ$	All ages	IIc
	$43^\circ \leq \alpha \leq 49^\circ$	$\beta > 77^\circ$	All ages	IId
III	$\alpha < 43^\circ$	$\beta > 77^\circ$	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:**
1. For the definitions of measurement, calculation and study, refer to "1.3 Measurement, Calculation and Study".
 2. A measurement tool can be activated by clicking the item either in the measurement menu or touch screen menu, it's described as "Select/Click ... (certain item) in the measurement menu" in the following procedures.

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 <Angle> 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 Hip 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.
4. Select the item/tool to start the measurement.
5. Press <Report> to view and output measurement report.

12.2 EM Measurement Tools

The commonly used measurement tools are contained in the EM package corresponding to each EM exam mode.

- NOTE:**
1. Measurement tools in each EM package depend on the specific measurement data preset for each ultrasound system.
 2. For detailed descriptions of the measurement item, please refer to the corresponding application chapter.
 3. 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 type
- Printing/ previewing the report
- Exporting Report

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

