MAGIC 3
ULTRASOUND UNIT

ADVANCED MANUAL

Art. No. 304350

Content

Intellectual Property Statement

Preface

This manual details the procedures for operating the DC-N3 PRO/DC-N3T/DC-N3S/DC-N3 Diagnostic Ultrasound System. Carefully read and understand the manual before using the system to ensure its safe and correct operation.

> **NOTE:** When you operate the system, you can refer to the following manuals:
> - Operator's Manual (Basic Volume)
> - Acoustic output data

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

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

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

Product Differences

DC-N3 PRO and DC-N3T: not sold in FDA region.

DC-N3S: not sold in Canada.

Product Model	B-Hist	B-Profile
DC-N3	√	√
DC-N3T	×	√
DC-N3S	×	√
DC-N3 PRO	√	√
NOTE:"√" means the option is configured on the product.		

Safety Precautions

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.

Meaning of Safety Symbols

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

Safety Precautions

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

⚠**CAUTION:**

1. **Select the proper patient image and measurement tools. Only the professionals can decide the appropriate measurements and results.**

2. **Confine measurement calipers to the actual Region of Interest (ROI). Measurements that extend beyond the ROI will be incorrect.**

3. **Before examining a new patient, it is necessary to press the < End Exam> key to end the current scan and delete the patient information and data. Otherwise, new patient data will be combined with the previous patient.**

4. **When the system is turned OFF or the < End Exam> key is pressed, all the data that have not been saved are lost.**

5. **Changing modes during a measurement will delete the General Measurement data.**

6. **Pressing the < Freeze> key to unfreeze the image during a measurement will clear the General Measurement data.**

7. **Pressing the < Measure> key during a measurement will clear the General Measurement data.**

8. **Pressing the < Clear> key will clear the measurement caliper, all data in the result window, comments and body mark.**

9. **In dual-B imaging mode, the measurement results of the merged image can be inaccurate. Therefore, the results are provided for reference only, not for confirming a diagnosis.**

10. **Quality of the extended image constructed in iScape (panoramic imaging) dependents on the skill of operator. Extra attention should be paid during the iScape measurement since the results could be inaccurate.**

11. **Ensure that measurement data correctly corresponds to the fetus during the Obstetric Measurement.**

12. **Fully understand the functionality of this system by referring to the *Operator's Manual - Basic Volume*.**

13. **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. 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 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

Key	Basic operations
Caliper	Enters/exits general measurement. Press <Esc> to exit measurement status.
Measure	To enter/exit the application measurement. Press <Esc> to exit measurement status.
Update	Press <Update> to switch between the fixed end and active end of the caliper during a 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.
Back	To return to the previous measurement step, or delete the caliper backwards.

Key	Basic operations
Clear	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	To move the cursor.
Multifunction 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 is as follows:
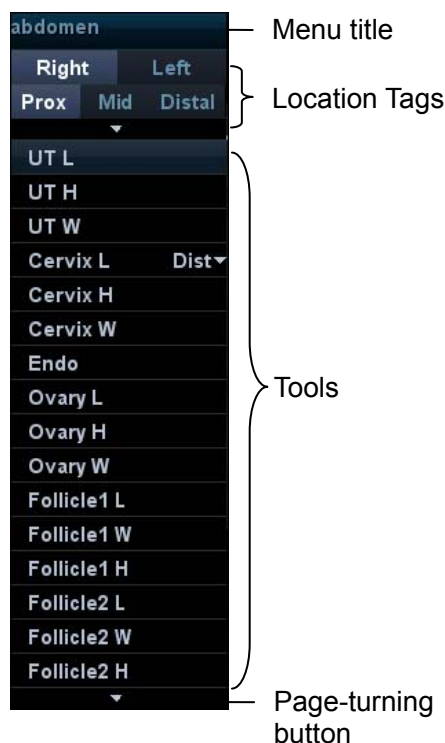
Click the arrow beside the measure tool in the main menu to open the sub-tools. Click [Return] on the sub-menu to return to the main menu.

1.2.1 Menu Title

It displays the name of the measure menu, i.e. name of the measurement package.

■ To switch to other measurement menus

1. Move cursor to the menu title and the submenu pops up displaying other measure packages available.

2. Move the cursor to an item and press <Set>.

1.2.2 Measurement Location

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

- Side (Left/Right): 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.
- To Select the Measurement Location
    1. Move the cursor to the location widgets (e.g. Side).
    2. Press <Set> to select the Measurement location.

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

1.2.3 Measurement Tool

There are two kinds of measurement tools.

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

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

To Active the Measurement Tool

The procedures are as follows:

1. Select the tool by moving the cursor to the item on the menu and press <Set>.
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.
2. Select the method.
3. 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.)

Features	Descriptions
Page up/down	Use the ▲/▼ on the menu
Unavailable item	Grayed out. Need switch to the proper imaging mode to enable it.
Result window	To show/hide the result window by clicking [Result] on the soft menu.

1.2.4 Mode Switching

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

1.3 Measurement, Calculation and Study

There are three kinds of measurement items.

Measurement

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

Calculation

Results of calculations are automatically derived by the system, using other measured or calculated values as parameters, they are indicated by "" 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.

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.

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.

$$+\times\asymp\maltese\ominus\times[+]|\boxtimes|$$
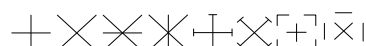
These symbols display in calipers as well as in the result window to identify different measurements.

> **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.

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

1.5.1   Result Display

Select [Show Result] on the menu 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. 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

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

Auto Spectrum Calculation Assignment

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

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 and 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:

- 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 to clear all measurement data.

Entering Ultrasound Remarks

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

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.
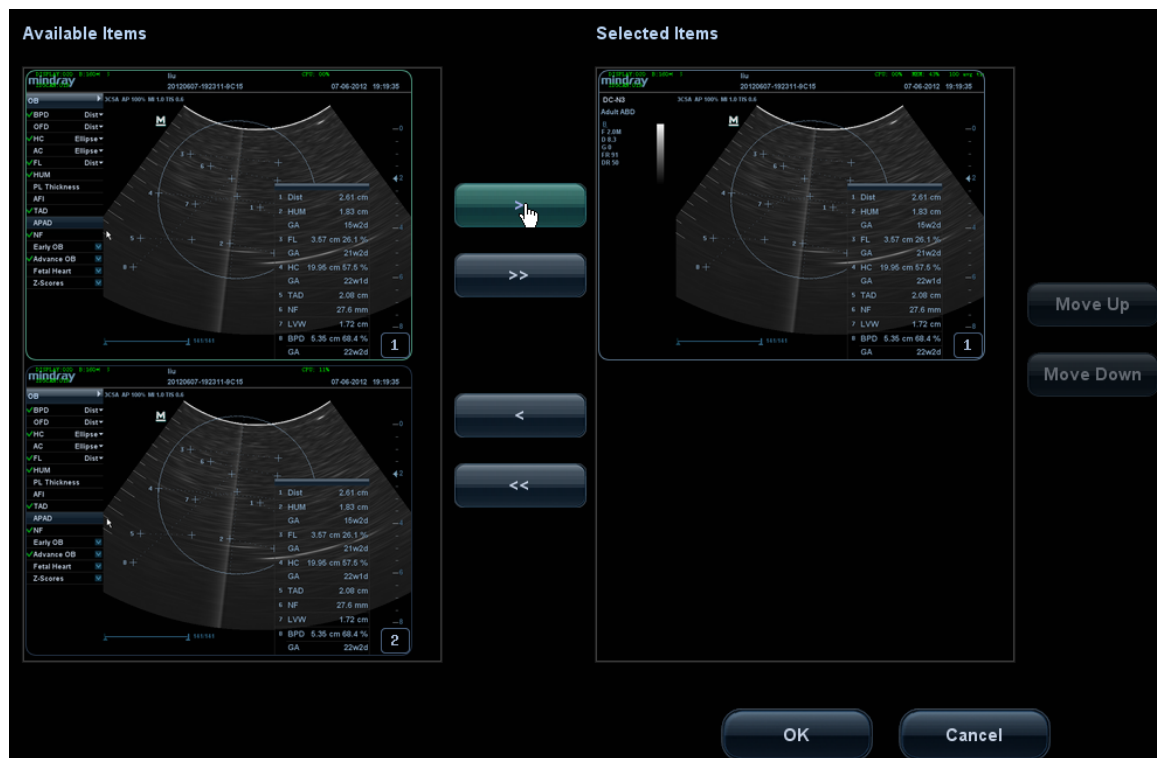
Left Column: Image(s) saved in current exam.
Right Column: Images selected to add into the report.

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.

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   Exporting Report

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

1. In the report dialog box, select [Export].
2. Select the drive, directory and file name in the dialogbox popped up.
3. Select a file type.
4. Click [OK].

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

[New]:   To create a new template.

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

[Rename]:   To rename a selected directory.

1.7.6   Fetal Growth Curve

If [Obstetric] in the [Patient Info] is selected in the report template (see "5.7.3 Fetal Growth Curve"), you can view the fetal growth curve by clicking the [Growth] button in the report page. See "5.7.3 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

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] or [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 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
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: ■ 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

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".

GA and FG formulae are shown in table below:

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

Measurement Tools	GA	FG
EFW	Tokyo Hadlock	Hadlock Tokyo Hansmann Brenner Willian
EFW2	Tokyo Hadlock	Hadlock Tokyo Hansmann Brenner Willian
GS	Hansmann China Tokyo Rempen	Hansmann Hellman Tokyo Rempen
CRL	Tokyo Jeanty Hadlock Nelson Robinson Rempen Hansmann China ASUM RobinsonBMUS	Hadlock ASUM Robinson Tokyo Rempen Hansmann
BPD	Tokyo Hadlock Jeanty Hansmann Merz Rempen ChittyOI Osaka China Nicolaides ASUM Kurtz	Tokyo Hadlock Kurtz Jeanty Sabbagha Hansmann Merz Rempen ChittyOI Osaka Nicolaides ASUM

Measurement Tools	GA	FG
HC	Hadlock Jeanty Hansmann ChittyDer ChittyPL Nicolaides ASUM	Hadlock Merz Hansmann ChittyPL ChittyDer Nicolaides ASUM
AC	Hadlock Jeanty Merz ChittyPL Nicolaides ASUM CFEF Hansmann	Hadlock Jeanty Merz ChittyPL ChittyDer Nicolaides ASUM CFEF Hansman
FL	Tokyo Hadlock Jeanty Hohler Merz Hansmann Warda Chitty Osaka China Nicolaides ASUM	Tokyo Hadlock Merz Hansmann O'Brien Warda Chitty Osaka Nicolaides ASUM
OFD	Hansmann Nicolaides ASUM	Hansmann Merz Nicolaides ASUM
APAD	/	Merz
TAD	/	Merz
FTA	Osaka	Osaka
THD	Hansmann	Hansmann
HUM	ASUM Jeanty	ASUM Merz
Ulna	/	Merz

Measurement Tools	GA	FG
Tibia	/	Merz
RAD	/	Merz Jeanty
FIB	/	Merz Jeanty
CLAV	Yarkoni	Yarkoni
TCD	Hill Nicolaides	Goldstein Hill Nicolaides
OOD	Jeanty	/
Cist Magna	/	Nicolaides
Mean Sac Diam	Daya	/
AFI	/	Moore
Umb A RI	/	JSUM
Umb A PI	/	JSUM
MCA RI	/	JSUM
MCA PI	/	JSUM

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 EAW2 of GA/ FG are different from those in the [Fetal Weight] page.
	■ EFW formulae of GA/ FG are used to perform the GA calculation or the Fetal Growth Curve based on EFW.
	■ EFW formulae in the [Fetal Growth] page are used in EFW calculation based on some OB measure results (e.g. AC).

The Fetal Weight formulae are shown in the following table:

Formula	Description	EFW	Measurement Tools
Hadlock (AC, FL)	EFW= 10^(1.304+ (0.05281*AC)+ (0.1938*FL)- (0.004*AC*FL))	g	cm
	SD=0.154*EFW SD Type=±2SD	g	g
Hadlock (AC, FL, BPD)	EFW= 10^(1.335 -(0.0034*AC*FL) + (0.0316*BPD) + (0.0457*AC) + (0.1623*FL))	g	cm
	SD=0.146*EFW SD Type=±2SD	g	g
Hadlock (AC, FL, HC)	EFW= 10^(1.326-(0.00326*AC*FL)+ (0.0107*HC)+ (0.0438*AC)+ (0.158*FL))	g	cm
	SD=0.148*EFW SD Type=±2SD	g	g
Hadlock (AC, FL, HC, BPD)	EFW= 10^(1.3596- (0.00386*AC*FL)+ (0.0064*HC)+ (0.00061*BPD*AC)+ (0.0424*AC)+ (0.174*FL))	g	cm
	SD=0.146*EFW SD Type=±2SD	g	g
Shepard	EFW (Kg) = 10^(-1.7492+ (0.166*BPD)+ (0.046*AC)- (2.646*AC*BPD/1000))	kg	cm
	SD=0.202*EFW SD Type=±2SD	g	g
Merz1	EFW=-3200.40479+(157.07186*AC)+(15.90391*(BPD^2))	g	cm
Merz2	EFW=0.1*(AC^3)	g	cm
Hansmann	EFW = (-1.05775*BPD)+ (0.0930707*(BPD^2)+ (0.649145*THD)- (0.020562*(THD^2)+ 0.515263	kg	cm
Tokyo	EFW=(1.07*(BPD^3))+(3.42*APTD*TTD*FL)	g	cm
Osaka	EFW=(1.25674*(BPD^3))+(3.50665*FTA*FL)+6.3	g	cm
Campbell	EFW (Kg) = EXP (-4.564+(0.282*AC)-(0.00331* (AC^2)))	kg	cm

Weight Percentile for Age

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

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

■ Clinical Percentile (CP)

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

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

average EFW x1.25 > EFW > average EFW x0.75

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

■ Ultrasound Percentile (UP)

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

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 √.

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

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

3. Set the fetal weight display.

   a) Enter the [Fetal Weight] page.

   b) Select the [Fetal Weight Unit].

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

   c) Select the formula to calculate the weight percentile.

   Select the formula from the drop-down list of [EFW-GP].

4. Click [Save] to confirm.

2.3.2.2　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	…	…	…	…

Tips:

➤ 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

➤ ±1SD

➤ ±2SD

➤ 3%~97%

➤ 5%~95%

➤ 10%~90%

● Unit of the measurement value: according to the table to import, select from mm, cm, g, kg, cm^2 or mm^2.

● 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	...	...	...	...

Tips:
> ➤ 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
> ➤ ±1SD
> ➤ ±2SD
> ➤ 3%~97%
> ➤ 5%~95%
> ➤ 10%~90%

- Unit of the measurement value: according to the table to import, select from mm, cm, g, kg, cm^2 or mm^2.
- 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.

2.3.2.3 Deleting Formula

Deleting is not supported by system-configured formulae.

1. In the [OB] page, select the OB item from the left column.
2. Select a formula from Author column.
3. Select [Delete] to delete the formula.

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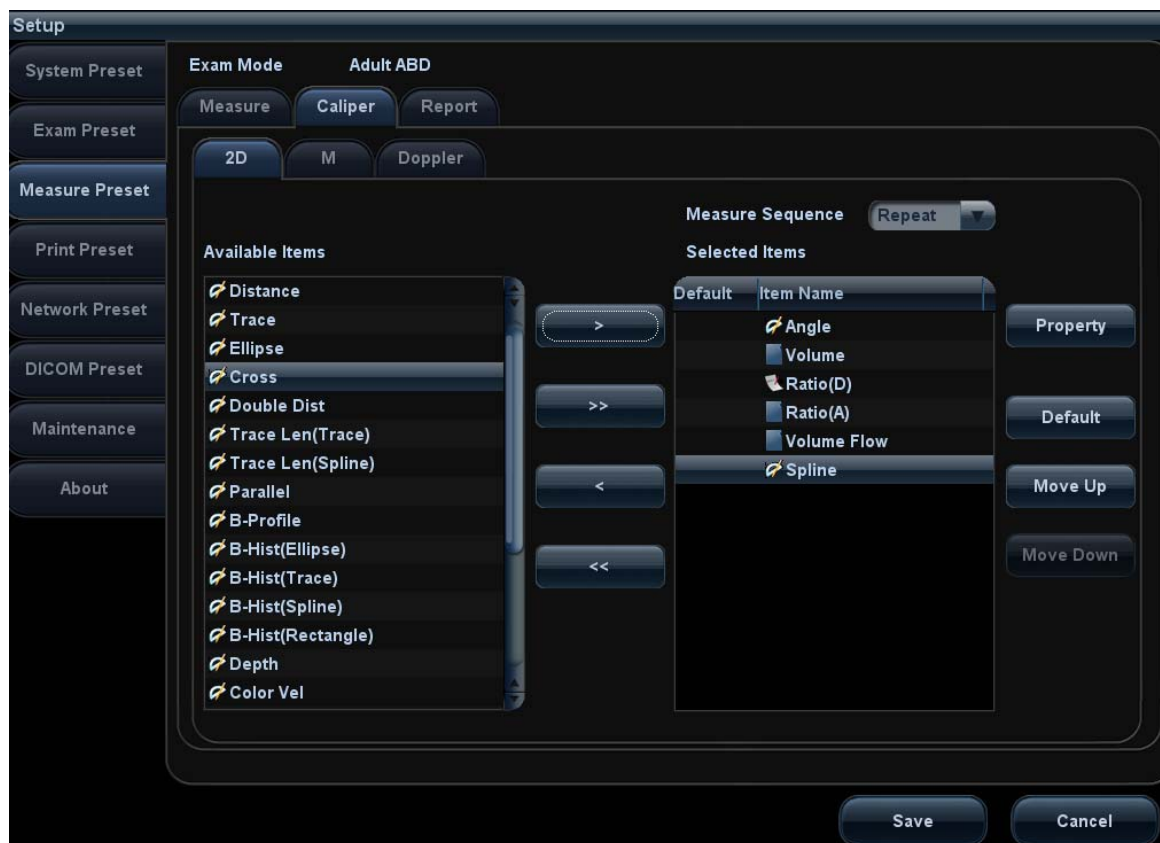
NOTE:	The general measurement menu preset here are exam mode-related.
	E.g. change of OB general measure preset will not affects the Adult ABD general measurement menu.

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.

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	☑	cm/s	Last
ED	☑	cm/s	Last
TAMAX	☑	cm/s	Last
TAMEAN	☑	cm/s	Last
PI	☑		Calc after Mean
RI	☑		Calc after Mean
S/D	☑		Calc after Mean
HR	☑	Bpm	Last
Vel	▭	cm/s	Last
PV	▭	cm/s	Last
MD	▭	cm/s	Last
PPG	▭	mmHg	Calc after Mean

OK   Cancel

Descriptions of the attributes are shown in the following table.

Attributes	Descriptions

Item Name & Result	Results obtained from D trace are listed. The selected items will be displayed in the result window.
	■ If PV is selected, other results become deselected (except the temporary result "velocity").
	■ Some results such as PS and ED can derived via simply method (e.g. Velocity); but others such as TAMAX can only derived via complicated method like Manual, Spline, Auto etc.
	   ● Only Vel in the [Method] is available if only PS or ED is selected.
	   ● Only 2 PT in the [Method] is available if both PS and ED are selected (with others deselected).
	   ● More complicated methods to obtain PS and TAMAX simultaneously are available if both PS and TAMAX are selected.

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, a default measurement package for the current exam mode needs to be added. You can input the package name directly in the [Measure Package] text box then add items into it; or click [Advanced] to enter the dialog box to add a new package.
   - If the package appears is not the one desired, click [Advanced] and select a new default package for current exam mode.

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

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".

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. Items in package are presettable and may belong to different application regions.

Click [Advanced] in the [Measure Preset] page to enter the following page.
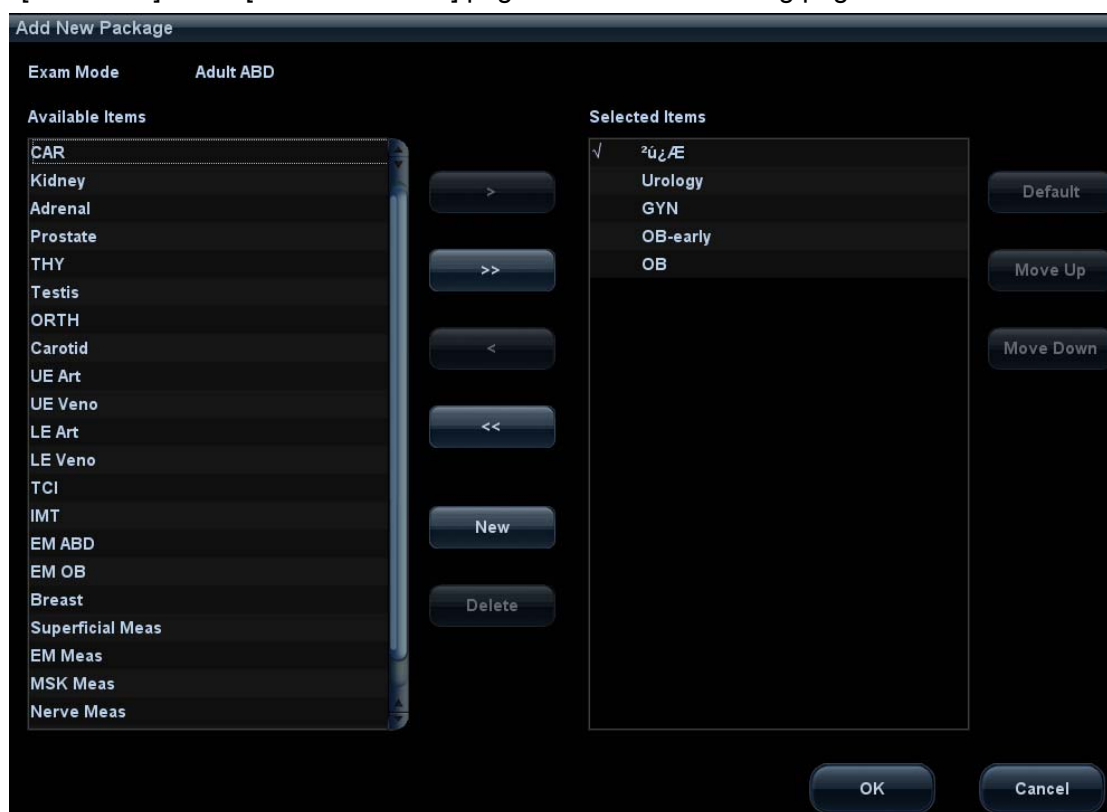
Where,

- [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.

Adding / Removing Package

Adding/ removing the package by pressing:

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

Deleting Package

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

2. Click [Delete].

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

Setting Default Package

1. Select a package in the [Selected Items] list, click [Default].

2. The default package is marked with a "√".

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

Adjusting Package Position

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

2.4.2.3 Preset of Measurement Menu

In the [Measure Preset] page, select [Menu] tab in the [Selected Items] field.

The following operations are available.

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

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

Adding/ Removing Item

■ Adding Item

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

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

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

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 "√".

   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.

User-defined Study Item

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

■ Add Study

   1. Click [Add Study].

   2. Input the study name.

   3. Click [OK].

■ 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. |

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 and freeze the image.
3. Press <Caliper> to enter the 2D/M/Doppler general measurement menu.
4. Select an item from the general measurement menu to start the measurement.

Tips:	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 in the measurement menu, it is described as "Select/Click ...(certain item) in the measurement menu" in the following procedures.

3.2   2D General Measurements

3.2.1   Depth

Function:

- Sector 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.

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&Circ

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

Trace

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

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

   Anticlockwise: to cancel a series of points.

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

Spline

1. Select [Spline] from the 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 <Back>.

7. Press <Set> twice to anchor the last reference point. The spline is fixed and the results display in the result window.

Cross

1. Select [Cross] from the measurement menu. The cursor appears on the screen.

2. Move the cursor to an area of interest.

3. Press <Set> to fix the starting point of the first axis.

4. Use the trackball to position the end point of the first axis and then press <Set>. Here,

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

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

5. Press <Set> to set the end point of the first axis. The second axis (perpendicular to the first axis) of cross appears on the screen.

6. Move the trackball and press <Set> to fix the starting point of the second axis.

7. Move the cursor to the end point of the second axis. Here,

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

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

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

3.2.5   Volume

Function: Measures the volume of the target object.

Method:

- 3Dist

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

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

  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.

- EDist

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

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

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

Operations:

3Dist

1. Select [Volume (3Dist)] from the measurement menu. The cursor appears on the screen.
2. Measure D1, D2, D3, which are length of three axes of the target object.

    See "3.2.2 Distance" for detailed procedures.

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

Ellipse

1. Select [Volume (Ellipse)] from the measurement menu. The cursor appears on the screen.
2. The procedures are similar to that of Ellipse in the volume measurement, see "3.2.4 Area" for details.

EDist

1. Select [Volume (Ellispe 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   Cross

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

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

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

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

3.2.8 Parallel

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

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

3.2.9 Trace Length

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

Trace

1. Select [Trace Len (Trace)] from the measurement menu. The cursor appears on the screen.
2. Move the cursor to an area of interest.
3. Press <Set> to fix the starting point.
4. Move the cursor along the target to trace the outline of the target.

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

    Anticlockwise: to cancel a series of points.

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

Spline

1. Select [Trace Len (Spline)] from 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 <Back>.

5. Press <Set> twice to set the end point of the spline.

3.2.10   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.

3.2.11   Ratio (A)

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

1. Select method from the drop-down list on the right of [Ratio (A)] in the menu. The cursor appears on the screen.

2. Measure the area of the two closed regions, see "3.2.4 Area" for detailed procedures.

3.2.12   B-Profile

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

1. Click [B-Profile] in the measurement menu, and the cursor appears on the screen.

2. Set a line segment, see "3.2.2 Distance" for detailed procedures.

   The result is shown in figure below:

Where,

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

3.2.13   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).

B-Hist (Rectangle)

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

1. Click [B-Hist] in the measurement menu, and the cursor appears on the screen.

2. Move the cursor to the first vertex of the rectangle, press <Set>.

3. Move the cursor to the second vertex of the rectangle, press <Set>. The result is shown in the following figure:

```
No:1
N:3773
M:35.5
MAX:6%
SD:25.8
```

Where,

Horizontal axis:	The gray of the image
The vertical axis:	The gray distribution percentage.
No:	The number of the graph. The last two results will be displayed on the screen.
N:	The total pixel number in the area to be measured.
M:	$M = \sum Di / N$;
MAX:	MAX = the pixel number in the maximum gray/ N×100%
SD:	Standard deviation. $SD=(\sum Di^2/N-(\sum Di/N)^2)^{1/2}$
	Di: The gray at each pixel point;
	$\sum Di$: The total grays of all pixels.

B-Hist (Ellipse)

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

B-Hist (Trace)

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

B-Hist (Spline)

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

3.2.14 Color Vel

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

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

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

   The compensation angle is 0°at the moment; you can change the angle (0°-80°) by rotating the <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.

3.2.15 Volume Flow

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

For details, please refer to "3.4.7 Volume Flow".

3.2.16 IMT

IMT (Intima-Media Thickness) measures the distance between LI (Lumen-Intima) and MA (Media-Adventia). For details, please refer to "6.4.3 Study Tool Operations"

3.3   M General Measurements

3.3.1   Distance

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

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

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

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

3.3.2   Time

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

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

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

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

3.3.3   Slope

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

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

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

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

3.3.4   Velocity

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

1. Click [Velocity] in the measurement menu, and two dotted lines perpendicular to each other appear on the screen.

2. Move the crossing point of the dotted lines to the measurement starting point and press <Set>.

3. Move the crossing point to the end point, and then the crossing point can only be moved in vertical direction.

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

   Press <Clear> to cancel setting the starting point.

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

3.3.5   HR

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

The number of cardiac cycles "n" can be preset in the [System Preset] -> [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

3.4.1   Time

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

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

3.4.2   HR

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

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

3.4.3   D Vel

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

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:
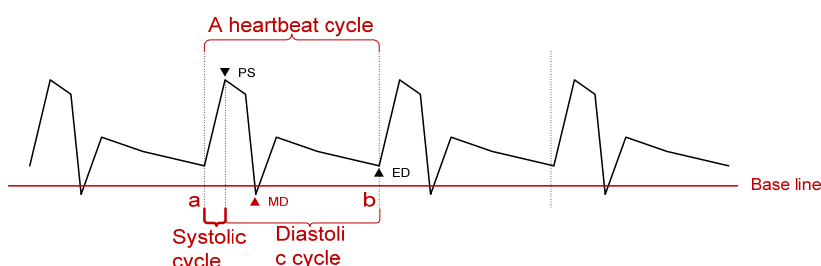
NOTE:	The heartbeat of the traced spectrum should equal to that is preset, otherwise the obtained HR (Heart Rate) is incorrect. See "2.2 Measurement Parameters Preset" for relevant preset.

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

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

Parameters		Descriptions
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

1. Select [2 PT] on the measurement menu, the cursor displays as a big "+".
2. Move the cursor to the starting point to be measured and press <Set> to fix the point.
3. Move the cursor to the end point to be measured and press <Set> to fix the point.

■ Manual

1. Select [Manual] from the drop-down list on the right of [D Trace] in the measurement menu.
2. Move the cursor to the starting point to be measured and press <Set> to fix the point.
3. Move the cursor around the object.

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

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

■ Spline

1. Select [Spline] from the drop-down list on the right of [D Trace] in the measurement menu.
2. Move the cursor to the starting point to be measured and press <Set> to fix the point.
3. Move the cursor along the edge of the desired region. Continue to fix the second, third … point (50 points at most) of spectrum.
4. Press <Set> twice to anchor the last reference point. Or,

   The measurement ends automatically when there are 50 reference points.

■ Auto

1. Select [Auto] from the drop-down list on the right of [D Trace] in the measurement menu, the measure cursor appears on the screen.
2. Move the cursor to the starting point to be measured and press <Set> to fix the point.

3. Press <Set> to anchor the end point of the trace line. The spectrum between the start point and the end point is traced.

■ 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, 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.
2. Select the measurement method of the [Vas Area] and select [PW Scope]
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.

3.5   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 to start the measurement.

   See section "4.3 Abdomen Measurement Tools" and "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 listed 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	

Types	Tools	Descriptions	Methods or Formulae
	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	
	Spleen	/	
	Aorta Diam	Aorta Diameter	
	Aorta Bif	/	
	Iliac Diam	Iliac Diameter	
	Pre-BL L	Pre-void Bladder Length	Distance in 2D General Measurements
	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	
	Ureter	/	
Calculation	Renal Vol	Renal Volume	See "9.4.2 Renal Vol"
	Pre-BL Vol	Pre-void Bladder Volume	See "9.4.2 Pre-BL Vol"
	Post-BL Vol	Post-void Bladder Volume	See "9.4.2 Post-BL Vol"
	Mictur.Vol	Micturated Volume	See "9.4.2 Mictur.Vol"
Study	Kidney	/	See "9.4.3 Kidney"

Types	Tools	Descriptions	Methods or Formulae
	Adrenal	/	See "9.4.3 Adrenal"
	Bladder	/	See "9.4.3 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	
	SMV	Superior Mesenteric Vein	
Calculation	/	/	
Study	/	/	

4.4   Abdomen Measurement Operations

Tips: 1. See the table in "4.3 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.

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 to start the measurement.

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

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

5.3 GA

5.3.1 Clinical GA

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

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

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

The calculating methods are listed as follows:

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

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

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

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

5.3.2 Ultrasound GA

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

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

GA in OB Items

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

1. You can preset the GA formulae and whether to display 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), humerus length (HL), Gestational Sac (GS), crown rump length (CRL) etc.

1. All valid values of all above items will be involved in AUA calculation in the system default method.

2. Clicking the check boxes at the right side of related items to select whether to involve the item in AUA calculation or not. The AUA value varies by the selection.

CUA

CUA is calculated according to formulae based on some measurement items (the involved items are among biparietal diameter (BPD), head circumference (HC), abdomen circumference (AC), and humerus length (HL)). 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*BPD2
2. CUA(HC) = 8.96+0.540*HC+0.0003*HC3
3. CUA(AC) = 8.14+0.753*AC+0.0036*AC2
4. CUA(FL) = 10.35+2.460*FL+0.170*FL2
5. CUA(BPD, HC) = 10.32+0.009*HC2+1.3200*BPD+0.00012*HC3
6. CUA(BPD, AC) = 9.57+0.524*AC+0.1220*BPD2
7. CUA(BPD, FL) = 10.50+0.197*BPD*FL+0.9500*FL+0.7300*BPD
8. CUA(HC, AC) = 10.31+0.012*HC2+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*FL2 - 0.0121*FL3
11. CUA(BPD, HC, AC) = 10.58+0.005*HC2 +0.3635*AC+ 0.02864*BPD*AC
12. CUA(BPD, HC, FL) = 11.38+0.070*HC*FL+0.9800*BPD
13. CUA(BPD, AC, FL) = 10.61+0.175*BPD*FL+0.2970*AC+0.7100*FL
14. CUA(HC, AC, FL) = 10.33+0.031*HC*FL+0.3610*HC+0.0298*AC*FL
15. CUA(BPD, HC, AC, FL)=10.85+0.060*HC*FL+0.6700*BPD+0.1680*AC

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

OB Growth Percentile

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

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

The system does not calculate the OB growth percentile if:

■   A FG table is not normal distributed.

■   There is no upper/ lower deviation set in the FG table.

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

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

5.4   Obstetric Measurement Tools

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

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

<table>
<tr><td colspan="2">2.</td><td colspan="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.</td></tr>
<tr><td colspan="2">3.</td><td colspan="2">If the results of the calculation items of CI, FL/BPD, FL/AC, HC/AC and FL/HC exceeds the clinical range, the result value displays as "value*".</td></tr>
</table>

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)*
	BPD	Biparietal Diameter	Distance in 2D General Measurements (Support Smart OB method if the Smart OB function is configured)
	OFD	Occipital Frontal Diameter	
	HC[1]	Head Circumference	
	AC	Abdominal Circumference	
	FL	Femur Length	
	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	
Measurement	IOD	Inter Orbital Diameter	
	HUM	Humerus Length	
	Ulna	Ulna Length	
	RAD	Radius Length	
	Tibia	Tibia Length	
	FIB	Fibula Length	
	CLAV	Clavicle Length	

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[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
	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	
	F-kidney	Fetal kidney Length	
	Mat Kidney	Matrix Kidney Length	
	Cervix L	Cervical Length	
	AF	Amniotic Fluid	
	NF	Nuchal Fold	
	Orbit	Orbit	
	PL Thickness	Placental Thickness	
	Sac Diam1	Gestational Sac Diameter 1	
	Sac Diam2	Gestational Sac Diameter 2	
	Sac Diam3	Gestational Sac Diameter 3	
	AF1	Amniotic Fluid 1	Distance in 2D General Measurements
	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	
	RV Diam	Right Ventricular Diameter	

Types	Tools	Descriptions	Methods or formulae
	RA Diam	Right Atrium Diameter	
	IVSd	Interventricular Septal Thickness at End-diastole	Distance in 2D General Measurements
	IVSs	Interventricular Septal Thickness at End-systole	
	IVS	Interventricular Septal Thickness	
	LV Area	Left Ventricular Area	
	LA Area	Left Atrium Area	
	RV Area	Right Ventricular Area	
	RA Area	Right Atrium Area	
	Ao Diam	Aorta Diameter	
	MPA Diam	Main Pulmonary Artery Diameter	
	LVOT Diam	Right 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
	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	
	IVC Diam	Inferior vena cava Diameter	
	AV Diam	Aorta Valve Diameter	
Calculation	Mean Sac Diam	Mean Gestational Sac Diameter	The average value of three sac diameters

Types	Tools	Descriptions	Methods or formulae
	AFI	/	Measure the maximum AFs of the four amniotic fluid pockets of pregnant woman. AFI = AF1+AF2+AF3+AF4
	EFW	Estimated Fetal Weight	EFW is calculated by the default 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
	TCD/AC	/	TCD / AC
	LVW/HW	/	LVW / HW × 100%
	LVD/RVD	/	LV Diam/RV Diam
	LAD/RAD	/	LA Diam/RA Diam
	AoD/MPAD	/	Ao Diam/MPA Diam
	LAD/AoD	/	LA Diam/Ao Diam
Study	AFI	/	Measures AF1, AF2, AF3, AF4, calculates AFI

*: Smart NT is not available in FDA region.

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	

Types	Tools	Descriptions	Methods or formulae
	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 Veno	Ductus Veno	
	Placenta A	Placenta Artery	
	MCA	Middle Cerebral Artery	
	Fetal Ao	Fetal Aorta	
	Desc Aorta	Descending Aorta	
	Ut A	Uterine Artery	
	Ovarian A	Ovarian Artery	
	Asc Aorta	Ascending Aorta	
	RVOT	Right Ventricle Outflow Tract	
	LVOT	Left Ventricle Outflow Tract	
	FHR	Fetal Heart Rate	HR in General D measurements
Calculation	/	/	
Study	/	/	

5.5   Obstetric Measurement Operations

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

Tips:	1.	See the table in "5.4 Obstetric Measurement Tools" above for measurement tools and methods.
	2.	For the definitions of measurement, calculation and study, refer to "1.3 Measurement, Calculation and Study".
	3.	The order of the measurement items is presettable, see "2.4.2 Application Measurement Preset" for details.
	4.	A measurement tool can be activated by clicking the item either in the measurement menu, it is described as "Select/Click ... (certain item) in the measurement menu" in the following procedures.

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 2/3/4, the [Fetus] widget displays in the OB measurement menu , as shown in the figure below.

   You can switch among [Fetus A], [Fetus B] or [Fetus C] via the widget.

2. Perform measurement to the fetus respectively.

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

3. In the Obstetric report, select [Fetus A], [Fetus B], [Fetus C], or [Fetus D] to switch among results of different fetuses.

4. In the [Obstetric Growth Curve] dialog box, select [A], [B], or [C] on the lower part to display the growth curves of different fetuses.

- Data of Fetus A/ Fetus B/ Fetus C: Three symbols $+ \times \!\!\!\times \;\; \times\!\!\!\!\!\times$ are used on the growth curves to indentify measurement data of different fetuses.
- History/ current data: Symbol size is used to distinguish them, with the history data appeared in smaller symbol.

5.7 Obstetric Exam Report

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

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

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

5.7.1 Fetal Biophysical Profile

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

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

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

Fetal growth index	0 score	2 score	Observation time	Remarks
FHR	<2, or Reactive FHR ≤15bpm	Reactive FHR ≥15bpm, duration≥15s, ≥2 times	30 minutes	The score(s) can be manually input into the

Fetal growth index	0 score	2 score	Observation time	Remarks
FM	≥2 fetal movements	FM ≥3 times (Continuous movement is deemed to 1 time)	30 minutes	system.
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   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 (predicted cardiac dimension)=m*ln(FL, GA or BPD)+c

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

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

1. Enter patient basic information and obstetric information in the [Patient Info] -> [OB] dialog box.
2. Measure BPD and FL.
3. Measure fetus cardiac parameters (e.g., Ao Diam).
4. Open the report to check the Z-Score result.

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

> **NOTE:**   Z-Score study is valid for single fetus only.

5.7.3   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. The dialog box displays the growth curve and the position of measurement value.

- Two drop-down lists above the curve display the measurement item/tool and formula of the curve, which can be changed.

- Three symbols $+ \times \divideontimes \ast$ are used on the growth curves to indentify 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 to start the measurement.

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

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

6.3 Cardiac Measurement Tools

The system supports the following cardiac measurements:

NOTE:	1.	Measurement tools mentioned below are configured in the system. The application measurement packages provided in this system are generally different combinations of measurement tools. For more information about package preset, see "2.4.2.2 Application Measurement Preset".
	2.	The heartbeat of the traced spectrum in VTI measurement should equal to that is preset, otherwise the obtained HR (Heart Rate) is incorrect. See "2.2 Measurement Parameters Preset" for relevant preset.
	3.	Some application items in the measurement preset library (and matching list in result assignment) are displayed different from that in the measurement menu and result window.
		In preset library (and matching list in result assignment), the item is followed with the word indicating the mode or location. Such as LA Diam (2D) means that the item is measured during 2D mode; LA Diam (LA Vol A-L) means that the item is contained in a study named LV Vol (A-L).

6.3.1　2D Cardiac Measurements

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

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

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

6.3.2 M Cardiac Measurements

Types	Tools	Descriptions	Methods or formulae
Measurement	LA Diam	Left Atrium Diameter	
	LVIDd	Left Ventricular Internal Diameter at end-diastole	
	LVIDs	Left Ventricular Internal Diameter at end-systole	
	RVDd	Right Ventricular Diameter at end-diastole	Distance in M General Measurements
	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	

Types	Tools	Descriptions	Methods or formulae
	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	
	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 2D General Measurements
	LVET	Left Ventricular ejection time	

Types	Tools	Descriptions	Methods or formulae
	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	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)
Study	See below		

6.3.3 Doppler Cardiac Measurements

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

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

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

Types	Tools	Descriptions	Methods or formulae
	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	D Vel in Doppler General Measurements
	VSD Vmax	Ventricular Septal Defect Maximum Velocity	
	ASD Vmax	Atrial Septal Defect Maximum Velocity	
	PDA Vel(d)	Patent Ductus Arteriosus Velocity at End-diastole	
	PDA Vel(s)	Patent Ductus Arteriosus Velocity at End-systole	
	Coarc Pre-Duct	Coarctation of Pre-Ductus	
	Coarc Post-Duct	Coarctation of Post-Ductus	
	HR	Heart Rate	
	RAP	Right Atrium Pressure	Select from the pop-up dialog box or input a value manually. See RAP measurement in "RVSP"
Calculation	MV E/A	Mitral Valve E-Vel/A-Vel	MV E Vel (cm/s) / MV A Vel (cm/s)
	MVA(PHT)	Mitral Valve Orifice Area (PHT)	MVA(PHT) (cm^2) = 220 / MV PHT (ms)
	TV E/A	Tricuspid Valve E-Vel/A-Vel	
	TVA(PHT)	Tricuspid Valve Orifice Area (PHT)	
Study	See below		

6.3.4   TDI Cardiac Measurements

The following measurement items are performed in TDI mode.

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

6.4   Cardiac Measurement Operations

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

6.4.1   Measurement Tool Operations

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

6.4.2   Calculation Tool Operations

1. Select the item/tool in the measurement menu.
2. The system calculates and displays the results after relating measurement items have been completed.

6.4.3   Study Tool Operations

6.4.3.1   Left Ventricular Function

This group of studies is to estimates the Left Ventricular (LV) diastolic and systolic capabilities by a series of clinical indices measured on B or M image. Except for calculating left ventricular volume

and end diastole and end systole, they may calculate the following indices (not all indices are calculated in every study, see Study Results table in each study for reference).

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

S-P Ellipse

■ Study Items

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

■ Study Results

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

■ Operating Procedures

1. Select [S-P Ellipse] in the measurement menu.

2. In apical long-axis view at end-diastole, measure the following parameters:

LVLd apical

LVAd apical

EDV value is then calculated.

3. In apical long-axis view at end-systole, measure the following parameters:

LVLs apical

LVAs apical

ESV value is then calculated.

The system calculates SV and EF;

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

4. Obtain in HR (heart rate) from ECG or input directly.

The CO and CI are calculated automatically.

B-P Ellipse

■ Study Items

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

■ Study Results

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

*1 means:

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

*2 means:

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

- Operating Procedures
1. Select [B-P Ellipse] in the menu.
2. In left ventricular short-axis view, measure the following parameters:
   At end diastole: LVIDd
   At end systole: LVIDs
3. In short-axis view at mitral valve level, measure the following parameters:
   At end diastole: LVAd sax MV
   At end systole: LVAs sax MV
4. In apical long-axis view, measure the following parameters:
   LVAd apical, the EDV is calculated
   LVAs apical, the ESV is calculated
   The system calculates SV and EF after LVAs apical has been measured;
   If height and weight have been input already, SI is calculated.
5. Obtain in HR (heart rate) from ECG or input directly.
   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	
LVAd sax MV	Left Ventricular Area at Mitral Valve level at End-diastole in Short-axis view	Area in 2D General Measurements
LVAs sax MV	Left Ventricular Area at Mitral Valve level at End-systole in Short-axis view	
HR	Heart Rate	Obtained by ECG or input directly

- Study Results

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

- Operating Procedures
1. Select [Bullet] in the measurement menu.
2. In apical long-axis view, measure the following parameters:

   At end diastole: LVLd apical

   At end systole: LVLs apical.
3. In short-axis view at mitral valve level, measure the following parameters:

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

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

   The system calculates SV and EF;

   If height and weight have been input already, SI is calculated.
4. Obtain in HR (heart rate) from ECG or input directly.

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

*1 means:

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

*2 means:

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

■ Operating Procedures

1. Select [Mod.Simpson] in the measurement menu.
2. In apical long-axis view, measure the following parameters:

   At end diastole: LVLd apical

   At end systole: LVLs apical
3. In short-axis view at mitral valve level, measure the following parameters:

   At end diastole: LVAd sax MV

   At end systole: LVAs sax MV
4. In short-axis view at papillary muscle level, measure the following parameters:

   At end diastole: LVAd sax PM, the EDV is calculated

   At end systole: LVAs sax PM, the ESV is calculated

   The system calculates SV and EF;

   If height and weight have been input already, SI is calculated.
5. Obtain in HR (heart rate) from ECG or input directly.

   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	$EDV(ml) = \pi \times \dfrac{LVLd\ apical(cm)}{20} \times \sum_{i=1}^{20} r_i^2\,(cm)$ LVLd apical: Left Ventricular Long-axis Length at End-diastole in apical view, i.e. the long-axis length obtained in measurement. r_i : Radiuses obtained from diastolic measurement
ESV(Simp SP)	End-systolic Left Ventricular Volume	$ESV(ml) = \pi \times \dfrac{LVLs\ apical(cm)}{20} \times \sum_{i=1}^{20} r_i^2\,(cm)$ LVLs apical: Left Ventricular Long-axis Length at End-systole in apical view, i.e. the long-axis length obtained in measurement. r_i : Radiuses obtained from systolic measurement

Tools	Descriptions	Formulae
SV	Stroke Volume	See table in "6.4.3.1 Left Ventricular Function"
CO	Cardiac Output	
EF	Ejection Fraction	
SI	SV Index	
CI	CO Index	

■ Operating Procedures

1. Select [Simp SP] in the measurement menu.

2. Measure the endocardium.

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

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

   The system calculates SV and EF;

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

3. Obtain in HR (heart rate) from ECG or input directly.

   The CO and CI are calculated automatically.

■ Measurement Methods

   The endocardium can be measured using the following methods.

   ● Trace

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

   ● Spline

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

   ● Auto

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

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

   ➤ B: Left ventricular wall and mitral valve junction;

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

   ➤ C: Midpoint of A and B.

   ➤ D: Apical part of left ventricle.

   You can:

   ● Adjust the long axis

   a) Rotate the trackball to position the cursor on the long axis (which turns yellow), and then press <Set>;

   b) Rotate the trackball, adjust the point D (with point C unchanged) after the cursor changes to ⟷.

   ● Adjust the trace line

   a) Rotate the trackball to position the cursor on the trace line (which turns yellow), and then press <Set>;

   b) Rotate the trackball, move the cursor along the endocardium edge to adjust the line after the cursor changes to ⟷ (with ABD points unchanged).
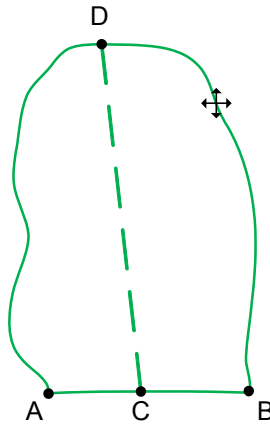
Press <Set> outside the line to confirm the adjustment.

Simpson BP

■ Study Items

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

■ Study Results

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

*1 means:

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

*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:

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

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

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

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

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

Where,

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

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

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

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

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

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

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

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

Tools	Descriptions	Operations
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 or input directly

■ Study Results

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

■ Operating Procedures

1. Select [Cube] in the measurement menu.
2. Measure Diastole in 2D or M mode.

   The IVSd, LVIDd. LVPWd and EDV are obtained.
3. Measure Systole in 2D or M mode.

   IVSs, LVSs, LVIDs, LVPWs and ESV are obtained.

   The system calculates SV, EF and FS;
4. Obtain in HR (heart rate) from ECG or input directly.

   If height and weight have been input already, SI, CO and CI are calculated.

   MVCF is calculated if LVET is measured.

In [Preset]-> [System Preset]-> [Application] screen, you can set the method for Cube/Teichholz/Gibson 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 or input directly

■ Study Results

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

■ Operating Procedures

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

See section "Cube" for measurement procedures.

In [Preset]-> [System Preset]-> [Application] screen, you can set the method for Cube/Teichholz/Gibson 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 or input directly

■ Study Results

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

■ Operating Procedures

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

See section "Cube " for measurement procedures.

6.4.3.2 Left Ventricular Mass (LV Mass)

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

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

LV Mass (Cube)

Study Items

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

Study Results

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

■ Operating Procedures

1. Select [LV Mass (Cube)] in the measurement menu.

2. At end diastole, measure the following parameters:

    IVSd

    LVIDd

    LVPWd

    The LV Mass (Cube) is calculated.

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

LV Mass (A-L)

■ Study Items

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

■ Study Results

Tools	Descriptions	Formulae
LV Mass (A-L)	Left Ventricular Mass	*1
LV MASS-I (A-L)	Index of Left Ventricular Mass	See LV Mass-I formula in "Left Ventricular Mass (LV Mass)"

*1 means:

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

Where,

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

■ Operating Procedures

1. Select [LV Mass (A-L)] in the measurement menu.

2. In long-axis view at end diastole, measure LVLd apical；

3. In short-axis view at papillary muscle level at end diastole, measure the following parameters:

     Endocardium area: LVAd sax Endo;

     Epicardium area: LVAd sax Epi

The LV Mass (A-L) is calculated.

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

LV Mass (T-E)

■ Study Items

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

■ Study Results

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

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

*1 means:

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

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

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

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

     t: Thickness of the myocardium

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

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

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

- Operating Procedures
1. Select [LV Mass(T-E)] in the measurement menu.
2. In short-axis view at papillary muscle level at end diastole, measure the following parameters:

   Endocardium area: LVAd sax Endo;

   Epicardium area LVAd sax Epi
3. Measure a and d.

   The LV Mass(T-E) is calculated.

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

6.4.3.3 Mitral Valve Area (MVA)

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

Tips:	MVA Calculation by PHT method should be performed in CW mode, see MVA(PHT) in "6.3.3 Doppler Cardiac Measurements" for calculation formula.

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	$MVA(VTI)(cm^2) = \dfrac{\pi \times \lvert LVOT\ VTI(cm) \rvert \times LVOT\ Diam(cm^2)^2}{4 \times \lvert MV\ VTI(cm) \rvert}$

- Operating Procedures

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

6.4.3.4 AVA(VTI)

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

- Study Items

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

- Study Results

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

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

■ Operating Procedures

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

6.4.3.5　LA Vol

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

LA Vol(A-L)

Estimates Left Atrium Volume using area and length.

■ Study Items

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

■ Study Results

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

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

■ Operating Procedures

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

LA Vol (Simp)

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

■ Study Items and Results

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

■ Operating Procedures

See "Simpson SP" for measurement procedures.

6.4.3.6　RA Vol (Simp)

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

■ Study Items and Results

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

■ Operating Procedures

See "Simpson SP" for measurement procedures.

6.4.3.7 LVIMP

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

■ Study Items

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

■ Study Results

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

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

■ 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 × TR Vmax $(m/s)^2$
RVSP	Right Ventricular Systolic Pressure	$RVIMP(No\ unit) = \dfrac{TV\ C\text{-}O\ dur(s) - RVET(s)}{RVET(s)}$

■ 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.

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　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	$RVIMP(No\,unit) = \dfrac{TV\,C\text{-}O\,dur(s) - RVET(s)}{RVET(s)}$

■　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
AV Diam	Aorta Valve Diameter	Distance in 2D General Measurements
PV Diam	Pulmonary Valve Diameter	
AV VTI	Aortic Valve Velocity-Time Integral	D Trace in Doppler General Measurements
PV VTI	Pulmonary Valve Velocity-Time Integral	

■ Study Results

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

Tools	Descriptions	Operations
AV HR	Aortic Valve Heart Rate	Obtained from AV VTI measurement
AV SV	Aortic Valve Stroke Volume	
AV CO	Aortic Valve Cardiac Output	
PV HR	Pulmonary Valve Heart Rate	Obtained from PV VTI measurement
PV SV	Pulmonary Valve Stroke Volume	
PV CO	Pulmonary Valve Cardiac Output	
Qp/Qs	Flow ration of Pulmonary circulation and Systemic circulation	Qp/Qs(No unit) = PV CO(l/min)/AV CO(l/min)
Qp-Qs	Flow difference of Pulmonary circulation and Systemic circulation	Qp-Qs(l/min) = PV CO(l/min) - AV CO(l/min)

■ 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	$MR\ Flow(ml) = \dfrac{2\pi MR\ Rad(cm)^2 \times MR\ Als.Vel(cm/s)}{\lvert MRV\ max(cm/s)\rvert} \times \lvert MR\ VTI(cm)\rvert$
MR Flow Rate	Mitral Regurgitation Flow Rate	$MR\ Flow\ Rate(ml/s) = 2\pi MR\ Rad(cm)^2 \times MR\ Als.Vel(cm/s)$
MR Fraction	Mitral Valve Regurgitation Fraction	$MR\ Fraction\ \ (Nounit)\ \ = \dfrac{MR\ \ Flow(ml)}{MV\ \ SV(ml)} \times 100\ \%$
MR EROA	Mitral Valve Effective Regurgitant Orifice Area	$MR\ EROA(cm)^2 = \dfrac{2\pi MR\ Rad(cm)^2 \times MR\ Als.Vel(cm/s)}{\lvert MR\ Vmax(cm/s)\rvert}$

■ Operating Procedures
1. Enter color mode, adjust the color map until the aliasing appears.
2. Select [PISA MR] in the measurement menu.
3. Measure MR Rad using PISA caliper.
   Input MR Als.Vel.
4. Measure the MR spectrum by D trace to obtain:
   MR Vmax
   MR VTI
   MR Flow, MR Flow Rate and MR EROAare 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	$AR\ Flow(ml) = \dfrac{2\pi AR\ Rad(cm)^2 \times AR\ Als.Vel(cm/s)}{\lvert ARV\ max(cm/s)\rvert} \times \lvert AR\ VTI(cm)\rvert$

Tools	Descriptions	Formulae
AR Flow Rate	Aortic Regurgitation Flow Rate	$AR\ Flow\ Rate(ml/s) = 2\pi AR\ Rad(cm)^2 \times AR\ Als.Vel(cm/s)$
AR Fraction	Aortic Valve Regurgitation Fraction	$AR\ Fraction\ (Nounit) = \dfrac{AR\ Flow(ml)}{AV\ SV(ml)} \times 100\ \%$
AR EROA	Aortic Valve Effective Regurgitant Orifice Area	$AR\ EROA(cm)^2 = \dfrac{2\pi AR\ Rad(cm)^2 \times AR\ Als.Vel(cm/s)}{\left|AR\ Vmax(cm/s)\right|}$

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

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

■ Operating Procedures

Same with the PISA MR measurement.

6.4.3.13 TDI

■ Study Items

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

Tools	Descriptions	Operations
Aa(lateral)	Mitral Valve lateral Late diastolic motion	
ARa(lateral)	Mitral Valve lateral Acceleration Rate	Acceleration in Doppler General Measurements
DRa(lateral)	Mitral Valve lateral Deceleration Rate	

■ Study Results

Tools	Descriptions	Formulae
Ea/Aa(medial)	MV medial E-Vel/ A-Vel	$Ea/Aa(medial)(Nounit) = \dfrac{Ea(medial)}{Aa(medial)}$
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	$Ea/Aa(lateral)(Nounit) = \dfrac{Ea(lateral)}{Aa(lateral)}$
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

■ 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.

EDV(S-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

ESV(S-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.

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):

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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.
- 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.

EDV(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

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

EDV (Bullet):

- 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

ESV (Bullet):

- 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

EDV (Simpson):

- 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

ESV (Simpson):

- 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

EDV (Simpson SP):

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

ESV (Simpson SP:

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EDV (Simpson BP):

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

ESV (Simpson BP):

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

EDV (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.

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

ESV (Cube):

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Fractional Shortening (FS):

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MVCF:

- Colan, S.D., Borow, K.M., Neumann, A., "Left Ventricular End-Systolic Wall Stress-Velocity of Fiber Shortening Relation: A Load-Independent Index of Myocardial Contractility," J Amer Coll Cardiol, October, 1984, Vol. 4, No. 4,pp. 715-724.

- Snider, A.R., Serwer, G.A., Echocardiography in Pediatric Heart Disease, Year Book Medical Publishers, Inc., Littleton, MA, 1990, p. 83.

Teichholz:

- Teichholz, L.E., et al., "Problems in Echocardiographic Volume Determinations: Echocardiographic-Angiographic Correlations in the Presence or Absence of Asynergy," American Journal of Cardiology, January 1976, Vol. 37, pp. 7-11

.LV MASS-I:

- John H. Phillips, "Practical Quantitative Doppler Echocardiography" , CRC Press, 1991, .Page 96.

LA/Ao:

- Roelandt, Joseph, Practical Echocardiology, Ultrasound in Medicine Series, Vol. 1,Denis White, ed., Research Studies Press, 1977, p. 270.

- 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.

MV E/A:

- Maron, Barry J., et al., "Noninvasive Assessment of Left Ventricular Diastolic Function by Pulsed Doppler Echocardiography in Patients with Hypertrophic Cardiomyopathy," Journal of the American College of Cardiology, 1987, Vol. 10, pp. 733-742.

Pressure Half Time (PHT):

- Oh, J.K., Seward, J.B., Tajik, A.J. The Echo Manual. Boston: Little, Brown and Company, 1994, p.59-60

Mitral valve area:

- Goldberg, Barry B., Kurtz, Alfred B., Atlas of Ultrasound Measurements, Year Book Medical Publishers, Inc., 1990, p. 65.
- 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.

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 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	

Types	Tools	Descriptions	Methods or formulae
Calculation	Stenosis D	Stenosis Diameter	Stenosis D (No unit) = (Normal Diam(cm) – Resid Diam (cm)) / Normal Diam (cm) × 100% Stenosis D (No unit) = |(D1-D2)/MAX(D1，D2)|*100% Where, D1 and D2 refers to the measured vascular diameter, and MAX(D1，D2) represents the larger value of the two.
	Stenosis A	Stenosis Area	Stenosis A (No unit) = |(A1-A2)/MAX(A1，A2)|*100% Where, A1 and A2 refers to the measured vascular area, and MAX(D1，D2) represents the larger value of the two.
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	
	Subclav A	Subclavian Artery	
	Axill A	Axillary Artery	D trace in General D measurements
	Brachial A	Brachial Artery	
	Ulnar A	Ulnar Artery	
	Radial A	Radial Artery	
	Subclav 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	

Types	Tools	Descriptions	Methods or formulae
	SFA	Superficial Femoral Artery	
	Pop A	Popliteal Artery	
	TP Trunk A	Tibial Peroneal Trunk Artery	
	Peroneal A	Peroneal Artery	
	P.Tib A	Posterior Tibial Artery	
	A.Tib A	Anterior Tibial Artery	
	Dors.Ped A	Dorsalis Pedis Artery	
	C.Iliac V	Common Iliac Vein	
	Ex.Iliac V	External Iliac Vein	
	Femoral V	Femoral Vein	
	Saph V	Great Saphenous Vein	
	Pop V	Popliteal Vein	
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	
	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	

Types	Tools	Descriptions	Methods or formulae
	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.
> 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 (PS)

Function: measures the flow velocity ratio between ICA and CCA to calculate the stenosis.
1. Select [ICA/CCA (PS)] in the measure menu.
2. Measure PS value of ICA and CCA distal using 2 PT method in D trace, and the system calculates the stenosis. Where, ICA value adopts the maximum PS value of proximal, middle and distal.

7.4.3   Study Tool Operations

IMT

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

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

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

1. Enter IMT exam mode, scan and freeze the image (or review a history image).

2. Select [IMT] in the measurement menu and enters the IMT measurement.

3. Select the side (Left/ Right), angle and vessel wall (Near/ Far).

4. Select an item such as [ICC IMT], the ROI box displays on screen.

    It appears as ⊡⁺ when Near is selected;

    It appears as ⊡⁺ when Far is selected;

Tips	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 <Back>. (Press <Clear> to clear all measurement calipers on the screen.)
    - Trace manually
        a) Move the cursor to a trace line. The trace line turns yellow. Press <Set>.
        b) Move the cursor along the interface of vessel. Press <Set> to confirm the trace after re-adjusting.

6. Press <Set> outside the box to confirm the adjustment result after the manual-trace is completed. The results are recorded in IMT report.

    The system calculates:

    - IMT Max
    - IMT Min
    - IMT Mean
    - IMT SD
    - IMT ROI Length
    - IMT Measure Length
    - IMT Quality Index

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

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

For multiple measurements in the same side, vessel and angle, the system calculates the following parameters in report:

- Average Mean IMT
- Average Max IMT
- Standard deviation

Also it provides Composite Mean IMT, which is an overall mean value of all IMT mean values derived from the measured items.

ABI

Function: Calculates Ankle Brachial Index (ABI) by measuring Ankle Systolic Pressure (ASP) and Brachial Systolic Pressure (BSP) on Doppler image.

$$ABI = ASP/BSP$$

Tips: 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 to start the measurement.

   See table in "8.3 Gynecology Measurement Tools" below for measurement tools.

   See section "8.4 Gynecology Measurement Operations" and steps in "3 General Measurement" for measurement methods.
4. Press <Report> to view the exam report, see "8.5 Gynecology Exam Report" for details.

8.3   Gynecology Measurement Tools

The system supports the following gynecology measurements.

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

Modes	Types	Tools	Descriptions	Methods or formulae
2D	Measurement	UT H	Uterine Height	Same as Distance measurement in 2D General Measurements
		UT W	Uterine Width	
		UT L	Uterine Length	Same as Distance, Trace and Spline measurement in 2D General Measurements*
		Cervix L	Uterine Cervix Length	
		Cervix H	Uterine Cervix Height	Same as Distance measurement in 2D General Measurements
		Cervix W	Uterine Cervix Width	

Modes	Types	Tools	Descriptions	Methods or formulae
		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 Body	/	
		UT-L/ CX-L	/	
		Follicle 1-16	/	
	Study	Uterus	/	Length, height and width of uterus, endometrium thickness
		Uterine Cervix	/	Length, height and width of uterine cervix
		Ovary	/	Length, height and width of ovary
		Follicle 1~16	/	Length, height and width of follicle 1~16
M	/		/	
Doppler	/		/	

*: Measurement methods of Trace and Spline for UT L and Cervix L are not available in FDA region.

8.4 Gynecology Measurement Operations

Tips:
1. See the table in "8.3 Gynecology Measurement Tools" above for measurement tools and methods.
2. For the definitions of measurement, calculation and study, refer to "1.3 Measurement, Calculation and Study".
3. The order of the measurement items is presettable, see "2.4.2 Application Measurement Preset" for details.

8.4.1 Measurement Tool Operations

The following procedure takes UT L measurement as an example. Measurements of other items are similar.

1. Select [UT L] in the measurement menu.
2. Use the Distance method in 2D General Measurements to measure uterine length.

8.4.2　Calculation Tool Operations

Ovary Vol

Function: measures Ovary L, Ovary H and Ovary W, calculates Ovary Vol.

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

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

UT Vol

Function: measures UT L, UT H and UT W, calculates UT Vol and Uterus Body.

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

Uterus Body

Function: measures UT L, UT H and UT W, calculates UT Vol and Uterus Body.

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

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

UT-L/ CX-L

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

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

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.

Follicle

Please refer to Follicle in "8.4.3 Study Tool Operations".

8.4.3　Study Tool Operations

Uterus

Function: measures UT L, UT H, UT W and Endo, calculates UT Vol, Uterine Body and UT-L/CX-L.

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

   UT Vol and Uterus Body are calculated automatically.

   If Cervix L has been measured, the system also calculates UT-L/CX-L.

Uterine Cervix

Function: measures Cervix L, Cervix H and Cervix W, calculates UT-L/CX-L.

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

Ovary

Function: measures Ovary L, Ovary H and Ovary W, calculates Ovary Vol.

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

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

Follicle

Function: Measures the length, width and height of follicle using method Distance and calculates the average of length, width and height as well as the follicle volume.

Results	Method	Formulae
Average Diameter	2-distance	$Average\ Diam = \dfrac{(Length + Width)}{2}$
	3-distance	$Average\ Diam = \dfrac{(Length + Width + Height)}{3}$
Follicle Volume	1-distance	$Vol = \dfrac{\pi}{6}(Length)^3$
	2-distance	$Vol = \dfrac{\pi}{6}(Length)^2 \times Width$
	3-distance	$Vol = \dfrac{\pi}{6} length \times Width \times Height$

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 Body: Feng Kui, Sun Yanling, Li Hezhou. Ultrasonic diagnosis of adenomyosis. Journal of Henan Medical University, 1995; 30 (2).

UT-L/ CX-L: Ji Jindi, et al. Ultrasonographic study of the intersex problems and the internal genitalia abnormalities. Journal of China medical ultrasound. 1996, Volume 12, No8 P40.

9   <u>Urology</u>

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 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 measurement items.

Types	Tools	Descriptions	Methods or formulae
Measurement	Renal L	Renal Length	Distance in 2D General Measurements
	Renal H	Renal Height	
	Renal W	Renal Width	
	Cortex	Renal Cortical Thickness	
	Adrenal L	Adrenal Length	
	Adrenal H	Adrenal Height	
	Adrenal W	Adrenal Width	
Measurement	Prostate L	Prostate Length	
	Prostate H	Prostate Height	
	Prostate W	Prostate Width	

Types	Tools	Descriptions	Methods or formulae
	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	
	Prostate Mass1 d1~d3	Prostate Mass1 Distance 1~3	
	Prostate Mass2 d1~d3	Prostate Mass2 Distance 1~3	Distance in 2D General Measurements
	Prostate Mass3 d1~d3	Prostate Mass3 Distance 1~3	
	Testis Mass1 d1~d3	Testis Mass1 Distance 1~3	
	Testis Mass2 d1~d3	Testis Mass2 Distance 1~3	
	Testis Mass3 d1~d3	Testis Mass3 Distance 1~3	
	Epididymis L	Epididymis Length	
	Epididymis W	Epididymis Width	
	Epididymis H	Epididymis Height	
	Scrotal Wall	/	
Calculation	Renal Vol	Renal Volume	
	Prostate Vol	Prostate Volume	
	Testis Vol	Testicular Volume	See below
	Pre-BL Vol	Pre-void Bladder Volume	
	Post-BL Vol	Post-void Bladder Volume	
	Mictur.Vol	Micturated Volume	
Study	Kidney	/	
	Adrenal	/	See below
	Prostate	/	

Types	Tools	Descriptions	Methods or formulae
	Seminal Vesicle	/	
	Testis	/	
	Bladder	/	
	Prostate Mass1~3	/	
	Testis Mass1~3	/	
	Epididymis	/	
	Smart Bladder	/	

9.4 Urology Measurement Operations

Tips:	1.	See the table in "9.3 Urology Measurement Tools" above for measurement tools and methods.
	2.	For the definitions of measurement, calculation and study, refer to "1.3 Measurement, Calculation and Study".
	3.	The order of the measurement items is presettable, see "2.4.2 Application Measurement Preset" for details.

9.4.1 Measurement Tool Operations

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

The following tools need to measure Left or Right side respectively:

Seminal L	Seminal H	Seminal W	Renal L
Renal H	Renal W	Cortex	Adrenal L
Adrenal H	Adrenal W	Testis L	Testis H
Testis W			

The measurement procedures are as follows taking Prostate L measurement as an example:

1. Select [Prostate L] in the measurement menu.
2. Use the Distance of 2D General Measurements to measure Prostate L.

9.4.2 Calculation Tool Operations

Renal Vol

Function: measures Renal L, Renal H and Renal W, calculates Renal Vol.

Tips: 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.

$$PPSA \ (ng/ml) = PPSA \ Coefficient \ (ng/ml^2) \times Prostate \ Vol \ (ml)$$

$$PSAD\ (ng/ml^2) = Serum\ PSA\ (ng/ml)\ /\ Prostate\ Vol\ (ml)$$

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.

Tips: 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.

Tips: 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.

Tips: 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.

$$PPSA\ (ng/ml) = PPSA\ Coefficient\ (ng/ml^2) \times Prostate\ Vol\ (ml)$$

$$PSAD\ (ng/ml^2) = Serum\ PSA\ (ng/ml) / Prostate\ Vol\ (ml)$$

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.

Tips: 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.

Tips: 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.

Prostate Mass

Function: measures Mass D1, Mass D2 and Mass D3 to calculate the Mass Volume. Up to 3 masses can be measured.
Take Prostate Mass1 as an example, the procedures are as follows:

1. Select the [Prostate Mass1] in the measure menu.

2. Use the Distance tool in the 2D General Measurement to measure D1, D2 and D3 of the prostate mass.

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

Testis Mass

Same as the Prostate Mass.

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.

Smart Bladder

NOTE:	1.	Smart Bladder must be used with convex-wide probe.
	2.	Measurement of the data earlier than V 2.0 software is not supported.
	3.	This function is not available in FDA region.

Function: measure the volume of the urine in the bladder.

1. Scan and obtain the horizontal section image of the bladder.
2. Select the [Smart Bladder] in the measurement menu.

    Envelop of the bladder section is traced automatically, and two diameters d1 and d2 (perpendicular to each other by default) are recognized by the system. Here,

    You can press <Update> to exchange among the ends of the diameters and modify the length and the position of the end points.
3. Press <Set> to fix the measurement of d1 and d2.
4. Scan and obtain the vertical section of the bladder.
5. Select the [Smart Bladder] in the measurement menu.

    Envelop of the bladder section is traced automatically, and diameter d3 is recognized by the system. Here,

    You can press <Update> to exchange the ends of the diameter and modify the length and the position of the end points.
6. Press <Set> to fix the measurement of d3.

    The Volume is calculated by the system.

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 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 Measurement Package 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	

Modes	Types	Tools	Descriptions	Methods or formulae
		Breast Mass1-10 d1	/	
		Breast Mass1-10 d2	/	
		Breast Mass1-10 d3	/	
		Thyroid Mass1 d1~d3	/	
		Thyroid Mass2 d1~d3	/	
		Thyroid Mass3 d1~d3	/	
		Epididymis L	Epididymis Length	
		Epididymis W	Epididymis Width	
		Epididymis H	Epididymis Height	
		Scrotal Wall	/	
	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 "9.4.3 Testis".
		Breast Mass1~10	/	Volume (3 Dist) in 2D General Measurements
		Thyroid Mass1~3	/	
		Epididymis	/	See "9.4.3 Epididymis"
		Testis Mass 1~3	/	See "9.4.3 Testis Mass"
M	/	/	/	
Doppler	Measurement	STA	Superior Thyroid Artery	D trace in General D measurements
		ITA	Inferior Thyroid Artery	
	Calculation	/	/	/
	Study	/	/	/

10.4   Small Parts Measurement Operations

> **Tips:**   1.   See table "10.3 Small Parts Measurement Tools" above for measurement tools and methods.
>
>   2.   For the definitions of measurement, calculation and study, refer to "1.3 Measurement, Calculation and Study".
>
>   3.   The order of the measurement items is presettable, see "2.4.2 Application Measurement Preset" for details.
>
>   4.   A measurement tool can be activated by clicking the item either in the measurement 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.

Breast Mass

Function: measures Mass D1, Mass D2 and Mass D3 to calculate the Breast Mass Volume. Up to 3 masses can be measured.

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

1.   Select [Breast Mass1] in the measurement menu.
2.   Use the Distance tool in the 2D General Measurement to measure Breast Mass1 D1, Breast Mass1 D2 and Breast Mass1 D3.

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

Thyroid Mass

Same as the Breast Mass.

Testis

Same as "Testis" in "9 Urology".

Epididymis

Same as "Epididymis" in "9 Urology".

Testis Mass

Same as "Testis Mass" 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: **(k= 0.479)**	Volumetrie der Schilddruesenlappn mittels Realtime-Sonographie; J Brunn, U. Block, G. Ruf, et al.; Dtsch.med. Wschr.106 (1981), 1338-1340.
Thyroid Vol: **(k=0.523)**	Gomez JM, Gomea N, et al. Determinants of thyroid volume as measured by ultrasonography in healthy adults randomly selected. Clin Endocrinol(Oxf), 2000;53:629-634

11 Orthopedics

HIP (Hip Joint Angle) measurement is used in pediatric orthopedics. Such measurement provides early diagnosis for infant hip joint dislocation.

11.1 Orthopedics Exam Preparations

Make the following preparations before measurement:

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

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

11.2 Basic Orthopedics Measurement Procedures

1. Register patient information in [Patient Info] -> [PED] dialog box.
2. Press <Measure> to enter the Application Measurements.
3. Select measurement tool in the menu to start the measurement.
4. See table in "11.3 Orthopedics Measurement Tools" below for measurement tools.
5. See section "11.4 HIP Measurement Operations" and steps in "3 General Measurement" for measurement methods.
6. Press <Report> to view the exam report, see "11.5 Orthopedics Exam Report" for details.

11.3 Orthopedics Measurement Tools

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

HIP

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

The three lines are:

- The baseline (BL), connecting the osseous acetabular convexity to the point where the joint capsule and the perichondrium unite with the ilium.
- The roof line (RL), connecting the lower edge of the ilium to the osseous acetabular convexity.
- The inclination line (IL), connecting the osseous acetabular convexity to the labrum acetabular.

The angles are:

- α: the angle between BL and RL.
- β: the angle between BL and IL
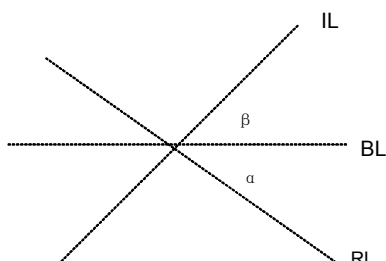
Dislocation type can be determined through Graf method, as described in the following table.

DISLOCATION TYPE	CRITERIA			RESULT
	α	β	Patient	
I	α≥60°	β<77°	All ages	I
II	50°≤α≤59°		Younger than three months of age	IIa
	50°≤α≤59°	β<55°	Three months of age or older than three months	IIb
	43°≤α≤49°	β≤77°	All ages	IIc
	43°≤α≤49°	β>77°	All ages	IId
III	α<43°	β>77°	All ages	III
IV	Quantitative angle measurement cannot be performed.		All ages	All
	Others	Others	All ages	?????

HIP-Graf

The measurement items, results and procedures are the same with "HIP".

d/D

Measures distance between baseline and bottom line of the osseous acetabular and maximum width of hip to estimate the hip osseous acetabular coverage.
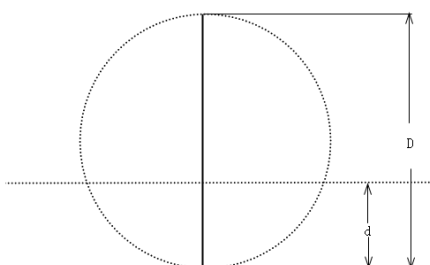
1. Click [d/D] in the measure menu.
2. Use the Distance tool in the 2D General Measurement to measure maximum width of hip (D), and distance between osseous acetabular roof and bottom (d).The system calculates d/D.

11.4   HIP Measurement Operations

Tips:	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, 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 Hop Dysplasia." Journal Pediatric Orthopedics, Vol. 4, No. 6:735-740,1984.

Graf, R. Guide to Sonography of the Infant Hip. Georg Thieme Verlag, Stuttgart and New York, 1987.

Morin, C., Harcke, H., MacEwen, G. "The Infant Hip: Real-Time US Assessment of Acetabular Development." Radiology, 177:673-677, December 1985.

12 Emergency

The following optional emergency exam modes are available in current system:

- EM ABD
- EM FAST
- EM OB
- EM Vascular
- EM Superficial

12.1   Basic Measurement Procedures

1. Press <Patient>, register patient information in proper page under [Patient Info] screen.
2. Scan the desired ultrasonic views and save image(s).
3. Press <Measure> to enter the Application Measurements.
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.

Mode	Type	Item	Item	Method or formulae
2D	Measurement	Renal L	Renal Length	Distance in 2D General Measurements
		Renal H	Renal Height	
		Renal W	Renal Width	
		CBD	Common bile duct	
		Portal V Diam	Portal Vein Diameter	
		CHD	Common hepatic duct	
		GB wall th	Gallbladder wall thickness	
		Aorta Diam	Aorta Diameter	
		Aorta Bif	/	
		Ureter	/	
		Pre-BL L	Pre-Animal Bladder Length	
		Pre-BL H	Pre-Animal Bladder Height	
		Pre-BL W	Pre-void Bladder Width	

Mode	Type	Item	Item	Method or formulae
		Post-BL L	Post-void Bladder Length	
		Post-BL H	Post-void Bladder Height	
		Post-BL W	Post-void Bladder Width	
		GS	Gestational Sac Diameter	
		YS	Yolk Sac	
		BPD	Biparietal Diameter	
		CRL	Crown Rump Length	Line (same as Distance in 2D General Measurements), Trace, Spline
		UT L	Uterine Length	
		UT H	Uterine Height	
		UT W	Uterine Width	
		Endo	Endometrium Thickness	Distance in 2D General Measurements
		Ovary L	Ovary Length	
		Ovary H	Ovary Height	
		Ovary W	Ovary Width	
	Calculation	Renal Vol	Renal Volume	Refer to "9.4.2 Renal Vol"
		Pre-BL Vol	Pre-void Bladder Volume	Refer to "9.4.2 Pre-BL Vol"
		Post-BL Vol	Post-void Bladder Volume	Refer to "9.4.2 Post-BL Vol"
		Mictur.Vol	Micturated Volume	Refer to "9.4.2 Mictur. Vol"
		Ovary Vol	Ovary Volume	Refer to "8.4.2 Ovary Vol"
		UT Vol	UT Volume	Refer to "8.4.2 UT Vol"
		Uterus Body	/	Refer to "8.4.2 Uterus Body"
	Study	Uterus	/	Refer to "8.4.3 Uterus"
		Ovary	/	Refer to "8.4.3 Ovary"
		Kidney	/	Refer to "Kidney"
		Bladder	/	Refer to "9.4.3 Bladder"
M/D Mode	Measurement	FHR	Fetal Heart Rate	Heart Rate in M General Measurements

NOTE: 1. Measurement tools in each EM package depend on the specific measurement data preset for each ultrasound system.

2. For more information about package preset, see "2.4.2.2 Application Measurement Preset".

12.3 EM Exam Report

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

Each EM exam mode has its corresponding EM report. Similar to other reports, the following functions are available in the EM report:

- Selecting anatomic diagnosis
- Editing report data and adding remarks
- Adding/ deleting ultrasound image(s)
- Changing report type
- Printing/ previewing the report
- Exporting Report

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

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