M5 Diagnostic Ultrasound System

Operator’s Manual

[Advanced Volume]

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Preface

This manual details the procedures for operating the M5 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:
(1) Operator's Manual (Basic Volume)
(2) 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 are dependent on the specific system you purchased.

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

Safety Precautions

1. Meaning of Signal Words

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

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

2. Meaning of Safety Symbols

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

3. Safety Precautions

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

⚠CAUTION:		
	1	**Select the proper patient image and measurement tools. Only the professionals can decide the appropriate measurements and results.**
	2	**Confine measurement calipers to the actual Region of Interest (RoI). Measurements that extend beyond the RoI will be incorrect.**
	3	**Before examining a new patient, it is necessary to press the [End Exam] key to end the current scan and delete the patient information and data. Otherwise, new patient data will be combined with the previous patient.**
	4	**When the system is turned OFF or the [End Exam] key is pressed, all the data that have not been saved are lost.**
	5	**Changing modes during a measurement will delete the General Measurement data, while the application measurement values are recorded in the report.**
	6	**Pressing the [Freeze] key to unfreeze the image during a measurement will clear the General Measurement data.**
	7	**Pressing the [Caliper] 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	**Ensure that measurement data correctly corresponds to the fetus during the Obstetric Measurement.**
	10	**Fully understand the functionality of this system by referring to the *Operator's Manual - Basic Volume*.**
	11	**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.**
	12	**The auto measurement might not be accurate when the result doesn't match the image exactly, please make the measurement manually.**

1 Measurement Overview

1.1 Entering/Exiting Measurement

- To enter General Measurements

Press the [Caliper] key to enter General Measurement and the General Measurement menu is displayed.

- To enter Application Measurements

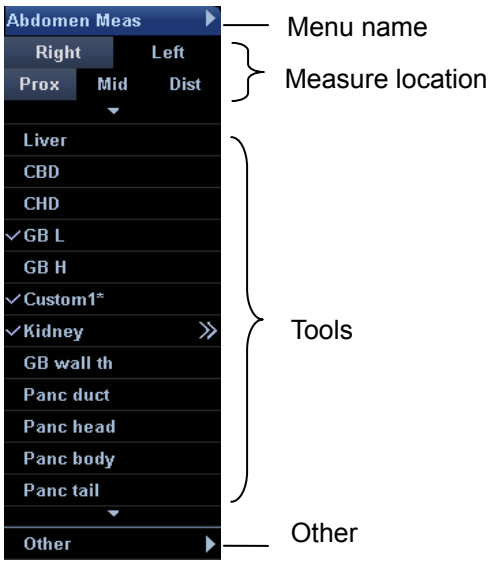
Press the [Measure] key to enter Application Measurements and the Application Measurement menu is displayed.

- To exit measurements

Press the [Caliper] key to exit General Measurements, or press the [Measure] key to exit Application Measurements.

1.2 Measurement Menu

The measurement menu consists of two parts: menu name, and measurement tools. The following is an example.



Menu name: displays the name of the measurement menu.

- If there are more than one measurement menu in the current exam mode, a "►" is displayed in the menu name line.
- Move the cursor to "►", the submenu pops up and displays other measurement menus in the current exam mode. Then move the cursor to an item in the submenu and press the [Set] key to enter the corresponding measurement menu or measurement package.

Measure location: select the measure location.

- If a tool in the menu is to measure parameters of left side or right side, move the cursor and press the [Set] key to select [Left] or [Right].
- If a tool in the menu is to measure parameters in the Proximal, Middle or Distal vessel, move the cursor and press the [Set] key to select [Prox], [Mid] or [Dist].

Tools: activate tools contained in the current measurement package.

- Move the cursor to a tool and then press the [Set] key to start the measurement.
- When a tool has a submenu, it has >> on its right.
  - Move the cursor to the tool and press the [Set] key to enter its submenu;
  - In the submenu, move the cursor to a tool and press the [Set] key to start the measurement;
  - After the measurement is completed, move the cursor to [Return] and press the [Set] key to return to the upper menu.
- When there are more than one page of tools, move the cursor to ▼ or ▲ and press the [Set] key to display the next or previous page.
- A measurement tool that is not selectable and is grayed out cannot be used in the present image mode. Switch to the corresponding image mode to gain the access to the tool.
- In the Application Measurement menu, √ is displayed before the tool that has been measured and the result has been obtained. (If one or some items in a submenu (extended menu) of a study are already performed, this study will be marked as measured.)
- User-defined measurement and calculation: A "*" is displayed posterior to the item for identification.

Other: if several image modes (e.g. B+PW) are applied in imaging, you can switch to the other modes by clicking here.

1.3 Soft Menu

When the system is in Measurement status, the following selections appear in the soft menu:

- Spectrum Scope: refer to auto trace scope in the Doppler mode. Top (above baseline), Bottom (below baseline) or All (above and below baseline). It appears in the Doppler mode.
- Result (window): used to show or hide the result window.
- Distance: Distance measurement on B or M Mode images.
- Ellipse Area: Area measurement using Ellipse method on B Mode images.
- TraceArea: Area measurement using Trace method on B Mode images.

1.4 Keys

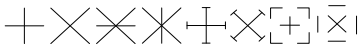
The following keys on the Control Panel may be used during a measurement.

- [Set]
  - Activates a measurement;
  - Fixes a point during a measurement;
  - Ends the current step and starts the next step during a measurement;
  - Ends the current measurement.
- [Change]
  - Changes the fixed end and active end of a caliper;
  - Toggles between the measurements in the current menu or submenu.
- [Back]
  - Returns to the previous step during a measurement;
  - Deletes the calipers with the reverse sequence of measurement operations.
- Trackball: Moves the cursor.
- [Report]: Opens/closes the exam report.
- [Clear]: Clears comments, body mark, measurement calipers and values in the result window.

1.5 Measurement Calipers

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

- The display format of measurement calipers can be preset in the [System] → [Meas] Preset dialog box. See “2.1 Preset of Measurement Parameters” for details.
- The ends of calipers can be active or fixed. The active end is called Cursor.
- The lines and points of calipers are green when active and white when fixed.
- The ends of calipers use one of the following symbols. They use these icons circularly.



1.6 Result Window

You can choose whether to display the measurement values on the screen through [Result] item in the soft menu.

When [On] is selected, the result window will display the latest measurement values. If the result window is full, new values will replace the old values.

1.6.1 Display of Result Window

- You can preset the result window style and contents in the [System] Preset dialog box. See “2.1 Preset of Measurement Parameters” for details.
- The result window uses Number or Symbol to identify different measurements.
- The result window displays the measurement data in real-time until the measurement is completed.

1.6.2 Moving Result Window

To move the result window,

1 Move the cursor to the result window title and press the [Set] key.
2 Move the trackball to position the result window to the desired place.
3 Press the [Set] key to fix the result window.

1.7 Measurement, Calculation and Study

- Measurement: Results of measurements are directly obtained via the measurement tool, they are indicated as “  ”.
- Calculation: Results of calculations are automatically derived by the system, using other measured or calculated values as parameters, they are indicated as “  ”.

  If all measurement tools related to a calculation tool are completed, the system will automatically complete the calculation 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 measurement and / or calculations for a specific clinical application, they are indicated as "  " (Closed) and "  " (Open).

1.8 Measurement Preset

The following can be preset:

- Measurement parameters
- Obstetric formulae
- General Measurement packages
- Application Measurement packages
- Measurement reports
- Automatic spectrum calculation parameters

See "2 Measurement Preset" for details.

1.9 Report

The report records measurement results. The system automatically saves results after each measurement.

To enter the report dialog box,

- Press the [Report] key.

The report dialog box shows the default report in the current exam mode. What the report contains can be preset. See "2.1 Preset of Measurement Parameters" and "2.4 Preset of Report Template" for details.

1.9.1 Viewing Report

- The report only displays the results of tools that are preset in the report template and are completed.
- Each measurement result contains three latest values at most and a final value. Select an option from [Method] to determine the final value. The options are [Last], [Avg], [Max] and [Min], respectively representing selecting the last, average, maximum and minimum values from the three values.
- For values that can calculate GA and SD, you can select another formula from [Author] to re-calculate GA and SD.

- Select [Previous] or [Next] to display the previous or next page if the report is more than one page.
- After viewing, press the [Report], [Freeze] or [Esc] key, or select [Cancel] or [OK] to close the report dialog box.

1.9.2 Editing Report

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

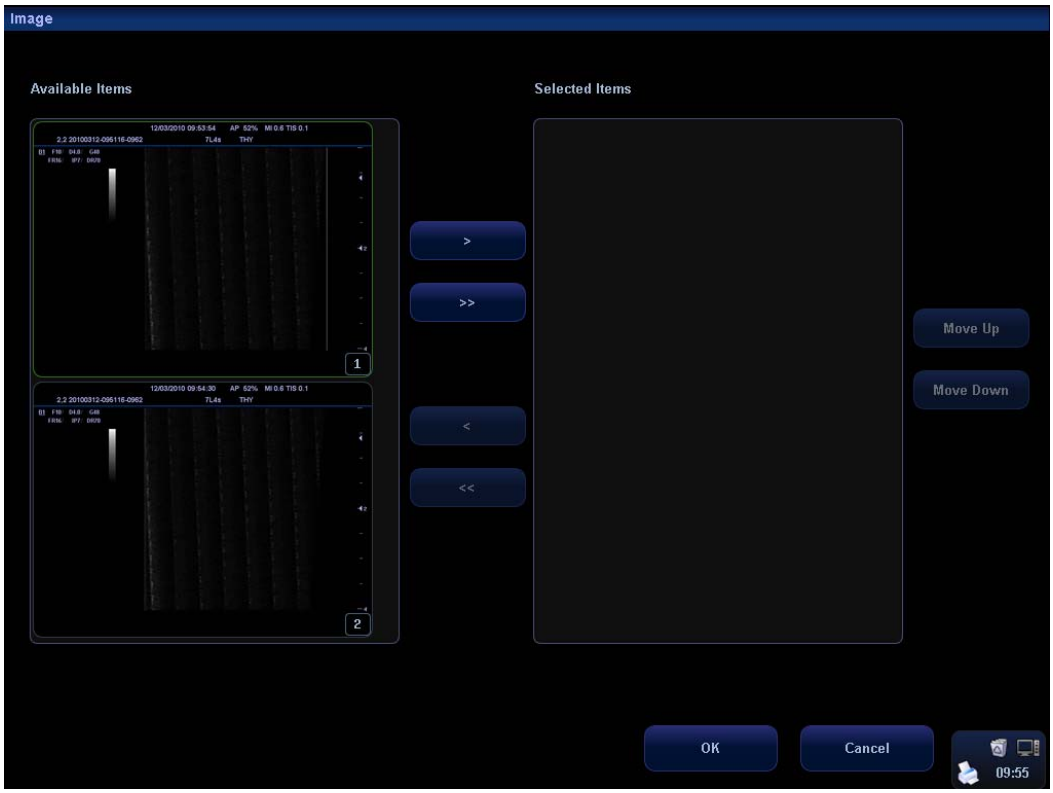
1 To edit a value in the report dialog box, move the cursor to the value and press the [Set] key, and then modify the value.

- Only measurement values can be edited. Calculation values cannot be edited.
- After a measurement value is modified, the average value of the tool and the corresponding calculation value will be updated automatically.
- After deleting/modifying measurement results, all results and the caliper on the screen will be deleted.

2 If [Prompt], [Findings] and [Comments] are selected in the report template, you can input corresponding information in the report dialog box.

3 To clear all data except the patient information in the report dialog box, select [Clear All].

4 Select [Image Select] to pop up the following dialog box. Select the images to be added into the report in the dialog box.



In the dialog box, the left column displays the images saved in the current exam, and the right column displays the images to be added into the report.

(1) Add images to the right column.

- Select an image in the left column and select [>] to add it into the right column.
- Select [>>] to add all images in the left column to the right column.
- Select an image in the right column and select [<] to clear it.
- Select [<<] to remove all images in the right column.

(2) Select an image in the right column and then select [Move Up] or [Move Down] to move it. Image sequence in the right column is the one in the report.

(3) Select [OK] to confirm the setting; Or, select [Cancel] to cancel the setting.

5 Select [Analyze] to pop up the following dialog box. The dialog box shows the anatomy options that have been preset in the report template. Select the anatomy options to be added into the report in the dialog box.

(1) Select an option from the drop-down list on the right of the anatomy option to be added into the report, or manually input an item; For the Fetal Biophysical Profile options, press the [Set] or [Back] key to select the score.

(2) Click [Auto Fill], and all drop-down list display as “Seen” (if the item has this option).

(3) Select [Previous] or [Next] to display the previous or next page.

(4) If [Prompt], [Findings] and [Comments] are selected in the report template, you can input corresponding information in the dialog box.

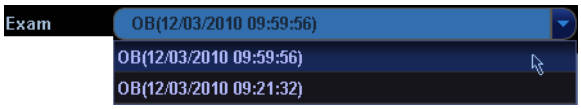
(5) Select [OK] to confirm the setting; Or, select [Cancel] to cancel the setting.

6 Select [OK] to confirm the editing; Or, press the [Report] or [Esc] key or select [Cancel] to cancel the editing.

1.9.3 Viewing History Report

History reports can be viewed, but cannot be edited.

1 In the report dialog box, select from the [Exam] drop-down list to display the history report.



Select a report to view it.

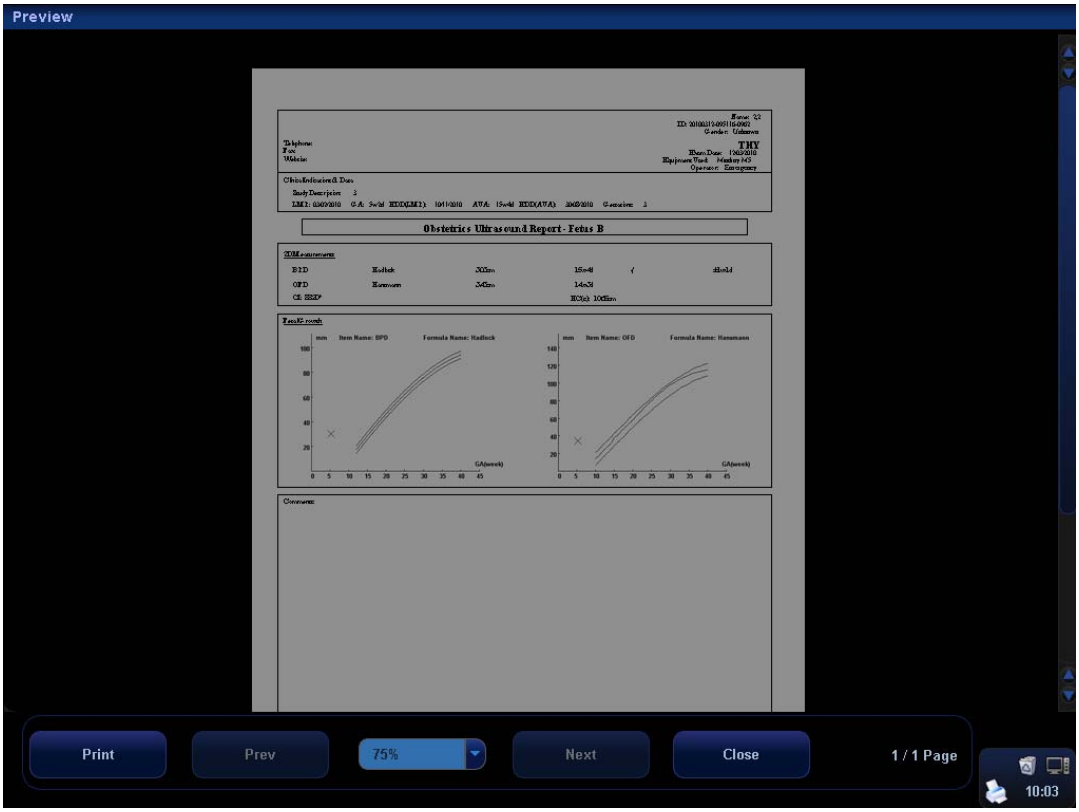
2 [Clear All], [Analyze] and [Image Select] buttons are not available in the history report.

1.9.4 Printing Report

- Select [Print] in the report dialog box to print a report; Or,
- Select [Print View] in the report dialog box to pop up the [Preview] dialog box.

  In the [Preview] dialog box,

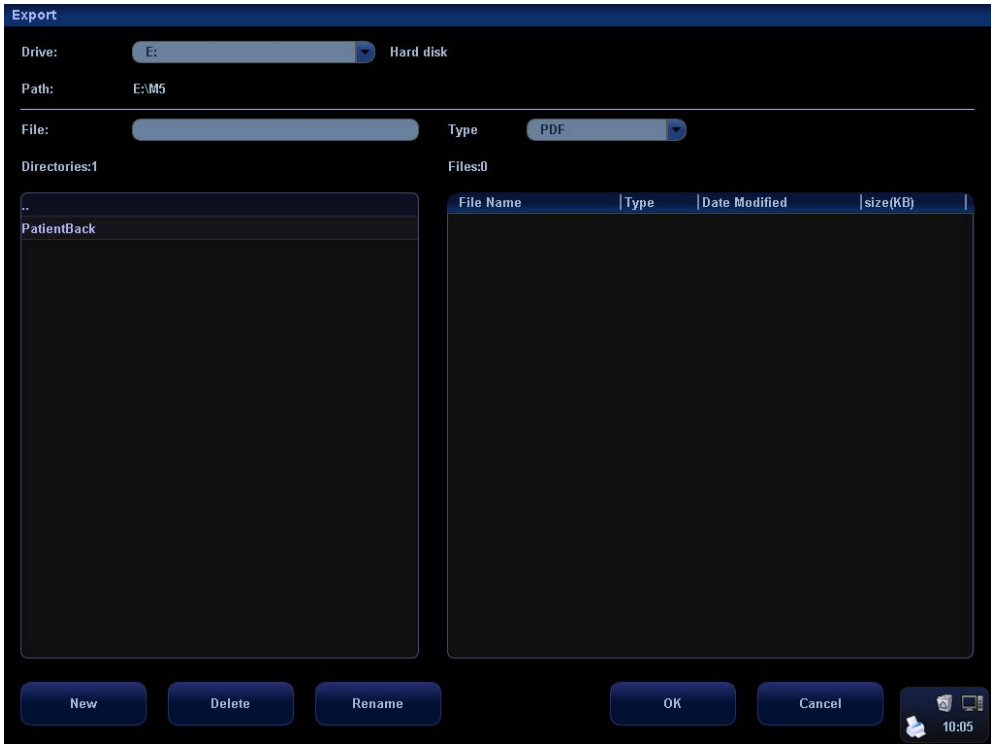
  - Select [Previous] or [Next] to view the previous or next page;
  - Select a ratio from the drop-down list to zoom in / out the report preview;
  - Select [Print] to print the report;
  - Select [Close] to close the [Preview] dialog box.



1.9.5 Exporting Report

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

1 Select [Export] to pop up the following dialog box.



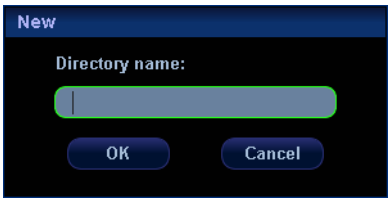
2 Select a hard disk from [Drive:].

3 To add a new directory,

(1) Move the cursor to a directory in the directory list and press the [Set] key twice. The new directory will be located under the directory selected.

To return to the upper directory, move the cursor to [..] and press the [Set] key twice.

(2) Select [New] to open the following dialog box.



(3) Input the new directory name.

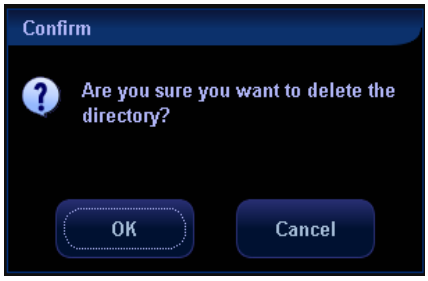
(4) Select [OK] to complete adding the new directory; Or, select [Cancel] to cancel the new directory.

4 To delete a directory,

(1) Move the cursor to a directory in the directory list and press the [Set] key twice to open a directory.

To return to the upper directory, move the cursor to [..] and press the [Set] key twice.

(2) Select [Delete] to open the following dialog box.



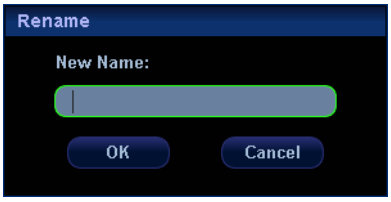
(3) Select [OK] to confirm the deletion; Or, select [Cancel] to cancel the deletion.

5 To rename a directory,

(1) Move the cursor to a directory in the directory list and press the [Set] key twice to open a directory.

To return to the upper directory, move the cursor to [..] and press the [Set] key twice.

(2) Select a directory, and click [Rename] to pop up the following dialog box.



(3) Input the new name for the directory.

(4) Select [OK] to complete the renaming; Or, select [Cancel] to cancel the renaming.

6 Move the cursor to a directory in the directory list and press the [Set] key twice. The exported report file will be located in the directory selected.

To return to the upper directory, move the cursor to [..] and press the [Set] key twice.

7 Input the file name in [File]. The exported file will use the name.

8 Select the file type from [Type].

9 Select [OK] to export the report; Or, select [Cancel] to cancel the export.

1.9.6 Send reports to DICOM storage

Select [Send] on the report to send the full screen images of the report for storage.

Every page of the report will be as a single file to send.

1.9.7 Viewing Fetal Growth Curve

If the current report uses the obstetric template, and LMP is input in the patient information, the [Growth] button will appear in the report dialog box after the related items are measured.

Select [Growth] to view fetal growth curve. See “5.8.2 Fetal Growth Curve” for details.

2 Measurement Preset

Before measuring, preset the following parameters.

- Measurement parameters;
- Obstetric preset;
- General measurement packages;
- Application measurement packages;
- Report templates.
- Automatic spectrum calculation parameters.

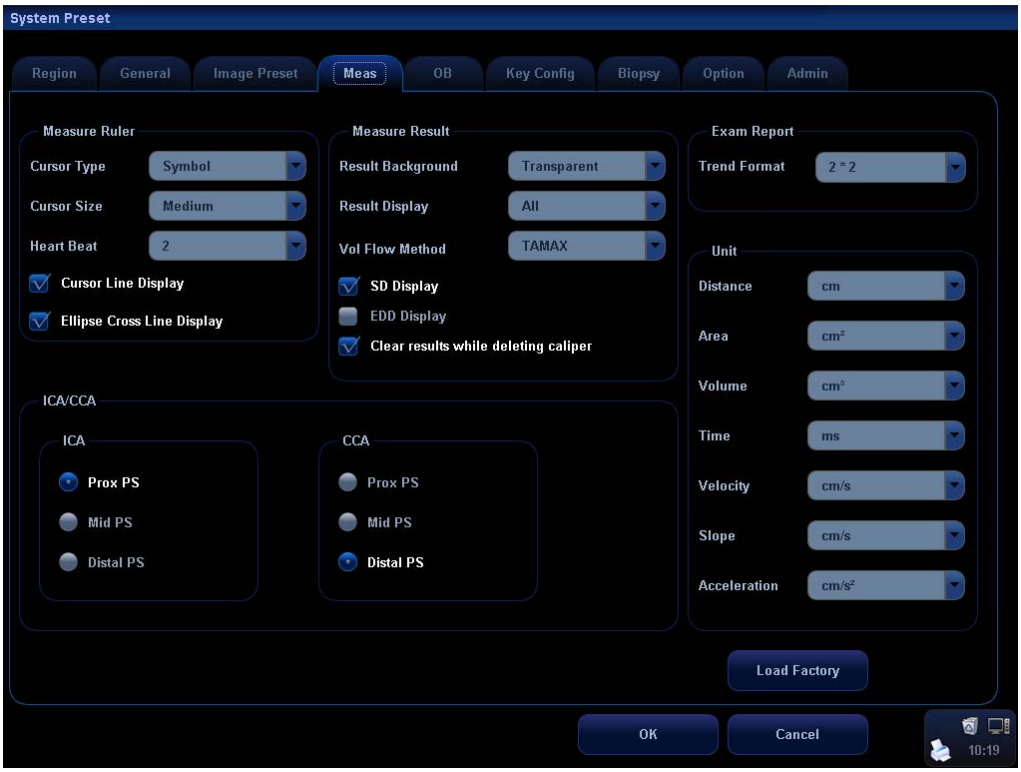
2.1 Preset of Measurement Parameters

To enter the Measurement Parameters Preset,

1 Press the [Setup] key to enter the [Setup] menu.

2 Select [System] in the menu to enter the [System] dialog box.

3 Select the [Meas] tab sheet to enter the Measurement Parameter Preset page.



4 You can preset the following parameters in the [Meas] tab sheet.

- Measure Ruler
  - Cursor Type: presets to use a Symbol or Number to mark a cursor. If “Number” is selected, the cursor will always be marked as “+”, and the system distinguishes different measurements with numbers. If “Symbol” is selected, the system distinguishes different measurements by switching the cursors among 8 different shapes.
  - Cursor Size: presets the cursor size.
  - Heart Beat: presets the number of cardiac cycle in a HR measurement. (In application, the number of cardiac cycle should match with the preset number).
  - Cursor Line Display: presets whether to display the dotted line between the two ends of a caliper after a measurement is completed.
  - Ellipse Cross Line Display: presets whether to display the dotted lines to indicate the long axis and short axis in ellipse measurement.
- Measure Result
  - Result Background: presets the background color of result window.
  - SD Display: presets whether to display SD (standard deviation) in the result window.
  - Vol Flow Method: presets the method to calculate the volume flow (by TAMEAN or TAMAX).
  - EDD Display: presets whether to display EDD (Estimated Delivery Date) in the result window.
  - Clear results while deleting caliper: presets whether to clear the measurement results when delete the caliper.
- ICA/CCA: presets the calculation method of flow velocity ratio between ICA and CCA. The calculation methods can be changed by selecting Prox PS/Mid PS/Distal PS. (The default method is the ratio between Prox PS of ICA and Distal PS of CCA; also, calculation method preset here can be applied to left and right vessels).
  - ICA
    Prox PS
    Mid PS
    Distal PS
  - CCA
    Prox PS
    Mid PS
    Distal PS
- Exam Report
  - Trend Format: presets the number of growth graphs displayed in one screen in the [Obstetric Growth Curve] dialog box.
- Unit
  - Presets the units of Distance, Area, Volume, Time, Velocity, Slope, and Acceleration.

5 You can select [Load Factory] to restore the factory setups.

6 Select [OK] to confirm the preset and close the dialog box.

Or, select [Cancel] to cancel the preset and close the dialog box.

2.2 Obstetric Preset

Enter the [OB] tab sheet:

1 Press the [Setup] key to enter the [Setup] menu.

2 Select [System] in the menu to enter the [System] dialog box.

3 Select the [OB] tab sheet.

2.2.1 Obstetric Formulae

The system provides the following .GA (Gestational Age) formulae and FG (Fetal Growth) formulae.

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

Obstetric measurement formulae

Tool	GA formula	Fetal growth curve formula
GS (Gestation Sac)	Tokyo Rempen Hansmann China	Tokyo Hellman Rempen Hansmann
CRL (Crown-rump Length)	Tokyo Jeanty Hadlock Nelson Robinson Rempen Hansmann China ASUM	Tokyo Hadlock Robinson Rempen Hansmann ASUM
BPD (Biparietal Diameter)	Tokyo Hadlock Jeanty Hansmann Merz Rempen	Tokyo Hadlock Kurtz Sabbagha Hansmann Merz

Tool	GA formula	Fetal growth curve formula
	ChittyOI	Rempen
	Osaka	ChittyOI
	China	Osaka
	ASUM	ASUM
	NICOLAIDES	NICOLAIDES
HC (Head Circumference)	Hadlock	Hadlock
	Jeanty	Merz
	Hansmann	Hansmann
	ChittyPL	ChittyPL
	ASUM	ASUM
	NICOLAIDES	NICOLAIDES
AC (Abdominal Circumference)	Hadlock	Hadlock
	ASUM	Jeanty
	NICOLAIDES	Merz
		ChittyPL
		ASUM
		NICOLAIDES
FL (Femur Length)	Tokyo	Tokyo
	Hadlock	Hadlock
	Jeanty	Merz
	Hohler	Hansmann
	Merz	O'Brien
	Hansmann	Warda
	Warda	Chitty
	Chitty	Osaka
	Osaka	ASUM
	China	NICOLAIDES
	ASUM	
	NICOLAIDES	
OFD (Occipitofrontal Diameter)	Hansmann	Merz
		Hansmann
APAD (Anteroposterior Abdominal Diameter)	/	Merz
TAD (Transverse Abdominal Diameter)	/	Merz
FTA (Fetal Trunk Cross-sectional Area)	Osaka	Osaka

Tool	GA formula	Fetal growth curve formula
THD (Thoracic Diameter)	Hansmann	Hansmann
APTD (Anteroposterior Trunk Diameter)	/	/
YS (Yolk Sac)	/	/
TTD (Transverse Trunk Diameter)	/	/
HUM (Humerus Length)	Jeanty ASUM	Merz ASUM
Ulna (Ulna Length)	/	Merz
Tibia (Tibia Length)	/	Merz
RAD (Radial Length)	/	Merz
FIB (Fibula Length)	/	Merz
CLAV (Clavicle Length)	Yarkoni	Yarkoni
TCD (Cerebellum Diameter)	Hill NICOLAIDES	Goldstein Hill NICOLAIDES
OOD (Outer Orbital Diameter)	Jeanty	
Vertebrae	/	/
NT (Nuchal Translucency)	/	/
Cist Magna	/	NICOLAIDES
EFW1	Tokyo	Hadlock1 Hadlock2 Hadlock3 Hadlock4 Hansmann Tokyo
EFW2	Tokyo	Hadlock1 Hadlock2 Hadlock3 Hadlock4 Hansmann Tokyo
Mean Sac Diam	/	/
MCA PI	/	JSUM
MCA RI	/	JSUM
Umb A PI	/	JSUM
Umb A RI	/	JSUM

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

EFW formulae

Formula	Description	Unit of	
		EFW	Measurement tools
Hadlock1	EFW=10^(1.304+(0.05281*AC)+(0.1938*FL)-(0.004*AC*FL))	g	cm
Hadlock2	EFW=10^(1.335-(0.0034*AC*FL)+(0.0316*BPD)+(0.0457*AC)+(0.1623*FL))	g	cm
Hadlock3	EFW=10^(1.326-(0.00326*AC*FL)+(0.0107*HC)+(0.0438*AC)+(0.158*FL))	g	cm
Hadlock4	EFW=10^(1.3596-(0.00386*AC*FL)+(0.0064*HC+(0.00061*BPD*AC)+ (0.0424*AC)+(0.174*FL))	g	cm
Shepard	EFW (Kg) =10^(-1.7492+(0.166*BPD)+(0.046*AC)-(2.646*AC*BPD/1000))	kg	cm
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

EFW

EFW is a calculation tool. It is obtained by measuring multiple fetal parameters.

- EFW supports multiple calculation formulae.
- If all tools required for EFW formula have been performed, EFW will be obtained automatically.
- If some tools have been performed already, the EFW value will be recalculated based on the latest values of the measurement tools.

2.2.2 Obstetric Preset

2.2.2.1 Setting the Fetal Weight Unit

Select the unit (Metric, English, English & Metric) from the drop-down list of Fetal Weight Unit.

2.2.2.2 Setting Default Formula

1 In the [OB] tab sheet, select a measurement tool in the left column.

2 Select the formula to be set as the default in the right column.

3 Select [Default]. The selected formula is set to the default and has a √.

2.2.2.3 Creating Formula

1 In the [OB] tab sheet, select a measurement tool in the left column.

2 Select [Add] to enter the [Add Obstetric Calculate Formula] dialog box.

3 There are four methods to add a new formula:

Note: in formula editing, the range of GA is 0~365 days, and the range of SD is 0~70 days.

- Create an empty OB GA table:

(1) Select [Create an Empty OB GA Table].

(2) Enter the name of the formula in the box after [Author Name:].

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

(4) Set [SD Type] in the table.

- None;
- ±1SD;
- ±2SD;
- 3%~97%;
- 5%~95%;

(5) Select the unit from the right side drop-down list of MeasValue, GA and SD respectively.

(6) Move the cursor to the position where new data will be added. Press the [Set] key to open an editable table. Then enter the corresponding data to the table.

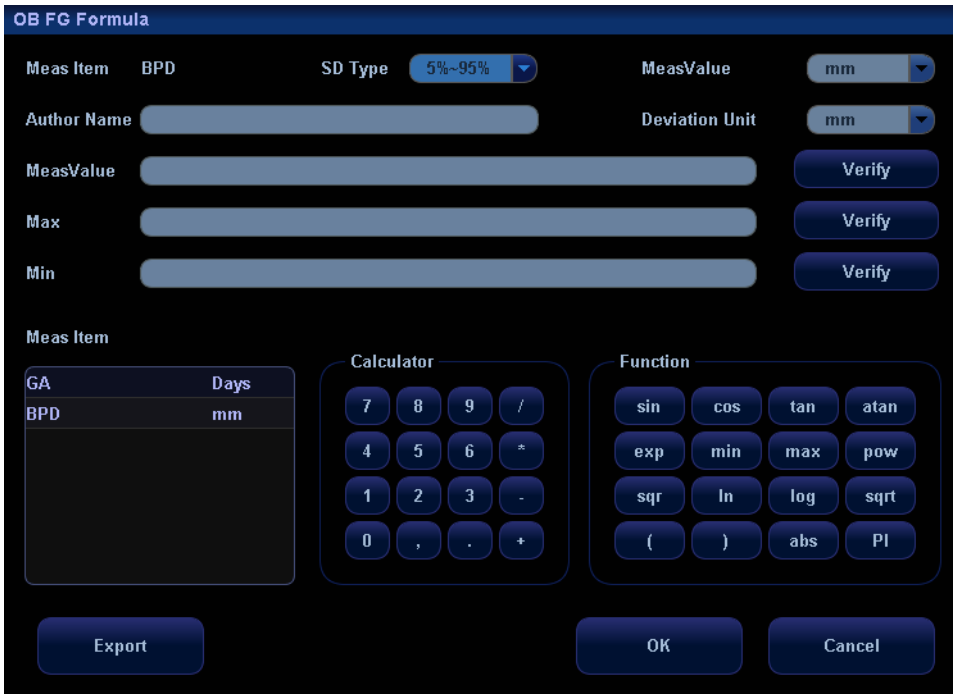
(7) Select [OK] to confirm the setting; Or, select [Cancel] to cancel the setting.

- Add an OB GA formula

(1) Select [Add an OB GA Formula] in the [Add New OB GA Table].

(2) Enter the formula name in the box after [Author Name:].

(3) Click [OK] to pop up the [OB GA Formula] editable window.



(4)

- Set [SD Type] in the table.
- None;
- ±1SD;
- ±2SD;
- 3%~97%;
- 5%~95%;

(5) Select the unit from the right side drop-down list of MeasValue and Deviation Unit respectively.

(6) Input the GA formulae and deviation values by Meas Item, Calculator, and Function. After entering each item, click [Verify] at the right side of the corresponding item to verify the input value.

About the Function: number, power and base in Function refer to numbers or variables (they are usually the measurement items, double click the item to add it to formula).

Function name	Expression	Description
sin	sin(number)	Returns sine of number
cos	cos(number)	Returns cosine of number
tan	tan(number)	Returns tangent of number
atan	atan(number)	Returns cotangent of number
exp	exp(number)	Returns the power of e (number times)
min	min(number1, number2, …)	Returns the minimal value of number1, number2, …
max	max(number1, number2, …)	Returns the maximal value of number1, number2, …
pow	pow(number, power)	Returns power value (power times) of number
sqr	sqr(number)	Returns the square value of number
ln	ln(number)	Returns natural logarithm of number
log	log(number)	Returns logarithm of number (based as 10)
sqrt	sqrt(number)	Returns square root value of number
abs	abs(number)	Returns absolute value of number
PI	/	Returns PI

- Import an OB GA table or formula

(1) Select [Import an OB GA Table or Formula] in the [Add New OB GA Table].

(2) Click [OK] to pop up the [Load Data] window.

(3) Select the drive and directory where the data is stored.

(4) Select the data to be imported.

(5) Click [OK] to import the data, and click [Cancel] to cancel the importing.

- To create a copy of existed formula as the new formula.

(1) Select [Copy an Existing OB GA Table or Formula] and then select a formula.

(2) Enter the formula name in [Author Name:] and select [OK] to enter a table with data already. The data in the table can be modified.

(3) Edit the table according to steps (4), (5), and (6) as described in Create an empty OB GA table.

(4) Select [OK] to confirm the setting; Or, select [Cancel] to cancel the setting.

2.2.2.4 Editing Formula

Only user-defined formulae can be edited.

1 In the [OB] tab sheet, select the measurement tool from the left column.

2 Select the formula to be edited in the right column.

3 Select [Edit] to enter the editing dialog box.

4 To change the formula name, enter the new name in [Author Name:].

5 To change the SD, set [SD Type].

6 Move the cursor to the position where data will be modified. Press the [Set] key to pop up an editable box. After modifying data, move the cursor to other places to continue modification.

7 Select [OK] to confirm the setting; Or, select [Cancel] to cancel the setting.

2.2.2.5 Deleting Formula

Only user-defined formulae can be deleted.

1 In the [OB] tab sheet, select the measurement tool from the left column.

2 Select the formula to be deleted in the right column.

3 Select [OK] to delete the formula; Or, select [Cancel] to cancel the deletion.

2.2.2.6 Browsing Formula

The formulae the system provides can be browsed, but cannot be edited or deleted.

1 In the [OB] tab sheet, select the measurement tool from the left column.

2 Select the formula to be browsed in the right column.

3 Select [Browse] to enter the formula editing dialog box.

4 After browsing, select [OK] or [Cancel] to exit the formula editing dialog box.

2.3 Preset of Measurement

To enter [Measure Preset] dialog box,

1 Press the [Setup] key to enter the [Setup] menu.

2 Select [Measure Preset] in the menu.

2.3.1 Preset of General Measurement

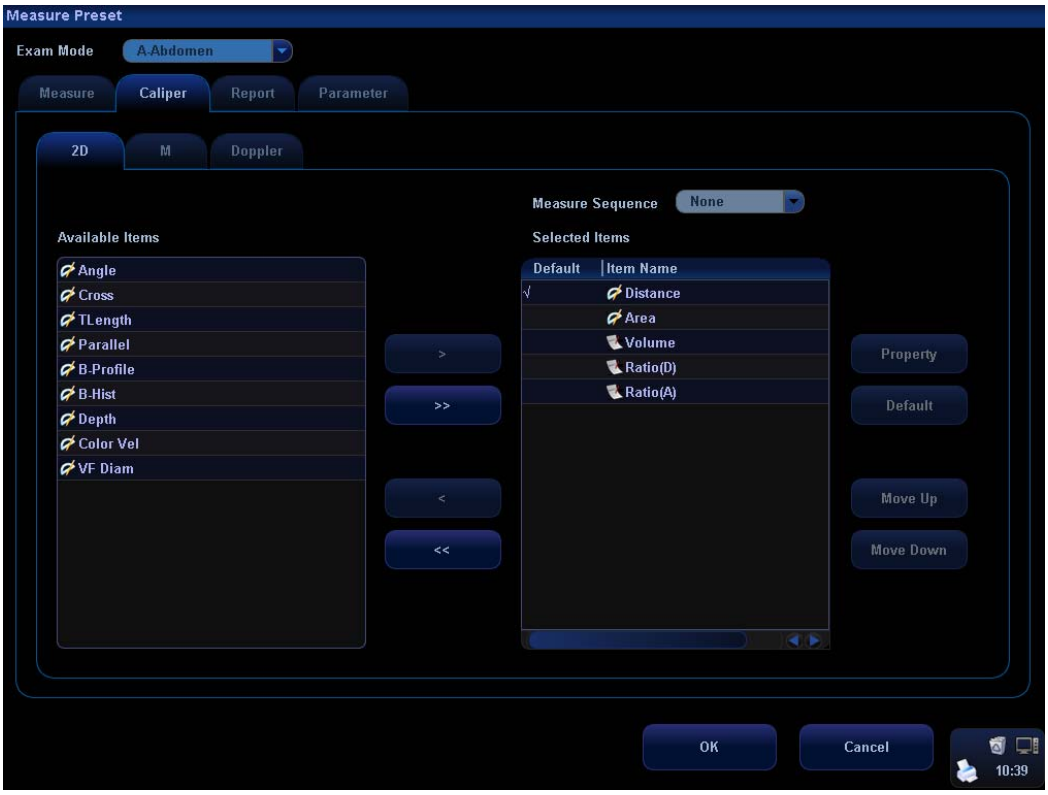
You can respectively preset the General Measurement for 2D (B / Color / Power / DirPower Mode), M Mode, or Doppler (PW / CW) Mode.

1 Open the [Measure Preset] dialog box.

2 Select an exam mode from the drop-down list at the right side of [Exam Mode]. The package set is to be used in the exam mode selected.

3 Select the [Caliper] tab sheet.

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



- The [Available Items] on the left side displays available general measurement tools configured by the system in the current scanning mode, but they are not assigned yet.
- The [Selected Items] on the right side displays the tools added to the general measurement.

5 Select an item: except Add and Delete, other operations can be performed only after one item is selected. Move the cursor to the target item, highlight the item by pressing [Set], and the item is then selected.

6 Select the tools you need from the [Available Items] and add them to the menu.

(1) To select the desired tool, move the cursor to it and then press the [Set] key to highlight it.

(2) [>]: Adds the item selected from the [Available Items] into the [Selected Items].

[>>]: Adds all tools in the [Available Items] into the [Selected Items]. You do not need to select any tools before pressing this button.

[<]: Deletes the tool selected from the [Selected Items] to the [Available Items].

[<<]: Deletes all tools in the [Selected Items] to the [Available Items]. You do not need to select any tools before pressing this button.

(3) Select a tool from [Selected Items] and then select [Move Up] or [Move Down] to move the tool. The sequence of tools displayed here will be the sequence in the menu.

(4) To set the default tool: select a tool from [Selected Items] and then select [Default]. The default tool is marked with √.

As the system enters the General Measurement menu, the default tool will be automatically activated.

To cancel the default tool, select the default tool first, and then select [Default].

7 To modify the property of a tool, select the tool in [Selected Items] and then select [Property]. The following dialog box pops up.

The measurement item property dialogue box varies with the tools they belong to, an example is shown as following.

(1) What the table list shows are the results of D Trace measurement, of which, some results such as PS and ED can be obtained from simple measurement (e.g. velocity), while some items like TAMAX are obtained from more complicated method, e.g. Trace, Spline, and Auto. If just to display PS or ED, then only velocity can be selected for the measurement method; but if both PS and ED are selected, only 2.PT can be selected for the measurement; if both PS and TAMAX are selected, then only the more complicated measurement method will take effect.

Move the cursor to the check box at the right side of the item and then press the [Set] key to select or deselect it. The item selected has a "√". Only the items selected can be displayed in the result window. PV is exclusive to the others, when PV is selected, other items (except the temporary result "velocity") will disappear in the window.

(2) If the result displayed can be measured through more than one measurement methods, then you can select the default method from the drop-down list of Method.

(3) If there are several measurement methods can be used, "Online Select" will appear at the right side of Method. If "Online Select" is selected, then the measurement methods can be selected during the measurement, and the methods selected here will be displayed as the default one; when "Online Select" is not selected, the measurement method only can be selected here.

(4) Move the cursor to an item and then press the [Set] key to select the item. Then select [Move Up] or [Move Down] to move it. The item order in the list is also the item list in the result window.

(5) The results displayed in the window can be added to the measure menu by different methods.

(6) Select [OK] to conform the setting, Or, select [Cancel] to cancel the setting.

- Select Extended Sub Menu, the selected results will be displayed in the sub-menu of D trace in the measure menu.
- Select Composite Menu, the selected results will be displayed in the measure menu independently.

8 Select [Repeat], [Next] or [None] from [Measure Sequence].

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

9 Select [OK] to confirm the settings and close the dialog box.

Or, select [Cancel] to cancel your settings and close the dialog box.

2.3.2 Preset of Application Measurement

1 Open the [Measure Preset] dialog box.

2 Select an exam mode from [Exam Mode]. The packages set are to be used in the exam mode selected.

3 Select the [Measure] tab sheet.

4 To set different package in different image mode, do not select [Use same menu for all scan modes];

To set the same package in all scan modes, select [Use same menu for all scan modes].

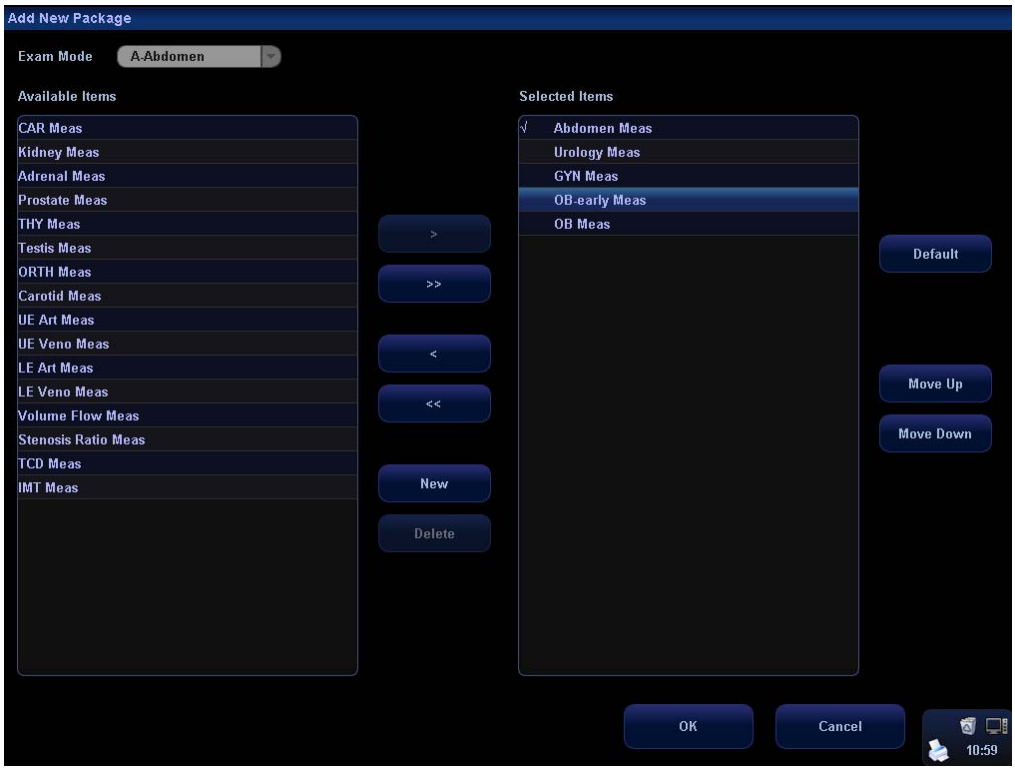
5 If [Use same menu for all scan modes] is not selected, select a tab sheet from [2D], [M] or [Doppler].

6 [Measure Package] shows the packages to be set.

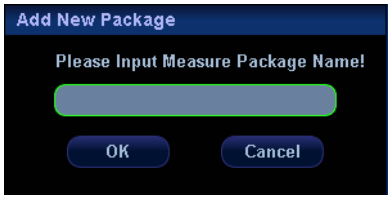
- If it is blank, input the package name directly or refer to the next step to set the default package.
- If it shows the package name to be set, skip this step.
- If it has a package name in it but you want to set a new package, refer to the next step to create a new package and set it as the default.
- If it has a package name in it but you want to set another existing package, refer to the next step to set the package as the default.
- To change the package name, simply input the new name in it.

7 To create, delete or set a package, select [Advanced] to pop up the following dialog box.

In the dialog box, [Available Items] shows application packages configured in the system, but they are not assigned to the current mode yet; [Selected Items] shows application packages configured in the current exam mode.



(1) To create a package, select [New] and the following dialog box pops up. Input the new package name and select [OK] in the dialog box.



(2) To delete a package, select it in [Available Items] and select [Delete].

(3) To move a package from [Available Items] to [Selected Items],

- Select a package in [Available Items] and select [>] to move it to [Selected Items].
- Select [>>] to move all packages in [Available Items] to [Selected Items].
- Select a package in [Selected Items] and select [<] to move it to [Available Items].
- Select [<<] to move all packages in [Selected Items] to [Available Items].

(4) Select a package in [Selected Items] and select [Move Up] or [Move Down] to move it.

(5) Select a package in [Selected Items] and select [Default] to set the package as the default of the exam mode (and image mode) selected.

(6) Select [OK] to confirm the setting; Or, select [Cancel] to cancel the setting.

8 Select a category from the left drop-down list under [Available Items], and the corresponding measurement items will be displayed in the list below.

9 Select [Measurement], [Calculate], [Study] or [All] from the right drop-down list under [Available Items], the corresponding category will appear.

10 Select tools in the left column to the right column. The tools in the right column can appear in the menu.

(1) To add an item to the existing study, you should select the study in the Selected Items; to add an item to the root of Selected Items, you should select the root directory or select a certain item under the root directory, or select nothing in the Selected Items.

(2) Add tools to the right column:

- Select a tool in the left column and select [>] to add it to the right column.
- Select a tool in the right column and select [<] to delete it from the right column.
- Select [>>] to add all tools in the left column to the right column.
- Select [<<] to delete all tools in the right column.

(3) To set a tool in a study as the default, which is to be automatically activated as the study is entered, select the tool and select [Default]. The default tool has a "√".

To deselect the default tool, select it and select [Default].

11 According to the requirement, repeat steps 8, 9, 10 to add other tools into the right column.

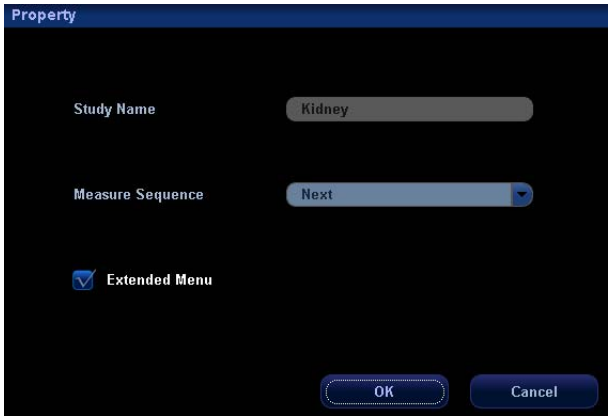
12 To adjust the order of tools, select a tool in the right column and select [Move Up] or [Move Down]. The tool order in the right column is also the tool order in the menu.

13 To set the default tool, which is to be automatically activated as the package is entered, select the tool in the root of right column and select [Default]. The default tool has a " √ ".

To deselect the default tool, select it and select [Default].

14 To change the property of a tool, select the tool in the right column and select [Property]. The [Property] dialog box pops up, and you can set the property in the dialog box (the property of calculation items cannot be changed).

- To edit the property of a measurement tool, please refer to Step 7 in 2.3.1 Preset of General Measurement.
- To edit the property of a study tool,



(1) Select [Repeat], [Next] or [None] in [Measure Sequence].

- [Repeat]: after the current measurement is completed, the system automatically activates the current measurement again.
- [Next]: after the current measurement is completed, the system automatically activates the next tool in the current study.
- [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.

(2) To display the measurement tools in the study into a submenu, select [Has Extended Menu].

(3) Select [OK] to confirm the setting; Or, select [Cancel] to cancel the setting.

15 Select [Repeat], [Next] or [None] in [Measure Sequence].

- [Repeat]: after the current tool is completed, the system automatically activates the current tool again.
- [Next]: after the current tool is completed, the system automatically activates the next tool in the menu.
- [None]: after the current tool is completed, the system automatically activates nothing.

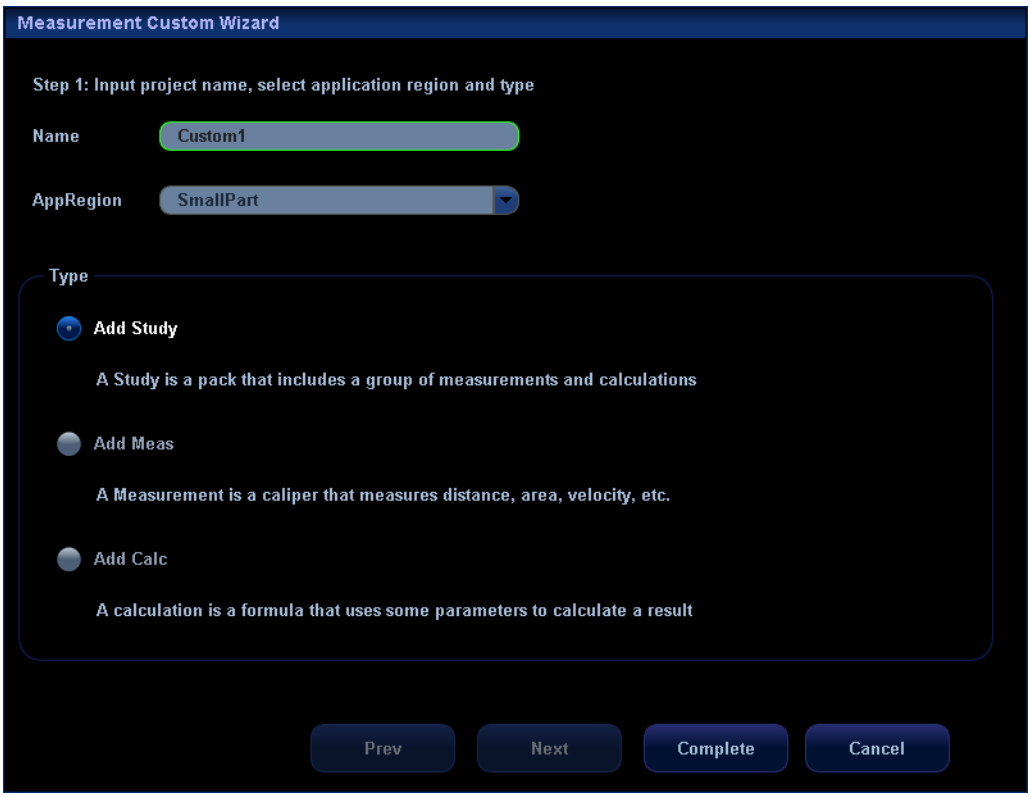
16 Select [OK] to confirm the setting and close the dialog box; Or, select [Cancel] to cancel the setting and close the dialog box.

2.3.3 User-defined Measurement

1 Enter [Measure Preset] -> [Measure] page, and make sure the [Exam Mode] and [Measure Package] are correctly selected.

2 Select the position to place the user-defined measurement item on the right column. (Select the study firstly if you want to add user-defined item into a study).

3 Click [New].
The “Measurement Custom Wizard” dialog box pops up, as shown in the following figure.



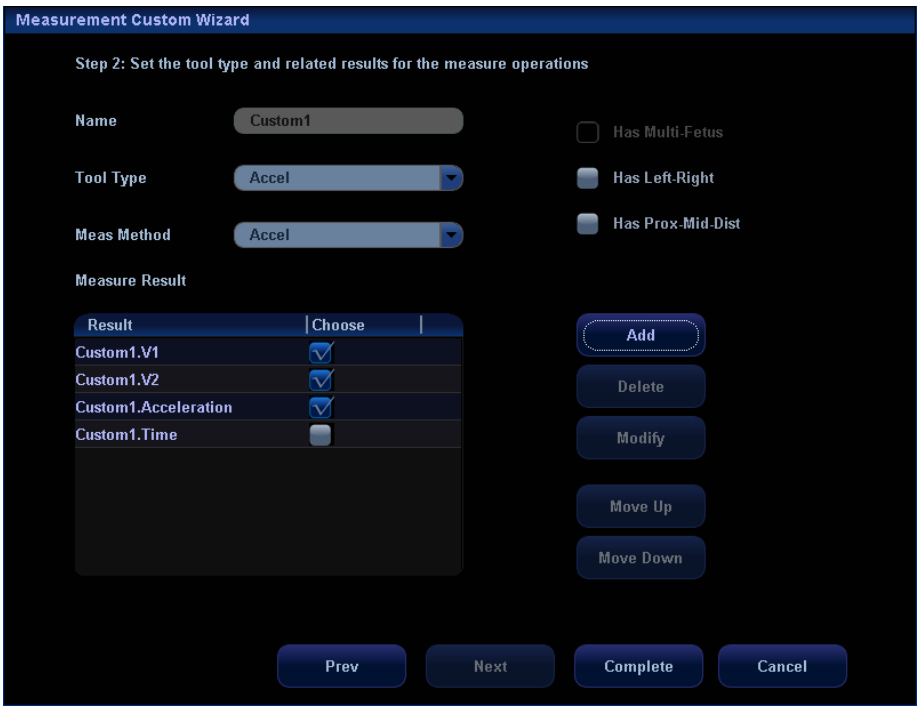
Available functions:

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

■ User-defined Measurement

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

2 Select the [Tool Type], [Meas Method] and the Measure Result.



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

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

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

■ User-defined Calculation

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

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

2 Edit the formula.

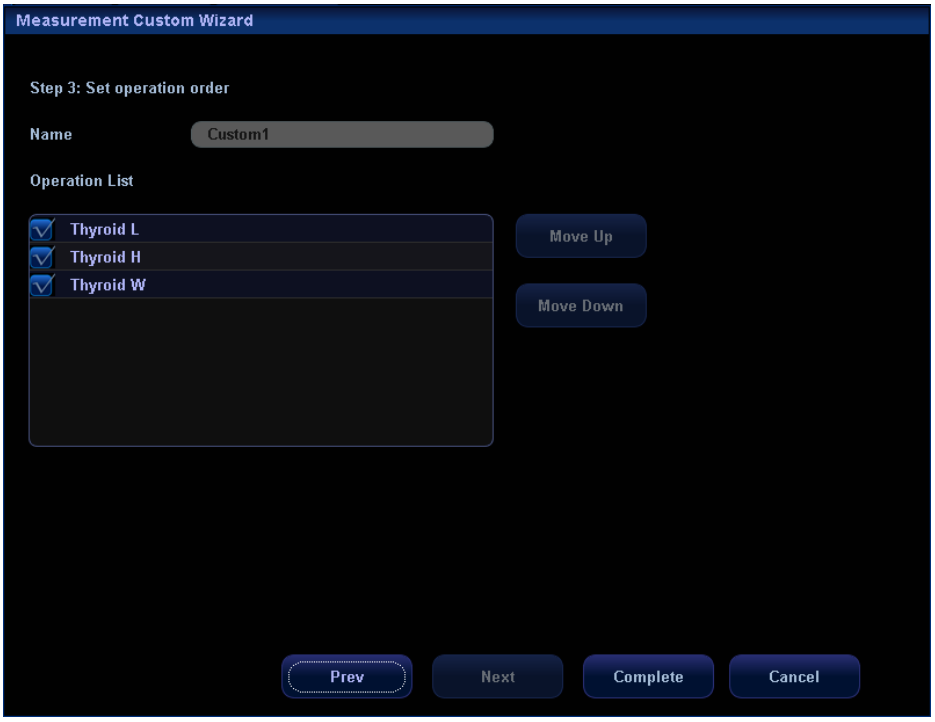
Descriptions of the attributes in the dialog box are shown in the following table.

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

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

3 Verify the formula and select the unit and range of the result, then click [Complete].

4 Click [Next] to set the measuring order of the items in the calculation if more than one measurement items are set as parameter in the formula.

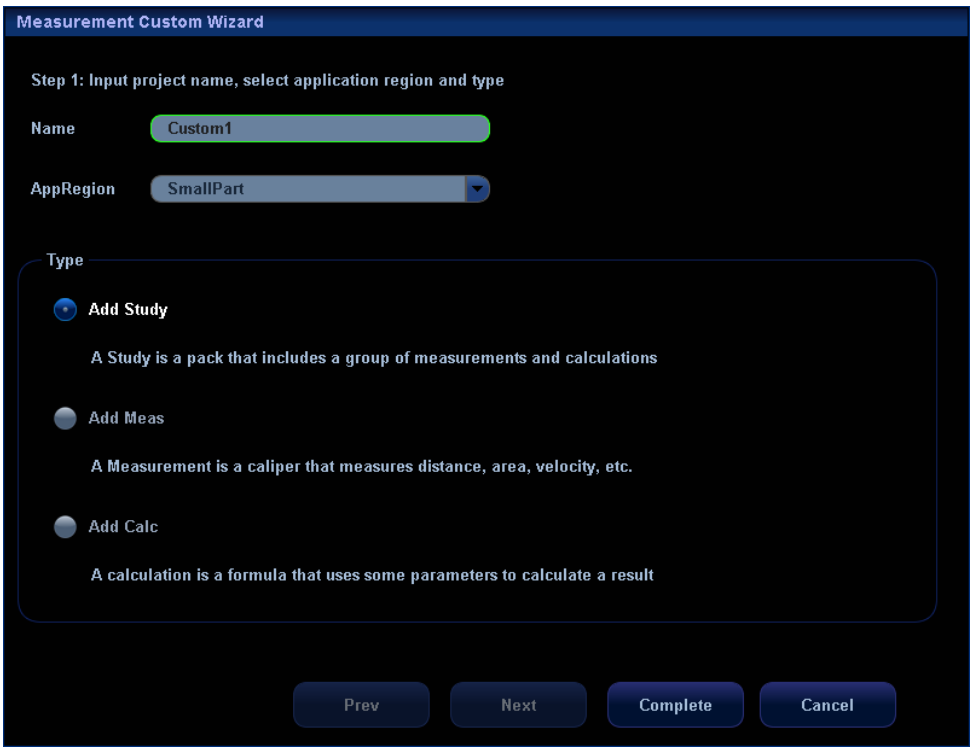


5 Select the item in the [Operation List], then click [Move Up]/ [Move Down] to adjust the position.

6 Click [Complete] to return to the [Measure Preset] page.
The new added user-defined calculation displays in the [Selected Item] list. An asterisk appears posterior to the user-defined item for identification.

■ User-defined Study

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



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

2 Click [Complete] and the empty study new added displays in the [Selected Item].

3 Select the user-defined study, add items into it. See "2.3.2 Preset of Application Measurement" for details.

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

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

2.4 Preset of Report Template

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

1 Enter the [Measure Preset] dialog box.

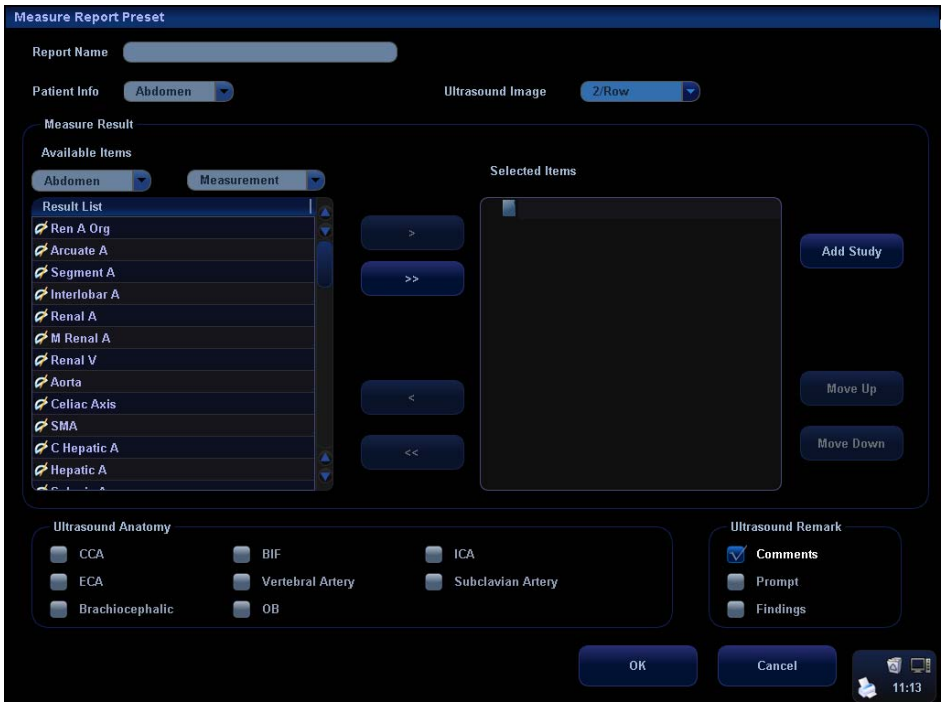
2 Select the [Report] tab sheet to enter the preset screen of report template.

In the preset screen of report template, you can create, edit, import, export and delete report templates, set default template and template order.

2.4.1 Creating Report Template

1 Enter the [Report] tab sheet in [Measure Preset] dialog box.

2 Select [New] to enter the editing dialog box of report template.



3 Input the template name in [Report Name].

4 Select a category in [Patient Info]. Different patient information items will be displayed in the report as different category is selected here. (If “Obstetric” is selected, item OB in the [Ultrasound anatomy] will be selected automatically; same with the vascular anatomy items when “Vascular” is selected in the [Patient Info].)

5 Select an option from [Ultrasound Image]. The option determines how many images are displayed in one row in the report.

6 Select a category from the drop-down list on the right of [Available Items].

7 Select [Measurement], [Calculate] or [Study] from the drop-down list on the right of the category drop-down list.

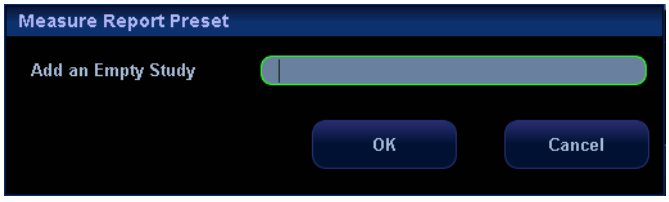
8 Add tools into the right column. Only the tools appear in the right column and are completed in the ultrasound exam can be displayed in the report.

(1) If the tools selected in the following steps are to be located in the root of the right column, either select the root or select nothing in the right column;

If the tools selected in the following steps are to be located under some study, select the study in the right column.

(2) To create a new study,

(a) Select [Add Study] to pop up the following dialog box.



(b) Input the study name in the text box.

(c) Select [OK] to confirm the setting and the new study will appear in the right column of preset dialog box of report template.

Or, select [Cancel] to cancel the setting.

(3) Add tools to the right column.

(a) Select a tool in the left column and select [>] to add it to the right column

(b) Select a tool in the right column and select [<] to delete it from the right column.

(c) Select [>>] to add all tools in the left column to the right column.

(d) Select [<<] to delete all tools in the right column.

9 Return to the steps 6~8 to add other tools into the right column.

10 Select a tool in the right column and select [Move Up] or [Move Down] to move it. The tool order in the right column is also the tool order in the report.

11 Select or deselect items in [Ultrasound Anatomy].

If the vascular anatomy item is selected, corresponding options will appear as the [Analyze] button in the report is selected.

12 Select or deselect [Comments], [Findings] and / or [Prompt] in [Ultrasound Remark]. If selected, the corresponding item will appear in the report.

13 Select [OK] to confirm the setting and close the dialog box; Or, select [Cancel] to cancel the setting and close the dialog box.

14 In the [Report] tab sheet, select [OK] and the new report template is adopted; Or, select [Cancel] and the new report template is cancelled.

2.4.2 Editing Report Template

1 Enter the [Report] tab sheet in [Measure Preset] dialog box.

2 Select the template to be modified in the list.

3 Select [Edit] to enter the editing dialog box of report template. See the steps 3-14 in “2.4.1 Creating Report Template” to edit the template.

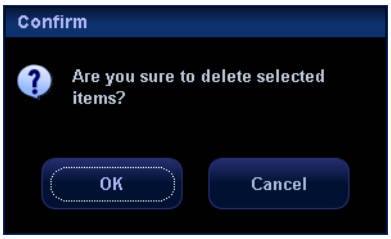
4 In the [Report] tab sheet, select [OK] and the modified template is adopted; Or, select [Cancel] and the template is not modified.

2.4.3 Deleting Report Template

1 Enter the [Report] tab sheet in [Measure Preset] dialog box.

2 Select the template to be deleted in the list.

3 Select [Delete] and the following dialog box pops up.



4 In the dialog box, select [OK] to delete the template selected; Or, select [Cancel] and the template selected is not deleted.

5 In the [Report] tab sheet, select [OK] and the template deletion takes effect; Or, select [Cancel], the template deletion is cancelled and the template is not deleted.

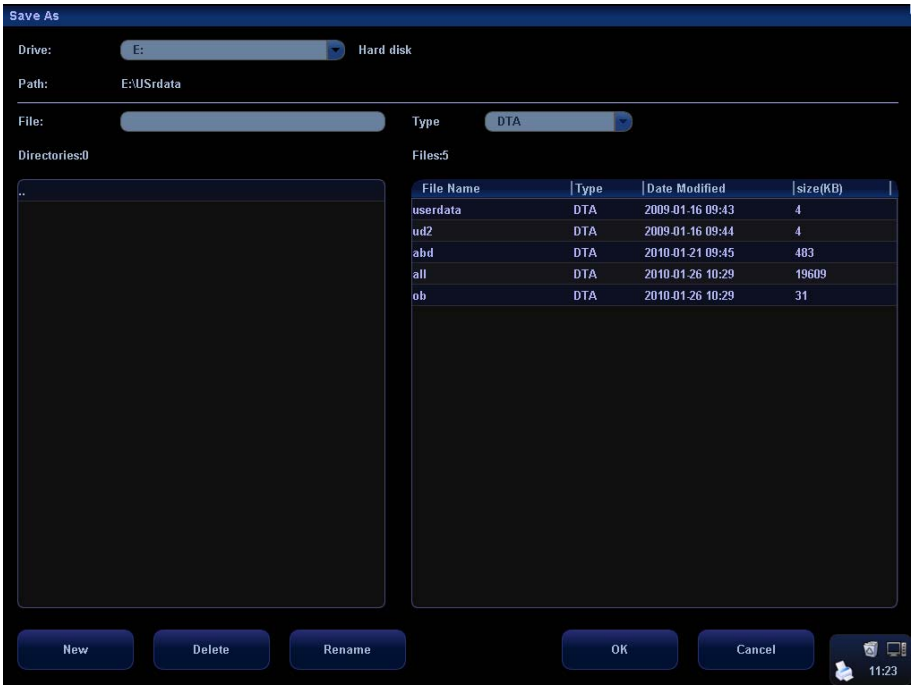
2.4.4 Exporting/ Importing Report Template

2.4.4.1 Exporting Report Template

1 Enter the [Report] tab sheet in [Measure Preset] dialog box.

2 Select the template to be exported in the list.

3 Select [Export] to pop up the following dialog box.



4 Select a hard disk from the right drop-down list of [Drive:].

5 Move the cursor to a directory in the directory list and press [Set] twice to select the directory. Select [New], [Delete] and [Rename] to manage the directory.

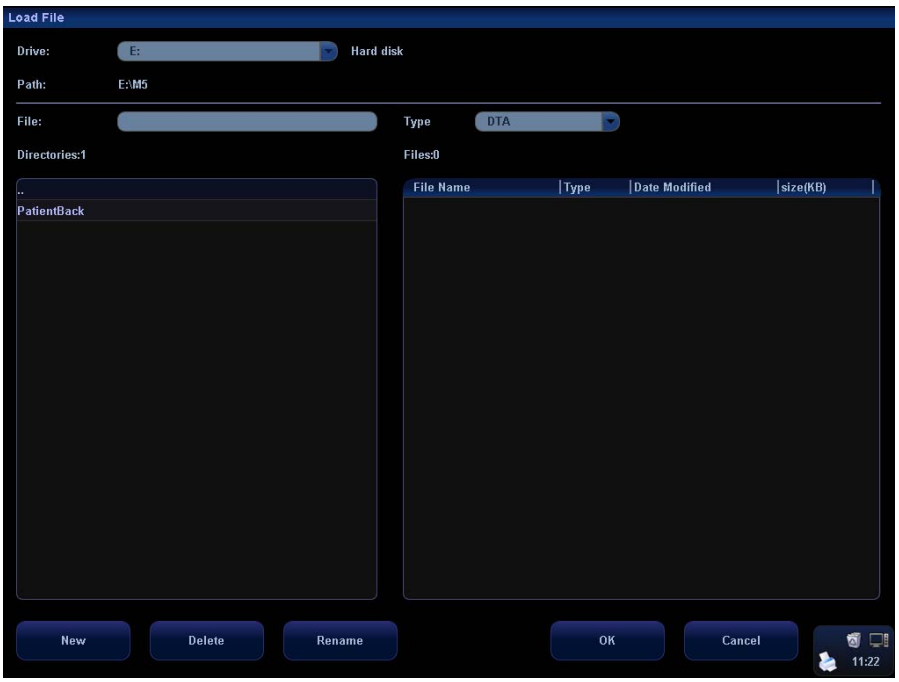
6 Input the file name in [File].

7 Select [OK] to export the report; Or, select [Cancel] to cancel the exporting.

2.4.4.2 Importing Report Template

1 Enter the [Report] tab sheet in [Measure Preset] dialog box.

2 Select [Import] to pop up the following dialog box.



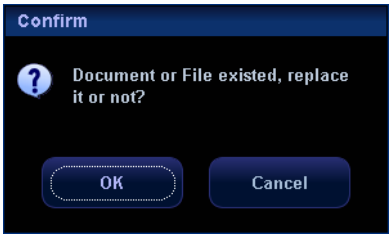
3 Select the drive where the report template is located from the right drop-down list of [Drive:].

4 Move the cursor to the directory where the report template is located in the directory list and press [Set] twice to select the directory. Select [New], [Delete] and [Rename] to manage the directory.

5 Select the report template to be imported in the right side file list.

6 Select [OK] to import the report template; Or, select [Cancel] to cancel the importing, and system will prompt “Import failed”.

7 If this report template already existed (the system can tell if the template already existed according to the template name, but not by the file name), the following dialog box will pop up.



Select [OK] to replace the existed report template; Or, select [Cancel] to cancel the importing.

2.4.5 Setting Template Order

1 Enter the [Report] tab sheet in [Measure Preset] dialog box.

2 Select the template to be moved in the list.

3 Select [Move Up] or [Move Down] to move the template selected.

4 Repeat the steps 2-3 to move other templates if necessary.

5 Select [OK] to confirm the moving; Or, select [Cancel] to cancel the moving.

2.4.6 Setting Default Template

1 Enter the [Report] tab sheet in [Measure Preset] dialog box.

2 Select an exam mode from [Exam Mode].

3 Select a report template in the list.

4 Select [Default] to set the report template selected as the default in the exam mode selected.

5 Select [OK] to confirm the setting; Or, select [Cancel] to cancel the setting.

2.5 Automatic Spectrum Calculation Parameters

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

1 Enter the [Parameter] tab sheet in [Measure Preset] dialog box.

2 Move the cursor to an item, press [Set] to select or deselect the item.

3 Select [OK] to confirm the setting; Or, select [Cancel] to cancel the setting.

3 General Measurements

There are three types of General Measurement menus available:

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

To perform General Measurements,

1 After the preset, you can start the exam.
2 Scan and freeze the image.
3 Press the [Caliper] key to enter the General Measurement.
4 Select a tool in the General Measurement menu to start the measurement.
Also, some measurements can be performed via the soft menu controls.

The following operations are performed on Freeze images by default.

3.1 2D General Measurements

The measure sequence can be preset in [Measure Preset] page, please refer to “2 Measurement Preset”.

3.1.1 Depth

Function: measures the depth

- For the phased array transducers, the depth is the distance from the sector center of image to the measuring cursor.;
- Or, for the convex array or linear array transducers, the depth is the distance from the transducer surface to the measuring cursor in the direction of ultrasonic wave

Method 1:

The value can be obtained in several measurement items. It can be preset in Measure Preset whether to display the depth in real-time during the measurement.

1 On a 2D image, select a tool (if it has set the Depth to be displayed in the result window) in the menu.
2 Move the cursor on the image and the depth value will be displayed in the result window. Once the [Set] key is pressed, the depth value disappears.

Method 2:

1 Select [Depth] in 2D tab sheet in the menu.

2 Use the trackball to move the cursor to the desired point.

3 Press the [Set] key.

3.1.2 Distance

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

1 Select [Distance] in the menu.

2 Use the trackball to move the cursor to the starting point.

3 Press the [Set] key to fix the starting point.

4 Use the trackball to move the cursor to the end point.

Or, press the [Back] key to cancel the fixed starting point;

Or, press the [Change] key to exchange the locations of the cursor and the fixed starting point.

5 Press the [Set] key to fix the end point.

3.1.3 Angle

Function: measures the angle formed by two crossing planes on the B/C image; range: 0°-180°.

1 Select [Angle] in the menu.

2 Use the method for distance measurement to fix line segments A and B respectively, and the angle will be displayed in the result window after fixing A and B segments.

3.1.4 Area

Function: measures the area and circumference of a closed region on the image. Four measurement methods are available: Ellipse, Trace, Cross, and Spline. The four methods are also applicable to other measurement items.

- Ellipse: to fix an ellipse region by two equal-cut perpendicular axes.

1 Select [Ellipse] from the drop-down list on the right of [Area] in the menu.

2 Move the cursor to an area of interest. Press the [Set] key to anchor the starting point of the fixed axis of the ellipse.

3 Move the cursor to position the end point of the fixed axis of the ellipse.

Or, press the [Change] key to switch between the fixed end and active end;

Or, press the [Back] key to activate the fixed end.

4 Press the [Set] key.

5 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 [Change] or [Back] key to return to the step 3.

6 Press the [Set] key to anchor the ellipse region.

- Trace: to fix a closed region by free tracing.

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

2 Move the cursor to the measurement starting point. Press the [Set] key to fix the starting point.

3 Use the trackball to move the cursor along the edge of the desired region and draw out the trace line.

To correct the trace line, rotate the Multifunctional Knob to recede or advance the trace line.

4 The trace line will close as a loop between the starting and end points when [Set] is pressed or when the cursor is very near to the starting point.

- Cross: to fix a closed region (consists of four 1/4 ellipses) by 2 perpendicular axes.

1 Select [Cross] from the drop-down list on the right of [Area] in the menu.

2 Move the cursor to the measurement starting point. Press the [Set] key to fix the starting point.

3 Use the trackball to position the end point of the first axis and then press the [Set] key. Another dashed axis and dashed close region appears. The second axis is perpendicular to the fixed axis.

4 Move the trackball to position the second axis.

5 Press the [Set] key to fix the one end of the second axis.

Or, press the [Change] or [Back] key to cancel the fixed axis.

6 Move the trackball to position the end point of the second axis.

Or, press the [Change] key to switch between the fixed end of the second axis and the cursor.

Or, press the [Back] key to cancel the fixed end of the second axis.

7 Press the [Set] key to anchor the length of the second axis.

- Spline: to fix a spline curve by a series of points (12 points at most).

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

2 Move the cursor to the measurement starting point. Press the [Set] key to fix the starting point.

3 Move the trackball along the area of interest. Press the [Set] key to anchor the second point. A closed region whose shape is to be determined appears on the screen.

4 Move the trackball along the area of interest further to position the third, fourth … points.

To correct a previous point, press the [Back] key.

A maximum of 12 points can be anchored to create the trace area along the area of interest as much as possible.

5 Press the [Set] key to anchor the final point and then press this key again.

3.1.5 Volume

Function: measures the volume of the target object. Three measurement methods are available:

- Ellipse: measures the vertical section of the target object. The formula is V = (π/6)×A×B^2, in which, A is the length of long axis of the ellipse and B is the length of short axis.
- EDist: measures both the vertical and horizontal sections of the target object. The formula is V = (π/6) ×A×B×M, in which, A is the length of long axis of the ellipse, B is the length of short axis of the ellipse, and M is the length of the third axis.
- 3Dist: to obtain the volume value by measuring the lengths of the three axes of the target object. The formula is V = (π/6) ×D1×D2×D3. This method is applied when the target object displays two perpendicular scanning planes in dual B/ C image mode. D1, D2, D3 refer to the length of the three axes.

Specific operation:

- Ellipse

1 Select [Ellipse] from the drop-down list on the right of [Volume] in the menu.

2 The steps of Ellipse-Volume measurement method are similar to those of Ellipse for area measurement. Refer to Ellipse in section “3.1.4 Area”.

- EDist

1 Select [EDist] from the drop-down list on the right of [Volume] in the menu.

2 Use the Ellipse method to measure the area of the vertical section. Refer to Ellipse in section “3.1.4 Area”.

3 Unfreeze the image. Rescan the area of interest perpendicular to the previous image.

4 Freeze the image again.

Use the method for distance measurement to measure the length of the third axis.

- 3Dist

1 Select [3Dist] from the drop-down list on the right of [Volume] in the menu.

2 Use the method for distance measurement to measure the lengths of three axes.

3.1.6 Cross Line

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

1 Move the cursor to [Cross] in the menu. Press the [Set] key.

2 Move the cursor to the measurement starting point. Press the [Set] key to fix the starting point.

3 Move the trackball to the end point of the first line segment.

Press the [Set] key to confirm the operation. Another line segment perpendicular to the fixed line segment appears on the screen. This line segment can be repositioned.

Or, press the [Change] key to switch between the fixed end and the active end.

Or, press the [Back] key to cancel the fixed starting point.

4 Move the trackball to the starting point of the second line segment.

Press the [Set] key to confirm the starting point.

Or, press the [Change] or [Back] key to return to the previous step.

5 Move the trackball to the end point of the second line segment.

Or, press the [Change] key to switch between the fixed end and the active end.

Or, press the [Back] key to cancel the previous operation and the end point.

6 Press the [Set] key to confirm the end point of the second line segment.

3.1.7 Parallel Line

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

1 Move the cursor to [Parallel] in the menu, then you can see two perpendicular lines appear, and the intersection is the starting point of the line that is perpendicular to the five parallel lines.

2 Rotate the Multifunctional Knob to change the angle of the baseline and then press the [Set] key to confirm it. A dash line appears starting with a short transverse line, indicating the position of the first parallel line.

3 Use the trackball to position the position of the second parallel line.

Press the [Set] key to confirm the operation. Short parallel lines appear at the original baseline.

Or, press the [Change] key to switch between the fixed end and the active end.

Or, press the [Back] key to cancel the previous operation.

4 Continue moving the trackball to position the third, fourth, and fifth parallel lines.

When the fifth parallel line is anchored, the tail end of the baseline is determined.

3.1.8 Trace Length

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

- Trace

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

2 Move the cursor to the measurement starting point. Press the [Set] key to fix the starting point.

3 Use the trackball to move the cursor along the target to draw out the trace line. To correct the trace line, rotate the Multifunctional Knob anticlockwise to cancel some points and clockwise to restore some points.

4 Press the [Set] key to anchor the end point of the trace line.

- Spline

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

2 Move the cursor to the measurement starting point. Press the [Set] key to fix the starting point.

3 Move the trackball along the target and press the [Set] key to anchor the second, third, fourth … points. A maximum of 12 points can be anchored. The points are connected by smooth curves. Press the [Set] key twice to anchor the final point, namely, the end point.

To correct a previous point, press the [Back] key.

3.1.9 Distance Ratio

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

1 Move the cursor to [RatioDist] in the menu. Press the [Set] key.

2 Use the method for distance measurement to measure two line segments A and B. The result will be displayed in the result window after the measurement of the second line is completed.

3.1.10 Area Ratio

Function: measures the area of two closes regions and then calculates their ratio.

1 Select a method from the drop-down list on the right of [RatioArea]. The methods are Ellipse, Trace, Cross, Spline.

2 Use the area method to measure the area of Region 1 and Region 2 respectively. Refer to the section “3.1.4 Area”.

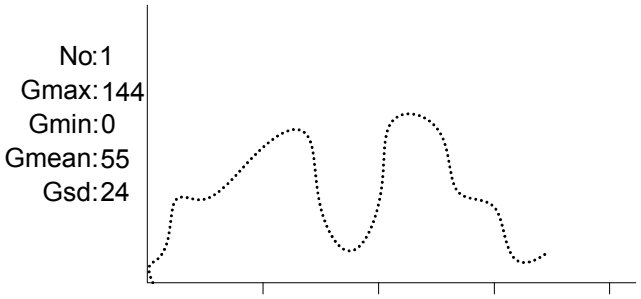
3.1.11 B Profile

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

Profile must be measured on the frozen image.

1 Select [B-Profile] in the menu.

2 Refer to the method for distance measurement. When the measurement completes, the gray distribution on the measured line appears on the screen, where the horizontal axis stands for the length of the line segment and the vertical axis for the gray of the image, as shown below:



No: number, the last two results will be displayed on the screen.

Gmax: the maximum gray.

Gmin: the minimum gray.

Gmean: the average gray.

Gsd: standard deviation of gray.

3.1.12 B Histogram

Function: measures the gray distribution of ultrasonic echo signals within a closed region.

Measurement methods available include Rect (Rectangle), Ellipse, Trace, and Spline.

Histogram must be measured on the frozen image.

1 Select [B-Hist] in the menu.

2 When Rectangle method is used:

(1) Move the cursor to the first vertex of the rectangle.

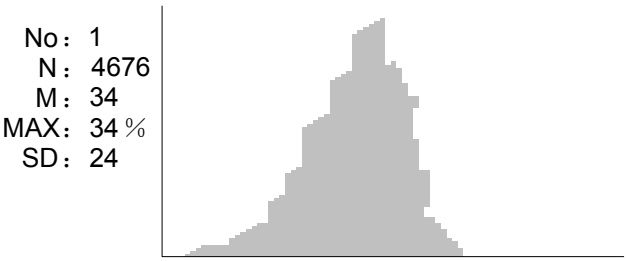
(2) Press [Set] to anchor the first vertex of the rectangle.

(3) Move the cursor to the second vertex of the rectangle.

(4) Press [Set] to anchor the second vertex of the rectangle.

When Ellipse, Trace, and Spline methods are used, refer to these methods used for area measurement respectively.

3 After the measurement completes, the result displays on the screen. The horizontal axis stands for the gray of the image and the vertical axis for the gray distribution percentage.



No; number, the last two results will be displayed on the screen.

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

M: M ＝∑Di / N.

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

SD: standard deviation, SD＝（∑Di^2/N－（∑Di/N）^{2}）$^{1/2}$.

Di is the gray at each pixel point, ∑Di is the total grays of all the pixels.

3.1.13 Color Velocity

Hint: This tool is only applied for evaluation, not for precise measurement.

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

Color velocity must be measured on the frozen image.

1 In the Color Mode, select [Color Vel] in the menu. The cursor in the shape of □ will display on the screen.

2 Move the cursor to the point to be measured for blood flow velocity and press the [Set] key to fix the point. A floating line is displayed in the direction parallel to the ultrasonic wave beam at that point. The compensation angle A is 0°.

3 Rotate the Multifunctional Knob to change the compensation angle within the range of 0°-80º to align the floating line in the direction same to that of blood flow at the point to be measured.

4 Press the [Set] key to fix the direction of blood flow.

3.1.14 VF Diam

Function: measures the distance between two points on the image to obtain the vessel flow diameter.

1 Select [VF Diam] in the menu.

2 Use the trackball to move the cursor to the starting point.

3 Press the [Set] key to fix the starting point.

4 Use the trackball to move the cursor to the end point.

Or, press the [Back] key to cancel the fixed starting point;

Or, press the [Change] key to exchange the locations of the cursor and the fixed starting point.

5 Press the [Set] key to fix the end point.

3.2 M General Measurements

3.2.1 Distance

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

1 Select [Distance] in the M Mode menu, then you will see two dash perpendicular lines appear on the screen.

2 Move the cross point of the two lines to the measurement starting point and press the [Set] key.

3 Move the cross point to the end point, the cross point can only be moved in vertical direction.

Or, press the [Change] key to switch between the fixed end and active end.

Or, press the [Back] key to delete the starting point just anchored.

4 Press the [Set] key.

3.2.2 Time

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

1 Select [Time] in the M Mode menu, then you will see two dash perpendicular lines appear on the screen.

2 Move the cross point of the two lines to the measurement starting point and press the [Set] key.

3 Use the trackball to move the cross point to the measurement end point. The cross point can only be moved in the horizontal direction. And the cross point is connected with the starting point by a dash line.

Or, press the [Change] key to switch between the fixed end and active end.

Or, press the [Back] key to delete the starting point just anchored.

4 Press the [Set] key.

3.2.3 Slope

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

1 Select [Slope] in the M Mode menu, then you will see two dash perpendicular lines appear on the screen.

2 Move the cross point of the two lines to the measurement starting point and press the [Set] key.

3 Use the trackball to move the cross point to the measurement end point. The cross point is connected with the starting point by a dash line.

Or, press the [Change] key to switch between the fixed end and active end.

Or, press the [Back] key to delete the starting point just anchored.

4 Move the big “+” cursor to the measurement end point and press the [Set] key.

3.2.4 Velocity

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

1 Select [Velocity] in the M Mode menu, then you will see two dash perpendicular lines appear on the screen.

2 Move the cross point of the two lines to the measurement starting point and press the [Set] key.

3 Use the trackball to move the cross point to the measurement end point. The cross point is connected with the starting point by a dash line.

Or, press the [Change] key to switch between the fixed end and active end.

Or, press the [Back] key to delete the starting point just anchored.

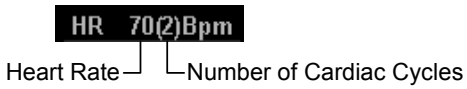
4 Use the trackball to move the big “+” cursor to the measurement end point. Press the [Set] key.

3.2.5 Heart Rate

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.

The number of cardiac cycles can be preset in the [System] → [Meas] preset dialog box.

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.



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

1 Select [Heart Rate] in the M Mode menu, then you will see two dash perpendicular lines appear on the screen.

2 Select the number of cardiac cycles.

3.3 Doppler General Measurements

3.3.1 Time

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

The operations are similar to the Time measurement in M Mode. See “3.2.2 Time” for details.

3.3.2 Heart Rate

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

The operations are similar to the Heart Rate measurement in M Mode. See “3.2.5 Heart Rate” for details.

3.3.3 D Velocity

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

1 In the D Mode, select a tool in the menu (if the tool has set the D Velocity to be displayed in the result window).

2 Move the cursor on the spectrum and the velocity value is obtained in real-time. Once the [Set] key is pressed, the velocity value disappears.

Or,

1 Select [D Vel] in the PW / CW Doppler Mode menu.

2 Move the cursor to the point to be measured for velocity and press the [Set] key.

3.3.4 Acceleration

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

angle.

1 Select [Acceleration] in the PW / CW Doppler Mode menu.

2 Move the cursor to the first point to be measured for velocity and press the [Set] key to fix the point.

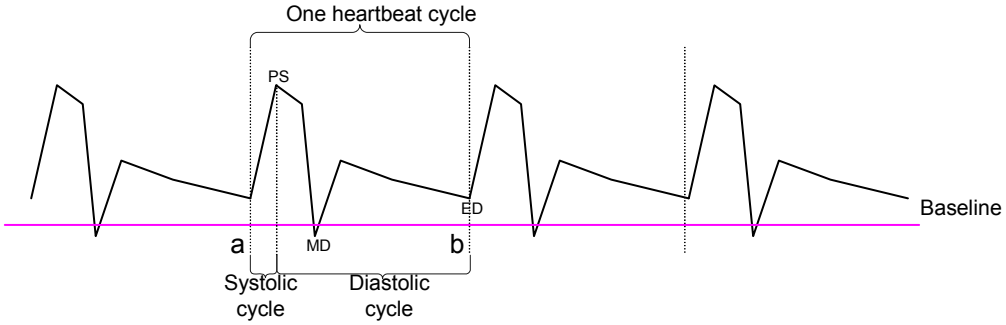
3 Move the cursor to the second point to be measured for velocity and press the [Set] key to fix the point.

3.3.5 D Trace

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

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

The sketch map of Doppler spectrum is shown as below:



The following parameters can be obtained through one D trace:

- PS: Peak Systolic Velocity. Measures the fastest velocity of red blood cell that crosses the sample volume.
- PV: Peak Velocity. There is no difference between diastolic and systolic cycle, the value is the fastest velocity of red blood cell that crosses the sample volume, and it can be used to examine the venous vessel.
- ED: End-Diastolic Velocity. Measures the blood velocity at the end of the cardiac cycle.
- Vel: Flow velocity.
- MD: Minimum Diastolic Velocity.
- Average Velocity: the average flow velocity in the whole traced Doppler spectrum.
  - TAMAX: Time Averaged Maximum Velocity.

$$TAMAX(\quad cm/s) = \int_{Ta}^{Tb} V(t)dt \Big/ (T_b - T_a)$$

- TAMEAN: Time Averaged Mean Velocity.

- Average Pressure Gradient: the average pressure gradient in the whole traced Doppler spectrum.

$$AveragePG(mmHg) = \int_{T_a}^{T_b} 4(V(t))^2 dt \Big/ T_b - T_a$$

  - MPG: Maximum Pressure gradient.
  - MMPG: Mean velocity Mean Pressure Gradient. (Obtained during auto-spectrum calculation.)

- PPG: PG time-averaged Peak Systolic Velocity. It is the corresponding pressure gradient of the peak systolic velocity. PPG (mmHg) = 4 × PS $(m/s)^2$
- VTI: Velocity-time Integral. It is the integral of the product of Doppler instantaneous velocity and the total time interval.
- AT: Systolic Acceleration Time. It is the time of the blood velocity accelerating from the end of diastole to the systolic peak.
- DT: Deceleration Time
- HR: Heart Rate.
- S/D: PS/ED. S/D (No unit) = PS (m/s) / ED (m/s)
- D/S: ED/PS. D/S (No unit) = ED (m/s) / PS (m/s)
- PI: Pulsatility Index. PI (No unit) = |(PS (m/s) – ED (m/s)) / TAMAX (m/s)|
- RI: Resistance Index. RI (No unit) = |(PS (m/s) – ED (m/s)) / PS (m/s)|
- θ: Correction angle, which is the spectrum angle during measurement.

NOTE:
1. In the above formulae, 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 gained in D trace, while in application, the system only displays part of them according to operation and preset.

- 2 PT

1. Select [2 PT] from the drop-down list on the right of [D Trace] in the menu, you will see the cursor changes into "+".
2. Move the cursor to the starting point to be measured and press the [Set] key to fix the point.
3. Move the cursor to the end point to be measured and press the [Set] key to fix the point.

- Manual

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

2 Move the cursor to the starting point to be measured and press the [Set] key to fix the point.

3 Move the cursor along the edge of the target region.

Move the cursor right to 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 the [Set] key to fix the point.

- Spline

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

2 Move the cursor to the starting point to be measured and press the [Set] key 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. The points are connected by smooth curve.

4 When there are 50 points fixed, the measurement ends automatically.

If it is necessary to end the measurement when there are less than 50 points fixed, press the [Set] key twice continuously at the final point.

- Auto

Auto D trace must be performed on the Freeze image.

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

2 Move the cursor to the starting point to be measured and press the [Set] key to fix the point.

3 Move the cursor to the end point to be measured and press the [Set] key to fix the point.

3.3.6 PS/ED

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

1 Select [PS/ED] in the Doppler Mode menu.

2 Move the cursor to the Systolic Peak and press the [Set] key to fix the point.

3 Move the cursor to the Diastolic End and press the [Set] key to fix the point.

3.3.7 VF Diam

Function: measures the distance between two points on the image to obtain the vessel flow diameter.

1 Select [VF Diam] in the menu.

2 Use the trackball to move the cursor to the starting point.

3 Press the [Set] key to fix the starting point.

4 Use the trackball to move the cursor to the end point.

Or, press the [Back] key to cancel the fixed starting point;

Or, press the [Change] key to exchange the locations of the cursor and the fixed starting point.

5 Press the [Set] key to fix the end point.

3.3.8 Vol Flow(Diam)

Function: measures the maximum or the mean velocity and the vessel diameter in PW+B or PW+ B+ Color mode to calculate the volume of the flow.

1 Select [Vol Flow(Diam)] in the Doppler Mode menu.

2 Measure TAMAX or TAMEAN on the spectrum. (Select whether to use the TAMAX or TAMEAN in “System Preset->Meas->Vol Flow Method”.)

3 Measures the vessel diameter on the 2D image. The system calculates the volume of flow.

Hints: If the TAMAX or TAMEAN value is obtained via auto spectrum calculation, the Vol Flow will be calculated after the VF Diam is measured. (The “Vol Flow” should be selected in “System Preset-> Measure Preset-> Parameter Preset”.)

3.4 References

3Dist Volume:

Emamian, S.A., et al., “Kidney Dimensions at Sonography: Correlation With Age, Sex, and Habitus in 665 Adult Volunteers,” American Journal of Radiology, January, 1993, 160: 83-86.

HR (M General Measurement):

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4 Abdomen Measurements

4.1 Abdomen Measurement Tools

The system supports the following abdomen measurement tools.

Mode	Type	Tool	Description	Method or formula
2D	Measure-ment	Liver	/	Same as Distance measurement in 2D General Measurements
		Renal L	Renal length	
		Renal H	Renal height	
		Renal W	Renal width	
		Cortex	Renal cortical thickness	
		Adrenal L	Adrenal length	
		Adrenal H	Adrenal height	
		Adrenal W	Adrenal width	
		CBD	Common Bile Duct	
		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	Celiac Aorta Diameter	
		Aorta Bif	/	
		Iliac Diam	Iliac Diameter	
		Portal V Diam	Portal Vein Diameter	
		Pre-BL L	Previous-bladder length	

Mode	Type	Tool	Description	Method or formula
		Pre-BL H	Previous-bladder height	
		Pre-BL W	Previous-bladder width	
		Post-BL L	Posterior-bladder length	
		Post-BL H	Posterior-bladder height	
		Post-BL W	Posterior-bladder width	
		Ren.A Diam	Renal Artery Diameter	
		Ren.V Diam	Renal Vein Diameter	
	Calculate	Renal Vol	Renal volume	See 10.4.2.2 Renal Vol
		Pre-BL Vol	Previous-bladder volume	See 10.4.2.3 Pre-BL Vol
		Post-BL Vol	Posterior-bladder volume	See 10.4.2.4 Post-BL Vol
		Mictur.Vol	Micturated volume	See 10.4.2.5 Mictur. Vol
	Study	Kidney	/	See 10.4.3.3 Kidney
		Bladder	/	See 10.4.3.5 Bladder
		Adrenal	/	See 10.4.3.4 Adrenal
M	/			
Doppler	Measure-ment	Ren A Org	Renal Artery Origin	Same as D Trace in Doppler General Measurements
		Arcuate A	Arcuate Artery	
		Segmental A	Segmental Artery	
		Interlobar A	Interlobar Artery	
		Renal A	Renal Artery	
		M Renal A	Main Renal Artery	
		Renal V	Renal Vein	
		Aorta	Celiac aorta	
		Celiac Axis	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	

Mode	Type	Tool	Description	Method or formula
		M Hepatic Vein	M Hepatic Vein	
		Splenic V	Splenic Vein	
		SMV	Superior Mesenteric Vein	
	Calculate	Vol Flow (Portal V)	Volume flow of Portal Vein	Same as Vol Flow(Diam) in Doppler General Measurement
		Vol Flow (Renal A)	Volume flow of Renal Artery	
		Vol Flow (Renal V)	Volume flow of Renal Vein	
	Study	/		

Measurement menus and reports can be preset. See the section “Measurement Preset” for details.

4.2 Abdomen Exam Preparations

Make the following preparations before performing Abdomen exam:

- Confirm that the current transducer is appropriate.
- Check that the current date of the system is correct.
- Register patient information in the [Patient Info] → [ABD] dialog box. See the section “Patient Information Input” in the *Basic Volume* for details.
- Switch to the proper exam mode.

4.3 Entering Abdomen Measurements

To enter the Abdomen Measurements,

Press the [Measure] key to enter the Application Measurements. If the current menu is not the one having Abdomen Measurement tools, move the cursor to the menu title and select the package having Abdomen Measurement tools.

4.4 Abdomen Measurement Operations

1 Select a tool in the menu.

2 Refer to the methods in 4.1 Abdomen Measurement Tools to complete the measurement.

4.5 Abdomen Exam Report

During the measurements or after a measurement, press the [Report] key on the Control Panel to browse the report. See “1.9 Report” for details on report browsing, printing and exporting etc.

5 Obstetric Measurements

5.1 Obstetric Measurement Tools

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.

The system supports the following obstetric measurement tools.

Mode	Type	Tools	Description	Method or formula
2D	Measure-ment	GS	Gestational Sac Diameter	Same as Distance measurement in 2D General Measurements
		YS	Yolk Sac	
		CRL	Crown Rump Length	"Line" is the same as Distance measurement in 2D General Measurements; "Trace" and "Spline" are the same as "Trace" in 2D General Measurements
		NT	Nuchal Translucency	Same as Distance measurement in 2D General Measurements
		BPD	Biparietal Diameter	
		OFD	Occipital Frontal Diameter	
		HC	Head Circumference	Same as Area measurement in 2D General Measurements
		AC	Abdominal Circumference	
		FL	Femur Length	Same as Distance measurement in 2D General Measurements
		TAD	Abdominal Transversal Diameter	
		APAD	Anteroposterior Abdominal Diameter	Same as Distance measurement in 2D General
		TCD	Cerebellum Diameter	

Mode	Type	Tools	Description	Method or formula
		Cist Magna	Cist Magna	Measurements
		LVW	Lateral Ventricle Width	
		HW	Hemisphere Width	
		OOD	Outer Orbital Diameter	
		IOD	Inner Orbital Diameter	
		HUM	Humerus Length	
		Ulna	Ulna Length	
		RAD	Radius Length	
		Tibia	Tibia Length	
		FIB	Fibula Length	
		CLAV	Clavicle Length	
		Vertebrae	Length of Vertebrae	
		MP	Middle Phalanx Length	Same as Distance measurement in 2D General Measurements
		Foot	Foot length	
		Ear	Ear Length	
		APTD	Anteroposterior Trunk Diameter	
		TTD	Transverse Trunk Diameter	
		FTA	Fetal Trunk Cross-sectional Area	Same as Area measurement in 2D General Measurements
		THD	Thoracic Diameter	Same as Distance measurement in 2D General Measurements
		HrtC	Heart Circumference	Same as Area measurement in 2D General Measurements
		TC	Thoracic Circumference	
		Umb VD	Umbilical Vein Diameter	Same as Distance measurement in 2D General Measurements
		F-Kidney	Fetal Kidney Length	
		Mat Kidney	Matrix Kidney Length	
		Cervix L	Cervical Length	
		AF	Amniotic Fluid	
		NF	Nuchal Fold	
		Orbit		
		PL Thickness	Placental Thickness	

Mode	Type	Tools	Description	Method or formula
		Sac Diam1	Gestational Sac Diameter 1	
		Sac Diam2	Gestational Sac Diameter 2	
		Sac Diam3	Gestational Sac Diameter 3	
		AF1	Amniotic Fluid 1	
		AF2	Amniotic Fluid 2	
		AF3	Amniotic Fluid 3	
		AF4	Amniotic Fluid 4	
		LVIDd		
		LVIDs		
		LV Diam		
		LA Diam		
		RVIDd		
		RVIDs		
		RV Diam		
		RA Diam		
		IVSd		
		IVSs		
		IVS		
		LV Area		Same as Area measurement in 2D General Measurements
		LA Area		
		RV Area		
		RA Area		
		Ao Diam		Same as Distance measurement in 2D General Measurements
		MPA Diam		
		LVOT Diam		
		RVOT Diam		
	Calculate	Mean Sac Diam		The average value of three sac diameters
		AFI		Measure AF1, AF2, AF3, AF4, AFI=AF1+AF2+AF3+AF4
		EFW1		EFW is calculated by the default EFW formula, based on the measured multiple parameters, The formulae are listed in the “EFW” formulae table as
		EFW2		

Mode	Type	Tools	Description	Method or formula
				described in 2.2.1 Obstetric Formulae. The formula can be reselected in the OB report.
		HC/AC		HC/AC=HC/AC
		FL/AC		FL/AC=FL/AC×100
		FL/BPD		FL/BPD=FL/BPD×100
		AXT		AXT=APTD×TTD
		CI		CI=BPD/OFD×100
		FL/HC		FL/HC=FL/HC×100
		HC(c)		$HC(c)=2.325\times((BPD)^2+(OFD)^2)^{1/2}$
		HrtC/TC		HrtC/TC=HrtC/TC
		TCD/AC		TCD/AC=TCD/AC
		LVW/HW		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	AF Index	Measure AF1, AF2, AF3, AF4, AFI=AF1+AF2+AF3+AF4
M	Measure-ment	FHR		Same as Heart Rate measurement in M General Measurement
		LVIDd		Same as Distance measurement in 2D General Measurements
		LVIDs		
		RVIDd		
		RVIDs		
		IVSd		
		IVSs		
	Calculate	/		
	Study	/		
Doppler	Measure-ment	FHR		Same as Heart Rate measurement in Doppler General Measurement

Mode	Type	Tools	Description	Method or formula
		Umb A	Umbilical Artery	Same as D Trace measurement in Doppler General Measurements
		Duct Veno		
		Placenta A		
		MCA	Fetal Middle Cerebral Artery	
		Fetal Ao	Fetal Aorta	
		Desc Aorta	Desc. Aorta	
		Ut A	Uterine Artery	
		Ovarian A	Ovarian Artery	
	Calculate	/		
	Study	/		

Measurement menus and reports can be preset. See the section “Measurement Preset” for details.

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.

5.2 Clinical GA

Clinical GA and clinical EDD are calculated according to the parameters obtained from clinical examinations. After you enter the relative information into the window, the system will automatically calculate the GA and EDD and will display them at the right side of Patient Info in the title. The calculating methods are listed as follows:

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

5.3 Ultrasound GA

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

the measurement.

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

5.3.1 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. The formulae can be preset in [OB] tab sheet of [System] preset. Please refer to 2.2 Obstetric Preset. You can reselect the GA table/ formulae in the right side drop-down list of the related OB items in the report. SD is also calculated through GA table/ formulae, it displays in the result window and report only when the system has clinical GA.

5.3.2 AUA

AUA is the average value of effective GA that is calculated according to biparietal diameter, head circumference, abdomen circumference, femur length, Gestational Sac, crown rump length etc. The value of all the above items will be involved to calculate AUA in the system default method. Also, you can change the measurement items that to be used to calculate AUA by clicking the check boxes at the right side of the related items.

5.3.3 CUA

CUA is calculated according to formulae based on some measurement items (the involved items are among biparietal diameter, head circumference, abdomen circumference, and femur length). To calculate the 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.

5.4 Obstetric Exam Preparations

Make the following preparations before performing obstetric exam:

- Confirm that the current transducer is appropriate.
- Check that the current date of the system is correct.
- Register patient information in the [Patient Info] → [OB] dialog box. See the section "Patient Information Input" in the *Basic Volume* for details.
- Switch to the proper exam mode.

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

5.5 Multi-fetus Exam

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

This system supports examination of more than one fetus.

In the case of multi-fetus exam,

- Set the number of fetuses in [Gestations] of the [Patient Info] → [OB] dialog box.
- After [Gestations] in the [Patient Info] → [OB] dialog box is selected to 2 or 3, [Fetus] item will display in the menu having Obstetric measurements. Switch to [Fetus A], [Fetus B], or [Fetus C] via the menu item.
- The fetuses are measured respectively.
- The values in the result window are marked with fetus label A, B or C.

- In the Obstetric Report dialog box, select [Fetus A], [Fetus B], or [Fetus C] to display the report of different fetuses.
- In the Anatomy dialog box, select [Fetus A], [Fetus B], or [Fetus C] to display anatomy options for different fetuses.
- In the [Obstetric Growth Curve] dialog box, select from the check-box [A], [B], or [C] on the lower part to display the growth curves of different fetuses.

5.6 Entering Obstetric Measurements

To enter the Obstetric Measurements,

Press the [Measure] key to enter the Application Measurements. If the current menu is not the one having Obstetric Measurement tools, move the cursor to the menu title and select the package having Obstetric Measurement tools.

5.7 Obstetric Measurement Operations

The measurement methods of all the tools are shown in 5.1 Obstetric Measurement Tools.

5.7.1 Measurement Tool Operations

1 Select a measurement tool in the menu.

2 Refer to the methods listed in 5.1 Obstetric Measurement Tools to complete the measurement.

- GA calculated from fetal parameters and the GA or FG table is called “Diagnostic GA”.
- After measurements, the result window displays measurement values and GA. Whether the result window displays EDD and SD (standard deviation) depends on the preset (Preset in [System] Preset → [Meas] dialog box).
- If the Diagnostic GA exceeds the threshold, it will display as OOR (out of range) in the result window and will not display in the report.

5.7.2 Calculation Tool Operations

1 Select a calculation tool in the menu.

2 Perform all measurement tools related to the calculation. The system automatically provides the calculation result.

5.7.3 Study Tool Operation

AFI Study

1 Select [AFI] in the menu.

2 Measure AFs of the four amniotic fluid pockets of pregnant woman. The system calculates AFI automatically.

5.8 Obstetric Exam Report

During the measurements or after a measurement, press the [Report] key on the Control Panel to browse the report.

For multi-fetus exam report, please refer to 5.5 Multi-fetus Exam.

See “1.9 Report” for details on report browsing, printing and etc.

5.8.1 Fetal Biophysical Profile

If [OB] of [Ultrasound Anatomy] in the Measure Report Preset dialog box is selected, then the fetal biophysical profile will appear after [Analyze] is selected in the measurement report. For more details, please refer to the related contents in “2.4 Preset of Report Template”.

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The fetal biophysical profile is a tool that communicates the fetal well being based on the assessment of the clinician over the course of ultrasound examination and using the following scoring criteria.

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

Fetal scoring criteria (Vintzileos formula)

Fetal growth index	0 score	2 scores	Observation time	Notes
FHR	<2, or FHR acceleration ≤15bpm	FHR acceleration≥15bpm; duration≥15s; ≥2 times	30 minutes	The score(s) can be manually input into the system.
FM	≤2	Fetal movements ≥3 (continuous movement regarded as once)	30 minutes	
FBM	No FBM, or duration≤30s	FBM≥1 times; duration≥30s	30 minutes	
FT	Limbs stretched, no bend, and fingers loose	Movements ≥1; Limbs and spine stretch-and-bend	/	
AF	No AF, or AF<2×2cm	No less than 1 AF>2×2cm	/	

After the scores are entered, the system will automatically generate an FBP Report based on the specified formula, the report includes the value of each index as well as the total score.

Fetal scoring results criteria

Total scores	Growth condition
8-10 scores	Normal fetus; low risk of chronic asphyxia
4-6 scores	Suspicious risk of fetal chronic asphyxia
0-2 scores	Highly suspicious risk of fetal chronic asphyxia

5.8.2 Fetal Growth Curve

Fetus growth curve means to compare the measured data of the fetus with the normal growth curve to judge whether the fetus is in normal growth state.

Data of growth curve are all sourced from FG table.

1 Enter patient's basic information and obstetric information in the [Patient Info] → [OB] dialog box.

2 Perform one or more tools of fetal growth parameters.

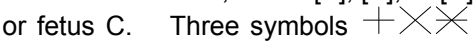
3 If [Obstetric] of [Patient Info] in the Report Template Edit dialog box is selected, the [Growth] button will appear in the report dialog box. Select the [Growth] button in the report dialog box to enter the [Obstetric Growth Curve] dialog box.

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

- There are two drop-down lists above the curve. Of which, the left drop-down list

is used to select a tool, and the right one is used to select a formula.

- In the growth curve, 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.

4 In the case of multi-fetus measurement, select [A], [B], or [C] to view the growth curve of fetus A, fetus B, or fetus C. Three symbols  are used on the growth curves to indentify measurement data of different fetuses.

5 ■ 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]/ [Next] to turn the growth curve pages.

6 Click [OK] to confirm the setting and exit the dialog box.

Hint: 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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Department of Obstetrics and Gynecology, Osaka University Medical School
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Revision 3 (September 1983)

Studies on Fetal Growth and Functional Developments

Takashi Okai

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6 Cardiac Measurements

6.1 Cardiac Measurement Tools

The system supports the following cardiac measurement tools:

6.1.1 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	
	Vas Area	Vascular Area	Area in 2D General Measurements
	LVIDd	Left Ventricular Internal Diameter at end-diastole	Distance in 2D General Measurements
	LVIDs	Left Ventricular Internal Diameter at end-systole	
	LVLd apical	Left Ventricular Long-axis Length at End-diastole in apical view	

Types	Tools	Descriptions	Methods or formulae
	LVLs apical	Left Ventricular Long-axis Length at End-systole in apical view	
	RVDd	Right Ventricular Diameter at end-diastole	
	RVDs	Right Ventricular Diameter at end-systole	
	LVPWd	Left Ventricular Posterior wall thickness at end-diastole	
	LVPWs	Left Ventricular Posterior wall thickness at end-systole	
	RVAWd	Right Ventricular Anterior wall thickness at end-diastole	
	RVAWs	Right Ventricular Anterior wall thickness at end-systole	
	IVSd	Interventricular Septal thickness at end-diastole	
	IVSs	Interventricular Septal thickness at end-systole	
Measurement	Ao Diam	Aorta 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	
	LVOT Diam	Left Ventricular Outflow Tract Diameter	Distance in 2D General Measurements
	AV Diam	Aorta Valve Diameter	
	AVA	Aortic Valve Area	Area in 2D General Measurements
	PV Diam	Pulmonary valve Diameter	
	LPA Diam	Left pulmonary Artery Diameter	
	RPA Diam	Right pulmonary Artery Diameter	Distance in 2D General Measurements
	MPA Diam	Main pulmonary Artery Diameter	
	RVOT Diam	Right Ventricular Outflow Tract Diameter	

Types	Tools	Descriptions	Methods or formulae
	MV Diam	Mitral Valve diameter	
	MVA	Mitral Valve area	Area in 2D General Measurements
	TVA	Tricuspid Valve Area	
	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	
	VSD Diam	Ventricular Septal defect Diameter	Distance in 2D General Measurements
	ASD Diam	Atrial Septal defect Diameter	
	PDA Diam	Patent ductus Arteriosus Diameter	
	PFO Diam	Patent Oval Foramen Diameter	
	PEd	Pericardial Effusion at diastole	
	PEs	Pericardial Effusion at systole	
Calculation	LA/Ao	Left Atrium Diameter/Aorta Diameter	LA Diam (cm) / Ao Diam (cm)
	Ao/LA	Aorta Diameter/Left Atrium Diameter	Ao Diam (cm) / LA Diam (cm)
Study	See below		

6.1.2 M Cardiac Measurements

Types	Tools	Descriptions	Methods or formulae
Measurement	LA Diam	Left Atrium Diameter	Distance in 2D General Measurements
	LVIDd	Left Ventricular Internal Diameter at end-diastole	
	LVIDs	Left Ventricular Internal Diameter at end-systole	
	RVDd	Right Ventricular Diameter at end-diastole	
	RVDs	Right Ventricular Diameter at end-systole	
	LVPWd	Left Ventricular Posterior wall thickness at end-diastole	
	LVPWs	Left Ventricular Posterior wall thickness at end-systole	
	RVAWd	Right Ventricular Anterior wall thickness at end-diastole	
	RVAWs	Right Ventricular Anterior wall thickness at end-systole	

Types	Tools	Descriptions	Methods or formulae
	IVSd	Interventricular Septal thickness at end-diastole	
	IVSs	Interventricular Septal thickness at end-systole	
	Ao Diam	Aorta Diameter	
	Ao 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	
	PV Diam	Pulmonary artery diameter	
	MV Diam	Mitral valve 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 ACV	Mitral valve AC velocity	
	MV DE	Amplitude of the Mitral Valve DE wave	Distance in 2D General Measurements
	MCS	Mitral Valve Cusp Separation	
	EPSS	Distance between point E and the interventricular septum	
	PEd	Pericardial effusion at diastole	
	PEs	Pericardial effusion at systole	
	LVPEP	Left Ventricular pre-ejection period	Time in M General Measurements
	LVET	Left Ventricular ejection time	
	RVPEP	Right Ventricular pre-ejection period	

Types	Tools	Descriptions	Methods or formulae
	RVET	Right Ventricular ejection time	
	RV Acct	Right ventricular acceleration time	
	MV C-O dur	Mitral Valve close-open Duration	
	HR	Heart Rate	Heart Rate in M General Measurements
Calculation	LA/Ao	Left Atrium diameter/Aorta diameter	LA Diam (cm) / Ao Diam (cm)
	Ao/LA	Aorta Diameter/Left Atrium Diameter	Ao Diam (cm) / LA Diam (cm)
Study	See below		

6.1.3 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	
	MV C-O dur	Mitral Valve close-open Duration	
	MV PHT	Mitral valve pressure half time	
	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

Types	Tools	Descriptions	Methods or formulae
Measurement	LVOT AccT	Left Ventricular Outflow Tract Acceleration Time	Time in Doppler General Measurements
	AAo Vmax	Ascending Aorta Maximum Velocity	D Vel in Doppler General Measurements
	DAo Vmax	Descending Aorta Maximum Velocity	
	AV Vmax	Aorta Valve Maximum Velocity	
	AV VTI	Aorta Valve Velocity-Time Integral	D trace in Doppler General measurements
	LVPEP	Left Ventricular Pre-ejection Period	Time in Doppler General Measurements
	LVET	Left Ventricular Ejection Time	
	AV AccT	Aorta Valve Acceleration Time	
	AV DecT	Aorta Valve Deceleration Time	
	RVET	Right Ventricular Ejection Time	Time in Doppler General Measurements
	RVPEP	Right Ventricular Pre-ejection Period	
	RV Acct	Right ventricular acceleration time	
	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
	TV C-O dur	Tricuspid Valve close-open Duration	
	TV PHT	Tricuspid Valve pressure half time	
	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

Types	Tools	Descriptions	Methods or formulae
	PV Vmax	Pulmonary Valve Maximum Velocity	D Vel in Doppler General Measurements
	PV VTI	Pulmonary Valve Velocity-Time Integral	D trace in Doppler General measurements
	PV AccT	Pulmonary Valve Acceleration Time	Acceleration in Doppler General Measurements
	MPA Vmax	Main Pulmonary Artery Maximum Velocity	D Vel in Doppler General Measurements
	RPA Vmax	Right Pulmonary Artery Maximum Velocity	
	LPA Vmax	Left Pulmonary Artery Maximum Velocity	
	PVein S Vel	Pulmonary Vein S-wave Flow Velocity	D Vel in Doppler General Measurements
	PVein S1 Vel	Pulmonary Vein S1-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
	MR Vmax	Mitral Valve Regurgitation Maximum Velocity	D Vel in Doppler General Measurements
	MR VTI	Mitral Valve Regurgitation Velocity-Time Integral	D trace in Doppler General measurements
	Vas Flow	Volume flow velocity trace	
	dP/dt	Rate of Pressure change	dP/dt Measurement
	Vas AccT	Vessel flow acceleration time	Time in Doppler General Measurements
	Vas DecT	Vessel flow deceleration time	
	Vas CycleT	Vessel flow cycle time	
	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	Aortic Regurgitation	

Types	Tools	Descriptions	Methods or formulae
	AR PHT	Aortic Valve Regurgitation Pressure Half Time	Doppler measurement
	AR Ved	Aortic Valve Regurgitation Velocity at end-Diastole	D Vel in Doppler General Measurements
	TR Vmax	Tricuspid Valve Regurgitation Maximum Velocity	
	TR VTI	Tricuspid Valve Regurgitation Velocity-Time Integral	D trace in Doppler General measurements
	PR Vmax	Pulmonary Valve Regurgitation Maximum Velocity	D Vel in Doppler General Measurements
	PR VTI	Pulmonary Valve Regurgitation Velocity-Time Integral	D trace in Doppler General measurements
	PR PHT	Pulmonary Valve Regurgitation Pressure Half Time	Doppler Measurement
	PR Ved	Pulmonary Valve Regurgitation Velocity at end-Diastole	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	
Calculation	MV E/A	Mitral Valve E-Vel/A-Vel	MV E Vel (cm/s) / MV A Vel (cm/s)
	MV A/E	Mitral Valve A-Vel/E-Vel	MV A Vel (cm/s) / MV E 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		

Measurement menus and reports can be preset. See the section “Measurement Preset” for details.

6.2 Cardiac Exam Preparations

Make the following preparations before performing a cardiac exam:

- Confirm that the current transducer is appropriate.
- Check that the current date of the system is correct.
- Register patient information in the [Patient Info] → [CARD] dialog box. See the section “Patient Information Input” in the *Basic Volume* for details.
- Switch to the proper exam mode.

6.3 Entering Cardiac Measurements

To enter the Cardiac Measurements,

Press the [Measure] key to enter the Application Measurements. If the current menu is not the one having Cardiac Measurement tools, move the cursor to the menu title and select the package having Cardiac Measurement tools.

6.4 Cardiac Measurement Operations

All measurements of some tools, described in this Chapter, will be performed in several image modes, so you shall select appropriate image modes to measure.

For the measurement methods of all the tools, please refer to the table in.6.1 Cardiac Measurement Tools.

6.4.1 Measurement Tool Operations

1 Select a measurement tool in the menu.

2 Refer to the methods listed in the table above to complete the measurement.

6.4.2 Calculation Tool Operations

1 Select a calculation tool in the menu.

2 Perform all measurement tools related to the calculation. The system automatically provides the calculation result.

6.4.3 Study Tool Operations

6.4.3.1 S-P Ellipse

S-P Ellipse is one of the studies that measure Left Ventricle (LV) function, which measures clinical indices to analyze the LV diastolic and systolic capabilities on the B or M image.

I. .Study items

Abbr.	Description	Operation
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

II. Study results

Abbr.	Description	Formula
EDV(SP Ellipse)	End-diastolic left ventricular volume	$EDV(SP\ Ellipse)(ml)=\frac{8}{3\pi}\times\frac{LVAd\ apical(cm^2)^2}{LVLd\ apical(cm)}$
ESV(SP Ellipse)	End-systolic left ventricular volume	$ESV(SP\ Ellipse)(ml)=\frac{8}{3\pi}\times\frac{LVAs\ apical(cm^2)^2}{LVLs\ apical(cm)}$
SV(SP Ellipse)	Stroke volume	SV(ml)=EDV(ml)-ESV(ml)
CO(SP Ellipse)	Cardiac output	CO(l/min)=SV(ml)×Heart Rate (bpm)/1000
EF(SP Ellipse)	Ejection fraction	EF(No unit)=SV(ml)/EDV(ml)
SI(SP Ellipse)	SV Index	SI (No unit) = SV (ml) / Body Surface Area (m^2)
CI(SP Ellipse)	CO Index	CI (No unit) = CO (l/min) / Body Surface Area (m^2)

III. Operating procedures

1 Select [S-P Ellipse] in the 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 After HR (heart rate) is measured, the CO and CI are calculated automatically.

6.4.3.2 B-P Ellipse

B-P Ellipse is one of the studies that measure Left Ventricle (LV) function, which measures clinical indices to analyze the LV diastolic and systolic capabilities on the B or M image.

I. Study items

Abbr.	Description	Operation
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	

II. Study results

Abbr.	Description	Formula
EDV(BP Ellipse)	End-diastolic left ventricular volume	1*
ESV(BP Ellipse)	End-systolic left ventricular volume	2*
SV(BP Ellipse)	Stroke volume	SV(ml)=EDV(ml)-ESV(ml)
CO(BP Ellipse)	Cardiac output	CO (l/min) = SV (ml) × Heart Rate (bpm) / 1000
EF(BP Ellipse)	Ejection fraction	EF(No unit)=SV(ml)/EDV(ml)
SI(BP Ellipse)	SV Index	SI (No unit) = SV (ml) / Body Surface Area (m^2)
CI(BP Ellipse)	CO Index	CI (No unit) = CO (l/min) / Body Surface Area (m^2)

*1 means:

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

*2 means:

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

III. 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 After HR (heart rate) is measured, the CO and CI are calculated automatically.

6.4.3.3 Bullet

Bullet is one of the studies that measure Left Ventricle (LV) function, which measures clinical indices to analyze the LV diastolic and systolic capabilities on the B or M image.

I. Study items

Abbr.	Description	Operation
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	

II. Study results

Abbr.	Description	Formula
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	SV(ml)=EDV(ml)-ESV(ml)
CO(Bullet)	Cardiac output	CO(l/min)=SV(ml)×Heart Rate (bpm)/1000
EF(Bullet)	Ejection fraction	EF(No unit)=SV(ml)/EDV(ml)

Abbr.	Description	Formula
SI(Bullet)	SV Index	SI (No unit) = SV (ml) / Body Surface Area (m^2)
CI(Bullet)	CO Index	CI (No unit) = CO (l/min) / Body Surface Area (m^2)

III. Operating procedures

1 Select [Bullet] in the 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 After HR (heart rate) is measured, the CO and CI are calculated automatically.

6.4.3.4 Simpson

Simpson is one of the studies that measure Left Ventricle (LV) function, which measures clinical indices to analyze the LV diastolic and systolic capabilities on the B or M image.

I. Study items

Abbr.	Description	Operation
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	

II. Study results

Abbr.	Description	Formula
EDV(Simpson)	End-diastolic left ventricular volume	*1
ESV(Simpson)	End-systolic left ventricular volume	*2
SV(Simpson)	Stroke volume	SV(ml)=EDV(ml)-ESV(ml)

Abbr.	Description	Formula
CO(Simpson)	Cardiac output	CO (l/min) = SV (ml) × Heart Rate (bpm) / 1000
EF(Simpson)	Ejection fraction	EF(No unit)=SV(ml)/EDV(ml)
SI(Simpson)	SV Index	SI (No unit) = SV (ml) / Body Surface Area (m^2)
CI(Simpson)	CO Index	CI (No unit) = CO (l/min) / Body Surface Area (m^2)

*1 means:

$$EDV[mL] = \frac{LVLd\ apical[cm]}{9} \times \left(\frac{4 \times LVAd\ sax\ MV[cm^2] + 2 \times LVAd}{sax\ PM[cm^2] + \sqrt{LVAd\ sax\ MV[cm^2] \times LVAd\ sax\ PM[cm^2]}} \right) \Big/ 1000$$

*2 means:

$$ESV[mL] = \frac{LVLs\ apical[cm]}{9} \times \left(\frac{4 \times LVAs\ sax\ MV\ [cm^2] + 2 \times LVAs}{sax\ PM[cm^2] + \sqrt{LVAs\ sax\ MV[cm^2] \times LVAs\ sax\ PM[cm^2]}} \right) \Big/ 1000$$

III. Operating procedures

1 Select [Simpson] in the 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 After HR (heart rate) is measured, the CO and CI are calculated automatically.

6.4.3.5 Simpson SP

Simpson SP is one of the studies that measure Left Ventricle (LV) function, which measures clinical indices to analyze the LV diastolic and systolic capabilities on the B or M image.

A vertical plane and a long axis are used to calculate left ventricular volume at apical two-chamber or apical four-chamber view.

I. Study items

Abbr.	Description	Operation
EDV(A2C/A4C)	End-diastolic Left Ventricular Volume (apical 2-chamber/ 4-chamber)	Simpson measurement (Trace/ Spline)
ESV(A2C/A4C)	End-systolic Left Ventricular Volume (apical 2-chamber/ 4-chamber)	

II. Study results

Abbr.	Description	Formula
EDV(Simpson SP)	End-diastolic left ventricular volume	$EDV(ml)=\pi\times\frac{LVLd\ apical(cm)}{20}\times\sum_{i=1}^{20}r_i^2(cm)$ 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(Simpson SP)	End-systolic left ventricular volume	$ESV(ml)=\pi\times\frac{LVLs\ apical(cm)}{20}\times\sum_{i=1}^{20}r_i^2(cm)$ LVLs apical: Left Ventricular Long-axis Length at End-systole in apical view, i.e. the long-axis length obtained in measurement. r_i : Radiuses obtained from systolic measurement
SV(Simpson SP)	Stroke Volume	SV(ml)=EDV(ml)-ESV(ml)
CO(Simpson SP)	Cardiac Output	CO (l/min) = SV (ml) × Heart Rate (bpm) / 1000
EF(Simpson SP)	Ejection Fraction	EF(No unit)=SV(ml)/ EDV(ml)
SI(Simpson SP)	SV INDEX	SI (No unit) = SV (ml) / Body Surface Area (m^2)
CI(Simpson SP)	CO INDEX	CI (No unit) = CO (l/min) / Body Surface Area (m^2)

III. Operating procedures

1 Select [Simpson SP] in the 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 After HR (heart rate) is measured, the CO and CI are calculated automatically.

IV. Measurement Methods

The endocardium can be measured using trace or spline method.

- Trace

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

- Spline

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

6.4.3.6 Simpson BP

Simpson BP is one of the studies that measure Left Ventricle (LV) function, which measures clinical indices to analyze the LV diastolic and systolic capabilities on the B or M image.

Two vertical planes (apical two-chamber view and apical four-chamber view) and a long axis are used to calculate left ventricular volume.

I. Study items

Abbr.	Description	Operation
EDV(A2C)	End-diastolic Left Ventricular Volume (apical 2-chamber)	Simpson measurement (Trace/ Spline) See "0 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)	

II. Study results

Abbr.	Description	Formula
EDV(Simpson BP)	End-diastolic left ventricular volume	*1
ESV(Simpson BP)	End-systolic left ventricular volume	*2
SV(Simpson BP)	Stroke Volume	SV(ml)=EDV(ml)-ESV(ml)

CO(Simpson BP)	Cardiac Output	CO (l/min) = SV (ml) × Heart Rate (bpm) / 1000
EF(Simpson BP)	Ejection Fraction	EF(No unit)=SV(ml)/ EDV(ml)
SI(Simpson BP)	SV INDEX	SI (No unit) = SV (ml) / Body Surface Area (m^2)
CI(Simpson BP)	CO INDEX	CI (No unit) = CO (l/min) / Body Surface Area (m^2)

*1 means:

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

*2 means:

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

To calculate LV volume at apical two-chamber view:

$$EDV2(ml) = \pi \times LVLd_{2i}(cm) / 20 \times \sum_{i=1}^{20} r_{2i}{}^{2}(cm)$$

$$ESV2(ml) = \pi \times LVLs_{2i}(cm) / 20 \times \sum_{i=1}^{20} r_{2i}{}^{2}(cm)$$

To calculate LV volume at apical four-chamber view:

$$EDV4(ml) = \pi \times LVLd_{4i}(cm) / 20 \times \sum_{i=1}^{20} r_{4i}{}^{2}(cm)$$

$$ESV4(ml) = \pi \times LVLs_{4i}(cm) / 20 \times \sum_{i=1}^{20} r_{4i}{}^{2}(cm)$$

In the formulae above,

$LVLd_{2i}$ – 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 two-chamber view

III. Operating procedures

1 Select [Simpson BP] in the 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 After HR (heart rate) is measured, the CO and CI are calculated automatically.

⚠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 measure result will be incorrect.

6.4.3.7 Cube

Cube is one of the studies that measure Left Ventricle (LV) function, which measures clinical indices to analyze the LV diastolic and systolic capabilities on the B or M image.

I. Study items

Abbr.	Description	Operation
Diastole	Measures left ventricle at end diastole	FoldLine in 2D mode Parallel Method in M mode
IVSd	Interventricular septal thickness at end diastole	Same as Distance measurement of 2D/M General Measurements
LVIDd	Left ventricular short-axis diameter at end diastole	Same as Distance measurement of 2D/M General Measurements
LVPWd	Left ventricular posterior wall thickness at end diastole	Same as Distance measurement of 2D/M General Measurements
Systole	Measures left ventricle at end systole	FoldLine in 2D mode Parallel Method in M mode
IVSs	Interventricular septal thickness at end systole	Same as Distance measurement of 2D/M General Measurements
LVIDs	Left ventricular short-axis diameter at end systole	Same as Distance measurement of 2D/M General Measurements

Abbr.	Description	Operation
LVPWs	Left ventricular posterior wall thickness at end systole	Same as Distance measurement of 2D/M General Measurements

II. Study results

Abbr.	Description	Formula
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	SV(ml)=EDV(ml)-ESV(ml)
CO(Cube)	Cardiac output	CO (l/min) = SV (ml) × Heart Rate (bpm) / 1000
EF(Cube)	Ejection fraction	EF(No unit)=SV(ml)/ EDV(ml)
FS(Cube)	Fractional shortening	FS[No unit] =(LVIDd [cm]–LVIDs[cm])/LVIDd [cm]
MVCF(Cube)	Mean velocity of circumferential fiber shortening	MVCF= (LVIDd [cm] – LVIDs [cm]) / (LVIDd [cm] × LVET [s] / 1000)
SI(Cube)	SV Index	SI(No unit)=SV(ml)/ Body Surface Area(m^2)
CI(Cube)	CO Index	CI(No unit)=CO(l/min)/ Body Surface Area(m^2)

III. Operating procedures

1 Select [Cube] in the 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 If height and weight have been input already and the HR (heart rate) is measured, SI, CO and CI are calculated.

If LVET is measured, MVCF will be calculated.

Or,

1 Select [Cube] in the menu.

2 At end diastole of left ventricle, measure the following parameters respectively:

IVSd: Same as Distance measurement of 2D/M General Measurements

LVIDd: Same as Distance measurement of 2D/M General Measurements.

LVPWd: Same as Distance measurement of 2D/M General Measurements

EDV value is then calculated.

3 At end systole of left ventricle, measure the following parameters respectively:

IVSs: Same as Distance measurement of 2D/M General Measurements

LVIDs: Same as Distance measurement of 2D/M General Measurements.

LVPWs: Same as Distance measurement of 2D/M General Measurements

ESV value is then calculated.

4 After LVPWs is measured, SV, EF and FS are calculated. If patient height and weight are entered, and heart rate is already measured, SI, CO and CI can be calculated.

If LVET is measured, MVCF will be calculated.

6.4.3.8 Teichholz

Teichholz is one of the studies that measure Left Ventricle (LV) function, which measures clinical indices to analyze the LV diastolic and systolic capabilities on the B or M image.

I. Study items

Abbr.	Description	Operation
Diastole	Measures left ventricle at end diastole	FoldLine in 2D mode Parallel Method in M mode
IVSd	Interventricular septal thickness at end diastole	Same as Distance measurement of 2D/M General Measurements
LVIDd	Left ventricular short-axis diameter at end diastole	Same as Distance measurement of 2D/M General Measurements
LVPWd	Left ventricular posterior wall thickness at end diastole	Same as Distance measurement of 2D/M General Measurements
Systole	Measures left ventricle at end systole	FoldLine in 2D mode Parallel Method in M mode
IVSs	Interventricular septal thickness at end systole	Same as Distance measurement of 2D/M General Measurements
LVIDs	Left ventricular short-axis diameter at end systole	Same as Distance measurement of 2D/M General Measurements
LVPWs	Left ventricular posterior wall thickness at end systole	Same as Distance measurement of 2D/M General Measurements

II. Study results

Abbr.	Description	Formula
EDV(Teichholz)	End-diastolic left ventricular volume	EDV(ml)=(7×(LVIDd(cm))^3)/(2.4 + LVIDd(cm))
ESV(Teichholz)	End-systolic left ventricular volume	ESV (ml)=(7×(LVIDs (cm))^3)/(2.4 + LVIDs(cm))
SV(Teichholz)	Stroke volume	SV(ml)=EDV(ml)-ESV(ml)
CO(Teichholz)	Cardiac output	CO(l/min)=SV(ml)×Heart Rate (bpm)/ 1000
EF(Teichholz)	Ejection fraction	EF(No unit)=SV(ml)/ EDV(ml)
FS(Teichholz)	Fractional shortening	FS[No unit] =(LVIDd [cm]–LVIDs[cm])/LVIDd [cm]
MVCF(Teichholz)	Mean velocity of circumferential fiber shortening	MVCF= (LVIDd [cm] – LVIDs [cm]) / (LVIDd [cm] × LVET [s] / 1000)
SI(Teichholz)	SV Index	SI(No unit)=SV(ml)/ Body Surface Area (m^2)
CI(Teichholz)	CO Index	CI(No unit)=CO(l/min)/Body Surface Area (m^2)

III. Operating procedures

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

See section "6.4.3.7 Cube" for measurement procedures.

6.4.3.9 Gibson

Gibson is one of the studies that measure Left Ventricle (LV) function, which measures clinical indices to analyze the LV diastolic and systolic capabilities on the B or M image.

I. Study items

Abbr.	Description	Operation
Diastole	Measures left ventricle at end diastole	FoldLine in 2D mode Parallel Method in M mode
IVSd	Interventricular septal thickness at end diastole	Same as Distance measurement of 2D/M General Measurements
LVIDd	Left ventricular internal diameter at end diastole	Same as Distance measurement of 2D/M General Measurements
LVPWd	Left ventricular posterior wall thickness at end diastole	Same as Distance measurement of 2D/M General Measurements
Systole	Measures left ventricle at end systole	FoldLine in 2D mode Parallel Method in M mode

Abbr.	Description	Operation
IVSs	Interventricular septal thickness at end systole	Same as Distance measurement of 2D/M General Measurements
LVIDs	Left ventricular internal diameter at end systole	Same as Distance measurement of 2D/M General Measurements
LVPWs	Left ventricular posterior wall thickness at end systole	Same as Distance measurement of 2D/M General Measurements

II. Study results

Abbr.	Description	Formula
EDV(Gibson)	End-diastolic left ventricular volume	$EDV(ml)=\pi/6\times(0.98\times LVIDd(cm)+5.90)\times LVIDd(cm)^2$
ESV(Gibson)	End-systolic left ventricular volume	$ESV(ml)=\pi/6\times(1.14\times LVIDs(cm)+4.18)\times LVIDs(cm)^2$
SV(Gibson)	Stroke Volume	SV(ml)=EDV(ml)-ESV(ml)
CO(Gibson)	Cardiac Output	CO(l/min)=SV(ml)× HR(bpm)/ 1000
EF(Gibson)	Ejection Fraction	EF(No unit)=SV(ml)/ EDV(ml)
SI(Gibson)	SV INDEX	SI(No unit)=SV(ml)/ BSA(m^2)
CI(Gibson)	CO INDEX	CI(No unit)=CO(l/min)/ BSA(m^2)
MVCF(Gibson)	Mean velocity of circumferential fiber shortening	MVCF= (LVIDd [cm] – LVIDs [cm]) / (LVIDd [cm] × LVET [s] / 1000)
FS(Gibson)	Fractional shortening	FS[No unit] = (LVIDd [cm] – LVIDs[cm]) / LVIDd [cm]

III. Operating procedures

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

See section "6.4.3.7 Cube" for measurement procedures.

6.4.3.10 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)

I. Study Items

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

II. 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)”

III. 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)

I. 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

II. 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,

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

III. 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)

I. 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	

II. 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.

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

III. 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.

6.4.3.11 LA/Ao

Function: measures LA Diam (left atrium diameter) and Ao Diam (aorta diameter), calculates LA/Ao and Ao/LA. The formulae are:

LA/Ao (No unit) = LA Diam (cm) / Ao Diam (cm)

Ao/LA (No unit) = Ao Diam (cm) / LA Diam (cm)

1 Select [LA/Ao] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure LA Diam and Ao Diam.

3 The values of LA/Ao and Ao/LA are obtained.

6.4.3.12 LVIMP

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

I. 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	

II. Study Results

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

Tools	Descriptions	Formulae
LVIMP	Left Ventricular Index of Myocardial Performance	$LVIMP(Noun\ it) = \frac{MV\ C\text{-}O\ dur(s) - LVET(s)}{LVET(s)}$

III. Operating Procedures

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

6.4.3.13 RVIMP

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

that of LVIMP.

I. Study Items

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

II. 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	$RVIMP(Noun\,it) = \frac{TV\ C\text{-}O\,dur(s) - RVET(s)}{RVET(s)}$

III. Operating Procedures

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

6.4.3.14 Mitral Valve

I. Study items

Mode	Abbr.	Description	Operation or formula
2D/M / Doppler	MV Diam	Mitral valve diameter	Same as Distance measurement of 2D General Measurements
	MVA	Mitral valve area planimetry	Same as Area measurement of 2D General Measurements
M/ Doppler	EPSS	Distance between point E and the interventricular septum	Same as Distance measurement of M General Measurements
	MV D-E Slope	Mitral valve D-E slope	Same as Slope measurement of M General Measurements
	MV E-F Slope	Mitral valve E-F slope	
	MV A Amp	Amplitude of the Mitral Valve A wave	Same as Distance measurement of M General Measurements
	MV E Amp	Amplitude of the Mitral Valve E wave	
	MV DE	Amplitude of the mitral valve DE wave	
	MV ACV	Mitral valve AC velocity	Same as Slope measurement of M General Measurements
	MV E Vel	Mitral valve E-wave flow velocity	

Mode	Abbr.	Description	Operation or formula
	MV A Vel	Mitral valve A-wave flow velocity	Same as D Velocity measurement of Doppler General Measurements
	MV E/A	/	MV E/A (No unit) = MV E Vel (cm/s) / MV A Vel (cm/s)
	MV A/E	/	MV A/E (No unit) = MV A Vel (cm/s) / MV E Vel (cm/s)
	MV PHT	Mitral valve pressure half time	Doppler measurement
	MVA(PHT)	Mitral Valve Orifice Area (PHT)	MVA(PHT) (cm^2) = 220 / MV PHT (ms)
	MV Acct	Mitral Valve Acceleration Time	Acceleration in Doppler General Measurements
	MV DecT	Mitral valve deceleration time	
	MV VTI	Mitral valve velocity-time integral	Same as D Trace of Doppler General Measurements
	IVRT	Isovelocity relaxation time	Same as Time measurement of Doppler General Measurements
	IVCT	Isovelocity Compression Time	
	MV E Dur	Mitral valve E-wave duration	
	MV A Dur	Mitral valve A-wave duration	
	MV C-O dur	Mitral Valve close-open Duration	
	MR VTI	Mitral regurgitation velocity-time integral	Same as D Trace of Doppler General Measurements
	dP/dt	Rate of Pressure change	dP/dt measurement

II. Study results

Abbr.	Description	Formula
MV CA/CE	/	MV CA/CE (No unit) = MV CA (cm) / MV CE (cm)
MV E PG	Mitral valve E-wave pressure gradient	Obtained from MV E Vel measurement
MV A PG	Mitral valve a-wave pressure gradient	Obtained from MV A Vel measurement
MV Acc Slope	Mitral valve acceleration slope	Obtained from MV AccT measurement

MV Dec Slope	Mitral valve deceleration slope	Obtained from MV DecT measurement
LVIMP	Left Ventricular Index of Myocardial Performance	Obtained from MV C-O dur measurement

The tools in the below table can be measured by MV VTI.

Abbr.	Description	Operation or formula
MV Vmax	Mitral valve velocity	Obtained from MV VTI measurement
MV Vmean	Mitral valve mean velocity	Obtained from MV VTI measurement
MV PGmax	Mitral valve pressure gradient	MV PGmax (mmHg) = 4 × MV Vmax $(m/s)^2$
MV PGmean	Mitral valve mean pressure gradient	Obtained from MV VTI measurement
MV VTI	Mitral valve velocity-time integral	Obtained from MV VTI measurement
MV θ	Mitral valve spectrum correction angle	Obtained from MV VTI measurement
MV HR	Mitral valve heart rate	Obtained from MV VTI measurement
MV SV	Mitral valve stroke volume	MV SV (ml) = 0.785 × MV Diam $(cm)^2$ × |MR VTI (cm)|
MV SI	Mitral valve SV index	MV SI (No unit) = MV SV (ml) / Body Surface Area(m^2)
MV CO	Mitral valve cardiac output	MV CO (l/min) = MV SV (ml) × MV HR (bpm) / 1000
MV CI	Mitral valve CO index	MV CI (No unit) = MV CO (l/min) / Body Surface Area (m^2)

The tools in the below table can be measured by MR VTI.

Abbr.	Description	Operation or formula
MR Vmax	Mitral regurgitation velocity	Obtained from MR VTI measurement
MR Vmean	Mitral regurgitation mean velocity	Obtained from MR VTI measurement
MR PGmax	Mitral regurgitation pressure gradient	MR PGmax (mmHg) = 4 × MR Vmax $(m/s)^2$
MR PGmean	Mitral regurgitation mean pressure gradient	Obtained from MR VTI measurement
MR VTI	Mitral regurgitation velocity-time integral	Obtained from MR VTI measurement

MR θ	Mitral regurgitation spectrum correction angle	Obtained from MR VTI measurement

III. Operating procedures

For the operation methods, please refer to the above tables.

6.4.3.15 Tricuspid Valve

I. Study items

Abbr.	Description	Operation
TV VTI	Tricuspid valve velocity trace	Same as D Trace of Doppler General Measurements
TV Vmax	Tricuspid valve velocity	Same as D Velocity of Doppler General Measurements, or obtained from TV VTI measurement
TR VTI	Tricuspid regurgitation velocity trace	Same as D Trace of Doppler General Measurements

II. Study results

The tools in the below table can be measured by TV VTI.

Abbr.	Description	Operation
TV Vmax	Tricuspid valve velocity	Obtained from TV VTI measurement
TV Vmean	Tricuspid valve mean velocity	Obtained from TV VTI measurement
TV PGmax	Tricuspid valve pressure gradient	TV PGmax (mmHg) = 4 × TV Vmax $(m/s)^2$, also can be measured by TV Vmax
TV PGmean	Tricuspid valve mean pressure gradient	Obtained from TV VTI measurement
TV VTI	Tricuspid valve velocity-time integral	Obtained from TV VTI measurement
TV θ	Tricuspid valve spectrum correction angle	Obtained from TV VTI measurement
TV HR	Tricuspid heart rate	Obtained from TV VTI measurement
TV SV	Tricuspid valve stroke volume	TV SV (ml) = 0.785 × TV Diam $(cm)^2$ × |TR VTI (cm)|
TV SI	Tricuspid valve SV index	TV SI (No unit) = TV SV (ml) /Body Surface Area (m^2)

TV CO	Tricuspid valve cardiac output	TV CO (l/min) = TV SV (ml) × MV HR (bpm)/1000
TV CI	Tricuspid valve CO index	TV CI (No unit) = TV CO (l/min) / Body Surface Area (m^2)

The tools in the below table can be measured by TR VTI.

Tool	Description	Operation
TR Vmax	Tricuspid regurgitation velocity	Obtained from TR VTI measurement
TR Vmean	Tricuspid regurgitation mean velocity	Obtained from TR VTI measurement
TR PGmax	Tricuspid regurgitation pressure gradient	TR PGmax (mmHg) = 4 × TR Vmax $(m/s)^2$
TR PGmean	Tricuspid regurgitation mean pressure gradient	Obtained from TR VTI measurement
TR VTI	Tricuspid regurgitation velocity-time integral	Obtained from TR VTI measurement
TR θ	Tricuspid regurgitation spectrum correction angle	Obtained from TR VTI measurement
RVSP	Right ventricle systolic pressure	RVSP (mmHg) = RA Press (mmHg) + TR PGmax (mmHg) RA Press – Right atrium pressure

III. Operating procedures

For the operation methods, please refer to the above tables. In TR VTI, if enter RA Press in the [Patient Info] → [CARD] dialog box, the RVSP can be obtained.

6.4.3.16 Aortic Valve

I. Study items

Abbr.	Description	Operation
LVOT Diam	Left ventricular outflow tract diameter	Same as Distance measurement of 2D General Measurements
LVOT Trace	Left ventricular outflow tract velocity trace	Same as D Trace of Doppler General Measurements

Abbr.	Description	Operation
LVOT Vmax	Left ventricular outflow tract velocity	Same as D Velocity measurement of Doppler General Measurements, or obtained from LVOT VTI measurement
AV Diam	Aortic valve diameter	Same as Distance measurement of 2D General Measurements
AVA	Aortic valve area	Same as Area measurement of 2D General Measurements
AV VTI	Aortic valve velocity trace	Same as D Trace of Doppler General Measurements
AV Vmax	Aortic valve velocity	Same as D Velocity measurement of Doppler General Measurements, or obtained from AV VTI measurement
AR	Aortic regurgitation	Same as Acceleration measurement of Doppler General Measurements

II. Study results

The tools in the below table can be measured by LVOT VTI.

Abbr.	Description	Operation or formula
LVOT Vmax	Left ventricular outflow tract velocity	Same as D Velocity measurement of Doppler General Measurements, or obtained from LVOT VTI measurement
LVOT Vmean	Left ventricular outflow tract mean velocity	Obtained from LVOT VTI measurement
LVOT PGmax	Left ventricular outflow tract pressure gradient	LVOT PGmax (mmHg) = 4 × LVOT Vmax $(m/s)^2$
LVOT PGmean	Left ventricular outflow tract mean pressure gradient	Obtained from LVOT VTI measurement
LVOT VTI	Left ventricular outflow tract velocity-time integral	Obtained from LVOT VTI measurement
LVOT θ	Left ventricular outflow tract spectrum correction angle	Obtained from LVOT VTI measurement

Abbr.	Description	Operation or formula
LVOT HR	Left ventricular outflow tract heart rate	Obtained from LVOT VTI measurement
LVOT SV	Left ventricular outflow tract stroke volume	LVOT SV (ml) = 0.785 × LVOT Diam (cm)^2 × |LVOT VTI|
LVOT SI	Left ventricular outflow tract SV index	LVOT SI (No unit) = LVOT SV (ml) / Body Surface Area (m^2)
LVOT CO	Left ventricular outflow tract cardiac output	LVOT CO (l/min) = LVOT SV (ml) × LVOT HR (bpm) /1000
LVOT CI	Left ventricular output tract CO index	LVOT CI (No unit) = LVOT CO (l/min) / Body Surface Area (m^2)
MVA(VTI)	Mitral Valve Area	$MVA(VTI)(c\ m^2) = \frac{\pi \times \lvert LVOT\ VTI(cm) \rvert \times LVOT\ Diam(cm^2)^2}{4 \times \lvert MV\ VTI(cm) \rvert}$
AVA(VTI)	Aortic valve area	$AVA(VTI)(c\ m^2) = \frac{\pi \times \lvert LVOT\ VTI(cm) \rvert \times LVOT\ Diam(cm^2)^2}{4 \times \lvert AV\ VTI(cm) \rvert}$

The tools in the below table can be measured by AV VTI.

Abbr.	Description	Operation or formula
AV Vmax	Aortic valve velocity	Same as D Velocity measurement of Doppler General Measurements, or obtained from AV VTI measurement
AV Vmean	Aortic valve mean velocity	Obtained from AV VTI measurement
AV PGmax	Aortic valve pressure gradient	AV PGmax (mmHg) = 4 × AV Vmax (m/s)^2
AV PGmean	Aortic valve mean pressure gradient	Obtained from AV VTI measurement
AV VTI	Aortic valve velocity-time integral	Obtained from AV VTI measurement
AV θ	Aortic valve spectrum correction angle	Obtained from AV VTI measurement
AV HR	Aortic valve heart rate	Obtained from AV VTI measurement

AV SV	Aortic Valve Stroke Volume	AV SV (ml) = 0.785 × AV Diam $(cm)^2$ × |AV VTI|
AV SI	Aortic valve SV Index	AV SI (No unit) = AV SV (ml) / Body Surface Area (m^2)
AV CO	Aortic Valve Cardiac Output	AVCO (l/min) = AVSV (ml) × AVHR (bpm) /1000
AV CI	Aortic Valve Cardiac output	AVCI (No unit) = AVCO (l/min) / Body Surface Area (m^2)
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(No unit) = PV CO(l/min) - AV CO(l/min)
AVA(VTI)	Aortic valve area	$AVA(VTI)(c\ m^2) = \frac{\pi \times \lvert LVOT\ VTI(cm) \rvert \times LVOT\ Diam(cm^2)^2}{4 \times \lvert AV\ VTI(cm) \rvert}$

The tools in the below table can be measured by AR.

Abbr.	Description	Operation or formula
AR Vmax	Aortic regurgitation velocity	Obtained from AR measurement
AR Ved	Aortic regurgitation velocity at end diastole	Obtained from AR measurement
AR DcR	Aortic regurgitation deceleration rate	AR DcR (cm/s^2) = (AR Vmax (cm/s) – AR Ved (cm/s)) / AR Time (s) AR Time – Aortic regurgitation time
AR DcT	Aortic regurgitation deceleration time	AR DcT (s) = AR Vmax (cm/s) / AR DcR (cm/s)
AR Time		

III. Operating procedures

For the operation methods, please refer to the above tables.

6.4.3.17 Pulmonary Valve

I. Measurement tools

Abbr.	Description	Operation
PV Diam	Pulmonary valve diameter	Same as Distance measurement of 2D General Measurements
PV VTI	Pulmonary valve velocity trace	Same as D Trace of Doppler General Measurements
PV Vmax	Pulmonary valve velocity	Same as D Velocity measurement of Doppler General Measurements, or obtained from PV VTI measurement

II. Study results

The tools in the below table can be measured by PV VTI.

Abbr.	Description	Formula
PV Vmax	Pulmonary valve velocity	Same as D Velocity measurement of Doppler General Measurements, or obtained from PV VTI measurement
PV Vmean	Pulmonary valve mean velocity	Obtained from PV VTI measurement
PV PGmax	Pulmonary valve pressure gradient	PV PGmax (mmHg) = 4 × PV Vmax $(m/s)^2$
PV PGmean	Pulmonary valve mean pressure gradient	Obtained from PV VTI measurement
PV VTI	Pulmonary valve velocity-time integral	Obtained from PV VTI measurement
PV θ	Pulmonary valve spectrum correction angle	Obtained from PV VTI measurement
PV HR	Pulmonary valve heart rate	Obtained from PV VTI measurement
PV SV	Pulmonary valve stroke volume	PV SV (ml) = 0.785 × PV Diam $(cm)^2$ × |PV VTI|
PV SI	Pulmonary valve SV index	PV SI (No unit) = PV SV (ml) / Body Surface Area (m^2)
PV CO	Pulmonary valve cardiac output	PV CO (l/min) = PV SV (ml) × PV HR (bpm) /1000
PV CI	Pulmonary valve CO index	PV CI (No unit) = PV CO (l/min) / Body Surface Area (m^2)
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(No unit) = PV CO(l/min) - AV CO(l/min)

III. Operating procedures

For the operation methods, please refer to the above tables.

6.4.3.18 RV Study

RV (Right Ventricle) study measures clinical indices of right ventricle.

I. Study items

Abbr.	Description	Operation
RVDd	Right ventricular end diastole diameter	Same as Distance measurement of 2D General Measurements
RVDs	Right ventricular end systole diameter	Same as Distance measurement of 2D General Measurements
RVET	Right ventricular ejection time	Same as Time measurement of Doppler General Measurements
RV AccT	Right ventricular acceleration time	Same as Time measurement of Doppler General Measurements
RVPEP	Right ventricular pre-ejection period	Same as Time measurement of Doppler General Measurements

II. Study results

Abbr.	Description	Formula
RV AccT/ET	Ratio of Right ventricular acceleration time to ejection time	RV AccT/ET(No unit)=RVAccT(s) / RVET (s)
RVPEP/ET	Right ventricular systolic time interval	RVPEP/ET (No unit)=RVPEP(s) / RVET (s)

III. Operation procedures

For the operation methods, please refer to the above tables.

6.4.3.19 Pulmonary Vein

Pulmonary Vein measures clinical indices of pulmonary vein flow.

I. Study items

Abbr.	Description	Operation
PVein S1 Vel	Pulmonary vein S1-wave flow velocity	Same as D Velocity measurement of Doppler General Measurements
PVein S Vel	Pulmonary vein S-wave flow velocity	
PVein D Vel	Pulmonary vein D-wave flow velocity	

Abbr.	Description	Operation
PVein A Vel	Pulmonary vein A-wave flow velocity	
PVein A Dur	Pulmonary vein atrial inversion duration	Same as Time measurement of Doppler General Measurements
PVein S VTI	Pulmonary vein S-wave velocity-time integral	Same as D Trace of Doppler General Measurements
PVein D VTI	Pulmonary vein D-wave velocity-time integral	Same as D Trace of Doppler General Measurements
PVein DecT	Pulmonary vein deceleration time	Same as Time measurement of Doppler General Measurements

II. Study results

Abbr.	Description	Formula
PVein S/D	Ratio of pulmonary vein S-wave flow velocity to D-wave flow velocity	PVein S/D (No unit) = PVein S Vel (cm/s) / PVein D Vel (cm/s)
PVein SF	Pulmonary vein systolic fraction	PVein SF (No unit) = PVein S VTI (cm) / (PVein S VTI (cm) + PVein D VTI (cm))

III. Operation procedures

For the operation methods, please refer to the above tables.

6.4.3.20 Volume Flow

Volume Flow measures clinical indices of blood flow.

I. Study tools

Abbr.	Description	Operation
Vas Area	Vessel cross sectional area	Same as Area measurement of 2D General Measurements
Vas Flow	Volume flow velocity trace	Same as D Trace of Doppler General Measurements
Vas AccT	Vessel flow acceleration time	Same as Time measurement of Doppler General Measurements
Vas DecT	Vessel flow deceleration time	
Vas CycleT	Vessel flow cycle time	

II. Study results

The tools in the table below can be measured by Vas Flow.

Abbr.	Description	Operation or formula
Vas Flow Vmax	Vas flow velocity	Obtained from Vas Flow measurement
Vas Flow Vmean	Vas flow mean velocity	
Vas Flow PGmax	Vas flow pressure gradient	Vas Flow PGmax (mmHg) = 4 × Vas Flow Vmax $(m/s)^2$
Vas Flow PGmean	Vas flow mean pressure gradient	Obtained from Vas Flow measurement
Vas Flow VTI	Vas flow velocity-time integral	
Vas Flow θ	Vas flow spectrum correction angle	
Vas Flow HR	Vas flow heart rate	
Vas Flow SV	Vas flow stroke volume	Vas Flow SV (ml) = Vas Flow Vmean (cm/s) × Vas Area $(cm)^2$ × 60 (s)
Vas Flow SI	Vas flow SV index	Vas Flow SI (No unit) = Vas Flow SV (ml) / Body Surface Area (m^2)
Vas Flow CO	Vas flow cardiac output	Vas Flow CO (l/min) = Vas Flow SV (ml) × Vas Flow HR (bpm) /1000
Vas Flow CI	Vas flow CO index	Vas Flow CI (No unit) = Vas Flow CO (l/min) / Body Surface Area(m^2)

III. Operating procedures

For the operation methods, please refer to the above tables.

6.4.3.21 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.

I. 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	

II. 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	$LA\ Vol(A\text{-}L)(ml) = \frac{8\pi}{3} LAA(A4C)(cm^2) \times LAA(A2C)(cm^2) \Big/ LA\ Diam(cm)$

III. 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.

I. 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	

II. Operating Procedures

See “

Simpson SP” for measurement procedures.

RA Vol(Simp)

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

I. Study Items and Results

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

II. Operating Procedures

See “

Simpson SP” for measurement procedures.

6.4.3.22 MVA(VTI)

Calculate the Mitral Valve Area (MVA) by the velocity-time integral (VTI).

I. 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	

II. Study Results

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

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

III. Operating Procedures

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

6.4.3.23 AVA

AVA(VTI)

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

I. 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	

II. Study Results

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

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

III. Operating Procedures

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

AVA(Vmax)

Calculate the Aortic Valve Area (AVA) by Aorta Valve Maximum Velocity (AV Vmax). Measurements should be performed on 2D and Doppler image.

I. Study Items

Tools	Descriptions	Operations
LVOT Diam	Left Ventricular Outflow Tract Diameter	Distance in 2D General Measurements
LVOT Vmax	Left Ventricular Outflow Tract Velocity	D trace in General D measurements
AV Vmax	Aorta Valve Maximum Velocity	

II. Study Results

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

Tools	Descriptions	Formulae
AVA(Vmax)	Aortic Valve Area	$AVA(Vmax)(\ cm^2) = \frac{\pi \times \lvert LVOT\ Vmax(m/s) \rvert \times LVOT\ Diam(cm^2)^2}{4 \times \lvert AV\ Vmax(m/s) \rvert}$

III. Operating Procedures

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

6.4.3.24 Qp/Qs

Flow ration of pulmonary circulation and systemic circulation.

I. 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	

II. 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	

Tools	Descriptions	Operations
AV SI	Aortic Valve SV index	
AV CO	Aortic Valve Cardiac Output	
AV CI	Aortic Valve CO index	
PV HR	Pulmonary Valve Heart Rate	Obtained from PV VTI measurement
PV SV	Pulmonary Valve Stroke Volume	
PV CO	Pulmonary Valve Cardiac Output	
PV SI	Pulmonary Valve SV index	
PV CI	Pulmonary Valve CO index	
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(No unit) = PV CO(l/min) - AV CO(l/min)

III. Operating Procedures

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

6.4.3.25 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.

I. 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

II. Study Results

Tools	Descriptions	Formulae
MR Vmax	Mitral Regurgitation Maximum Velocity	Obtained from MR VTI measurement
MR Als.Vel	Mitral Valve Regurgitation Aliasing Maximum Velocity	MR Als.Vel(m/s)=(|max positive vel on color bar(m/s)|+|max negative vel on color bar(m/s|)/2
MR Flow	Mitral Regurgitation Flow	$MR\ Flow(ml)=\frac{2\pi MR\ Rad(cm)^2\times MR\ Als.Vel(cm/s)}{\lvert MRV\ max(cm/s)\rvert}\times\lvert MR\ VTI(cm)\rvert$
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	$MRF(Nounit)=\frac{MR\ Flow(ml)}{MV\ SV(ml)}\times 100\%$

III. 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.

   The MR Als.Vel is calculated.
4. Measure the MR spectrum by D trace to obtain:

   MR Vmax

   MR VTI

   MR Flow and MR Flow Rate are calculated automatically.

   If MV SV is measured, MR Fraction will be calculated automatically.

PISA AR

Estimates aortic valve regurgitation using PISA.

See “PISA MR” for study items, results and measurement procedures.

PISA TR

Estimates tricuspid valve regurgitation using PISA.

See “PISA MR” for study items, results and measurement procedures.

PISA PR

Estimates pulmonary valve regurgitation using PISA.

See “PISA MR” for study items, results and measurement procedures.

6.5 Cardiac Exam Report

During the measurements or after a measurement, press the [Report] key on the Control Panel to browse the report. See “1.9 Report” for details on report browsing, printing and etc.

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MV E/A:

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PHT:

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MVA:

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7 Gynecology Measurements

7.1 Gynecology Measurement Tools

The system supports the following gynecology measurement tools.

Mode	Type	Tool	Description	Method or formula
2D	Measurement	UT L	Uterine Length	Same as Distance measurement of 2D General Measurements
		UT H	Uterine Height	
		UT W	Uterine Width	
		Cervix W	Uterine cervix width	
		Cervix L	Uterine cervix length	
		Cervix H	Uterine cervix height	
		Endo	Endometrium Thickness	
		Ovary L	Ovary length	
		Ovary H	Ovary height	
		Ovary W	Ovary width	
		Follicle1~16 L	Follicle1~16 length	
		Follicle1~16 W	Follicle1~16 width	
		Follicle1~16 H	Follicle1~16 height	
	Calculate	Ovary Vol	Ovary Volume	See below
		UT Vol	UT Volume	
		Uterus Body	/	
		UT-L/CX-L	Ratio of UT-L to Cervix L	
	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, width, height and volume of follicle 1~16
M	/			
Doppler	/			

Measurement menus and reports can be preset. See the section “2 Measurement Preset” for

details.

7.2 Gynecology Exam Preparations

Make the following preparations before performing gynecology exam:

- Confirm that the current transducer is appropriate.
- Check that the current date of the system is correct.
- Register patient information in the [Patient Info] → [GYN] dialog box. See the section “Patient Information Input” in the *Basic Volume* for details.
- Switch to the proper exam mode.

7.3 Entering Gynecology Measurements

To enter the Genecology Measurements,

Press the [Measure] key to enter the Application Measurements. If the current menu is not the one having Gynecology Measurement tools, move the cursor to the menu title and select the package having Gynecology Measurement tools.

7.4 Gynecology Measurement Operations

7.4.1 Measurement Tool Operations

For the operation method, please refer to 7.1 Gynecology Measurement Tools.

The following takes UT L as the example. Operations of other measurement tools are similar.

1 Select [UT L] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure uterine length.

7.4.2 Calculation Tool Operations

7.4.2.1 Ovary Vol

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

Hint: needs to measure Left or Right side respectively.

1 Select [Ovary Vol] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Ovary L, Ovary H and Ovary W. The system calculates Ovary Vol.

7.4.2.2 UT Vol

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

1 Select [UT Vol] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure UT L, UT H and UT W. The system calculates UT Vol and Uterus Body.

7.4.2.3 Uterus Body

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

Uterus Body (cm) = UT L (cm) + UT H (cm) + UT W (cm)

1 Select [Uterus Body] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure UT L, UT H and UT W. The system calculates UT Vol and Uterus Body.

7.4.2.4 UT-L/CX-L

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

UT-L/CX-L (No unit) = UT L (cm) / Cervix L (cm)

1 Select [UT-L/CX-L] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure UT L and Cervix L. The system calculates UT-L/CX-L.

7.4.3 Study Tool Operations

7.4.3.1 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 menu.

2 Use the method of Distance measurement of 2D General Measurements to measure UT L, UT H, UT W and Endo. The system calculates UT Vol and Uterine Body. If Cervix L has been measured, the system also calculates UT-L/CX-L.

7.4.3.2 Uterine Cervix

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

1 Select [Uterus Cervix] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Cervix L, Cervix H and Cervix W. If UT L has been measured, the system calculates UT-L/CX-L.

7.4.3.3 Ovary

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

Hint: needs to measure Left or Right side respectively.

1 Select [Ovary] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Ovary L, Ovary H and Ovary W. The system calculates Ovary Vol.

7.4.3.4 Follicle

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

Up to 16 follicles can be measured. Specify the serial numbers of the follicles before measuring a follicle.

Hint: needs to measure Left or Right side respectively.

The following takes Follicle1 as an example. Operations of other follicles are similar.

1 Select [Follicle1] in the 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 volume of Follicle1.

$$\text{Follicle X Diam (Average)} = (\text{Follicle X L} + \text{Follicle X W} + \text{Follicle X H})/3$$

$$\text{Follicle X Vol}(cm^3) = 0.523 \times \text{Follicle X L}(cm) \times \text{Follicle X W}(cm) \times \text{Follicle X H}(cm)$$

Where, X=1, 2, 3, …16.

7.5 Gynecology Exam Report

During the measurements or after a measurement, press the [Report] key on the Control Panel to browse the report. See “1.9 Report” for details on report browsing, printing and etc.

7.6 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.

8 Vascular Measurements

8.1 Vascular Measurement Tools

Vascular Measurements measure vascular of carotid, upper and lower extremities, and cerebral vascular.

The system supports the following vascular measurement tools.

Mode	Type	Tool	Description	Method or formula
2D	Measure-ment	Vas Diam	Vascular diameter	Same as Distance measurement of 2D general Measurements
		Vas Area	Vascular area	Same as Area measurement of 2D general Measurements
		Normal(D)	Vessel diameter	Same as Distance measurement of 2D general Measurements
		Resid(D)	Residual diameter	
		Normal(A)	Vessel area	Same as Area measurement of 2D general Measurements
		Resid(A)	Residual area	
		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	
	Calculate	Stenosis D	Stenosis diameter	Stenosis D (No unit) = (Normo Diam(cm) – Resid Diam (cm)) / Normo Diam (cm) × 100%
		Stenosis A	Stenosis area	Stenosis A (No unit) = (Normo Area(cm^2) – Resid Area (cm^2)) / Normo Area (cm^2) × 100%

Mode	Type	Tool	Description	Method or formula
		Vol Flow(Diam)-TAMAX	Volume flow diameter	Vol Flow(Diam) (ml/min) = |Vas TAMAX (cm/s)| × (π × Vas Diam (cm)^2 / 4) × 60 (s) Vas TAMAX - Time Averaged Maximum Velocity, obtained from Vas Trace measurement.
		Vol Flow(Area)-TAMAX	Volume flow area	Vol Flow(Area) (ml/min) = |Vas TAMAX (cm/s)| × Vas Area (cm^2) × 60 (s) Vas TAMAX: Time Averaged Maximum Velocity, obtained from Vas Trace measurement.
	Study	Volume Flow	/	See below
		Stenosis	/	
		IMT	/	
M	/			
Doppler	Measure-ment	Soleal V		Same as D Trace of Doppler General Measurements
		Sural V		
		Ulnar A	Ulnar artery	
		Ulnar V	Ulnar vein	
		ACA	Anterior cerebral artery	
		PCA	Posterior cerebral artery	
		MCA	Middle cerebral artery	
		Saph V	Great saphenous vein	
		Bulb	/	
		Peroneal A	Peroneal artery	
		Peroneal V	Peroneal vein	
		Brachial A	Brachial artery	
		Brachial V	Brachial vein	
		Femoral V	Femoral vein	
		SFA	Superficial femoral artery	
		SFV	Superficial femoral vein	
		PFA	Deep femoral artery	
		PFV	Deep femoral vein	
		CFA	Common femoral artery	

Mode	Type	Tool	Description	Method or formula
		CFV	Common femoral vein	
		Basilic V	Basilic vein	
		Pop A	Popliteal artery	
		Pop V	Popliteal vein	
		AComA	Ant. Communicating br.	Same as D Trace of Doppler General Measurements
		BA	Basilar artery	
		Ba V	Basilar vein	
		CCA	Common carotid artery	
		ICA	Internal carotid artery	
		ECA	External carotid artery	
		TP Trunk A	Tibial peroneal trunk artery	
		TP Trunk V	Tibial peroneal trunk vein	
		P.Tib A	Posterior tibial artery	
		P.Tib V	Posterior tibial vein	
		A.Tib A	Anterior tibial artery	
		A.Tib V	Anterior tibial vein	
		IIA	Internal iliac artery	
		IIV	Internal iliac vein	
		Ex.Iliac A	External iliac artery	
		Ex.Iliac V	External iliac vein	
		C.Iliac A	Common iliac artery	
		C.Iliac V	Common iliac vein	
		PComA	Post. Communicating br.	
		Radial A	Radial artery	
		Radial V	Radial vein	
		Subclav A	Subclavian artery	
		Subclav V	Subclavian vein	
		Cephalic V	Cephalic vein	
		Innom A	Innominate artery	
		SSV	Small saphenous vein	
		Vas Trace	Volume flow velocity trace	
		Axill A	Axillary artery	
		Axill V	Axillary vein	
		Vert A	Vertebral artery	

Mode	Type	Tool	Description	Method or formula
		Dors.Ped A	Dorsalis pedis artery	
	Calculate	/		
	Study	Volume Flow		See below

Measurement menus and reports can be preset. See the section “Measurement Preset” for details.

8.2 Vascular Exam Preparations

Make the following preparations before performing Vascular exam:

- Confirm that the current transducer is appropriate.
- Check that the current date of the system is correct.
- Register patient information in the [Patient Info] → [VAS] dialog box. See the section “Patient Information Input” in the *Basic Volume* for details.
- Switch to the proper exam mode.

8.3 Entering Vascular Measurements

To enter the Vascular Measurements,

Press the [Measure] key to enter the Application Measurements. If the current menu is not the one having Vascular Measurement tools, move the cursor to the menu title and select the package having Vascular Measurement tools.

8.4 Vascular Measurement Operations

8.4.1 Measurement Tool Operations

1 Select a measurement tool in the menu.

2 Refer to the methods listed in the table of 8.1 Vascular Measurement Tools to complete the measurement.

8.4.2 Calculation Tool Operations

8.4.2.1 Stenosis D

Function: measures Normo Diam and Resid Diam, calculates Stenosis D.

1 Select [Stenosis D] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Normo Diam and Resid Diam. The system calculates Stenosis D.

8.4.2.2 Stenosis A

Function: measures Normo Area and Resid Area, calculates Stenosis A.

1 Select [Stenosis A] in the menu.

2 Use the method of Area measurement of 2D General Measurements to measure Normo Area and Resid Area. The system calculates Stenosis A.

8.4.2.3 Vol Flow (Diam)-TAMAX

Function: measures Vas Trace and Vas Diam, calculates Vol Flow (Diam)-TAMAX.

1 Switch to Doppler mode, select [Vol Flow (Diam)-TAMAX] in the menu.

2 Use the method of D Trace of Doppler General Measurements to measure Vas Trace.

3 Use the method of Distance measurement of 2D General Measurements to measure Vas Diam. The system calculates Vol Flow (Diam)-TAMAX.

8.4.2.4 Vol Flow (Area)-TAMAX

Function: measures Vas Trace and Vas Area, calculates Vol Flow(Area)-TAMAX.

1 Select [Vol Flow (Area)-TAMAX] in the menu.

2 Use the method of D Trace of Doppler General Measurements to measure Vas Trace.

3 Use the method of Area measurement of 2D General Measurements to measure Vas Area. The system calculates Vol Flow (Area)-TAMAX.

8.4.3 Study Tool Operations

8.4.3.1 Volume Flow

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

1 Select [Volume Flow] in the menu.

2 Use the method of D Trace of Doppler General Measurements to measure Vas Trace.

3 Use the method of Distance measurement of 2D General Measurements to measure Vas Diam. The system calculates Vol Flow (Diam)-TAMAX.

4 Use the method of Area measurement of 2D General Measurements to measure Vas Area. The system calculates Vol Flow (Area)-TAMAX.

8.4.3.2 Stenosis

Function: measures and calculates stenosis diameter and stenosis area.

1 Select [Stenosis] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Normo Diam and Resid Diam. The system calculates Stenosis D.

3 Use the method of Area measurement of 2D General Measurements to measure Normo Area and Resid Area. The system calculates Stenosis A.

8.4.3.3 IMT

NOTE:	1.	The IMT function is not available in the product sold in U.S.A and Canada or the product not configured with IMT.
	2.	IMT measurement is available on frozen (or history) linear array image only.

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

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

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

   It appears as  when Near is selected;

   It appears as  when Far is selected;

Tips:	Make sure that you select the right vessel wall (Near/ Far) before IMT measurement; otherwise the intima may be recognized incorrectly due to different algorithm that applied in near/ far wall recognition.

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

   The ROI box is green while you can:

   - Adjust the size of the ROI box.
   - Erase the trace lines inside the box by pressing <Clear>. (Long press <Clear>: to clear all measurement calipers on the screen.)
   - Trace manually

     a) Move the cursor to a trace line. The trace line turns yellow. Press <Set>.

     b) Move the cursor along the interface of vessel. Press <Set> to confirm the trace after re-adjusting.

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

   The system calculates:

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

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

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

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

- Average Mean IMT
- Average Max IMT
- Standard deviation

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

8.5 Vascular Exam Report

During the measurements or after a measurement, press the [Report] key on the Control Panel to browse the report. See “1.9 Report” for details on report browsing, printing and etc.

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.

8.6 References

Vol Flow (Diam)-TAMAX:

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

Vol Flow (Area)-TAMAX:

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

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.

9 Small Parts Measurements

9.1 Small Parts Measurement Tools

The system supports the following small parts measurement tools.

Mode	Type	Tool	Description	Method
2D	Measure-ment	Thyroid L	Thyroid length	Same as Distance Measurement of 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	
		Mass1 D1	Mass1 Distance1	
		Mass 1 D2	Mass 1 Distance 2	
		Mass 1 D3	Mass 1 Distance 3	
		Mass 2 D1	Mass 2 Distance 1	
		Mass 2 D2	Mass 2 Distance 2	
		Mass 2 D3	Mass 2 Distance 3	
		Mass 3 D1	Mass 3 Distance 1	
		Mass 3 D2	Mass 3 Distance 2	
		Mass 3 D3	Mass 3 Distance 3	
	Calculate	Thyroid Vol	Thyroid volume	See below
	Study	Thyroid	Thyroid	See below
		Testis	Testis	
		Mass1	Mass1	
		Mass2	Mass2	
		Mass3	Mass3	
M	/			
Doppler	Measure-ment	STA	Superior thyroid artery	Same as D Trace of Doppler General Measurements
		ITA	Inferior thyroid artery	

	Calculate	/		
	Study	/		

Measurement menus and reports can be preset. See the section “Measurement Preset” for details.

9.2 Small Parts Exam Preparations

Make the following preparations before performing small parts exam:

- Confirm that the current transducer is appropriate.
- Check that the current date of the system is correct.
- Register patient information in the [Patient Info] → [SMP] dialog box. See the section “Patient Information Input” in the *Basic Volume* for details.
- Switch to the proper exam mode.

9.3 Entering Small Parts Measurements

To enter the Small Parts Measurement menu,

Press the [Measure] key to enter the Application Measurements. If the current menu is not the one having Small Parts Measurement tools, move the cursor to the menu title and select the package having Small Parts Measurement tools.

9.4 Small Parts Measurement Operations

9.4.1 Measurement Tool Operations

For the measurement methods, please refer to the table in 9.1 Small Parts Measurement Tools.

9.4.2 Calculation Tool Operations

Thyroid Vol

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

Hint: measure Left or Right side respectively.

Thyroid Vol (cm^3) = k × Thyroid L (cm) × Thyroid H (cm) × Thyroid W (cm)

Wherein, k= 0.479 or 0.523

1 Select [Thyroid Vol] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Thyroid L, Thyroid H and Thyroid W. The system calculates Thyroid Vol.

9.4.3 Study Tool Operations

9.4.3.1 Thyroid

Function: measures Thyroid L, Thyroid H and Thyroid W respectively, and calculates Thyroid Vol.

Hint: measure Left or Right side respectively.

1 Select [Thyroid] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Thyroid L, Thyroid H and Thyroid W. The system calculates Thyroid Vol.

9.4.3.2 Mass

Function: measures 3 distances of a mass, and calculates the mass volume.

Note: the system supports measuring 3 masses.

Use mass1 for an example:

1 Select [Mass1] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Mass1 D1, Mass1 D2, Mass1 D3. The system calculates mass1 volume.

9.4.3.3 Testis

See “10.4.3.6 Testis”.

9.5 Small Parts Exam Report

During the measurements or after a measurement, press the [Report] key on the Control Panel to browse the report. See “1.9 Report” for details on report browsing, printing and etc.

9.6 Reference

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)

10 Urology Measurements

10.1 Urology Measurement Tools

The system supports the following urology measurement tools.

Mode	Type	Tool	Description	Method or formula
2D	Measure-ment	Pre-BL W	Pervious-bladder width	Same as Distance Measurement of 2D General Measurements
		Pre-BL H	Previous-bladder height	
		Pre-BL L	Previous-bladder length	
		Post-BL L	Posterior-bladder length	
		Post-BL H	Posterior-bladder height	
		Post-BL W	Posterior-bladder width	
		Testis L	Testicular length	
		Testis H	Testicular height	
		Testis W	Testicular width	
		Prostate L	Prostate length	
		Prostate H	Prostate height	
		Prostate W	Prostate width	
		Seminal L	Seminal vesicle length	
		Seminal H	Seminal vesicle height	
		Seminal W	Seminal vesicle width	
		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	
		Ureter	/	
	Calculate	Prostate Vol	Prostate volume	See below
		Renal Vol	Renal volume	
		Pre-BL Vol	Previous-bladder volume	
		Post-BL Vol	Posterior-bladder volume	

Mode	Type	Tool	Description	Method or formula
		Mictur. Vol	Micturated volume	
		Testis Vol	Testicular volume	
	Study	Prostate	/	See below
		Seminal Vesicle	/	
		Kidney	/	
		Adrenal	/	
		Testis	/	
		Bladder	/	
M	/			
Doppler	/			

Measurement menus and reports can be preset. See the section “Measurement Preset” for details.

10.2 Urology Exam Preparations

Make the following preparations before performing a urology exam:

- Confirm that the current transducer is appropriate.
- Check that the current date of the system is correct.
- Register patient information in the [Patient Info] → [URO] dialog box. See the section “Patient Information Input” in the *Basic Volume* for details.
- Switch to the proper exam mode.

10.3 Entering Urology Measurements

To enter the Urology Measurement menu,

Press the [Measure] key to enter the Application Measurements. If the current menu is not the one having Urology Measurement tools, move the cursor to the menu title and select the package having Urology Measurement tools.

10.4 Urology Measurement Operations

10.4.1 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
- Ureter

The following takes Prostate L as an example. Operations of other tools are similar.

1 Select [Prostate L] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Prostate L.

10.4.2 Calculation Tool Operations

10.4.2.1 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) × Prostate Vol (ml)

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

Where, 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 menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Prostate L, Prostate H and Prostate W. The system calculates Prostate Vol and PPSA. If Serum PSA value has input, the system also calculates PSAD.

10.4.2.2 Renal Vol

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

Hint: measure Left or Right side respectively.

1 Select [Renal Vol] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Renal L, Renal H and Renal W. The system calculates Renal Vol.

10.4.2.3 Pre-BL Vol

Function: measures Pre-BL L, Pre-BL H and Pre-BL W, calculates Pre-BL Vol.

1 Select [Pre-BL Vol] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Pre-BL L, Pre-BL H and Pre-BL W. The system calculates Pre-BL Vol. If Post-BL Vol has been obtained, the system also calculates Mictur. Vol.

10.4.2.4 Post-BL Vol

Function: measures Post-BL L, Post-BL H and Post-BL W, calculates Post-BL Vol.

1 Select [Post-BL Vol] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Post-BL L, Post-BL H and Post-BL W. The system calculates Post-BL Vol. If Pre-BL Vol has been obtained, the system also calculates Mictur. Vol.

10.4.2.5 Mictur. Vol

Function: measures Pre-BL Vol and Post-BL Vol, calculates Mictur. Vol.

1 Select [Mictur. Vol] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Pre-BL L, Pre-BL H and Pre-BL W. The system calculates Pre-BL Vol.

3 Use the method of Distance measurement of 2D General Measurements to measure Post-BL L, Post-BL H and Post-BL W. The system calculates Post-BL Vol and Mictur. Vol.

10.4.2.6 Testis Vol

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

Hint: measure Left or Right side respectively.

1 Select [Testis Vol] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Testis L, Testis H and Testis W. The system calculates Testis Vol.

10.4.3 Study Tool Operations

10.4.3.1 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) × Prostate Vol (ml)

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

Where, 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] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Prostate L, Prostate H and Prostate W. The system calculates Prostate Vol and PPSA. If Serum PSA value has input, the system also calculates PSAD.

10.4.3.2 Seminal Vesicle

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

Hint: measure Left or Right side respectively.

1 Select [Seminal Vesicle] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Seminal L, Seminal H and Seminal W.

10.4.3.3 Kidney

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

Hint: measure Left or Right side respectively.

1 Select [Kidney] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Renal L, Renal H and Renal W. The system calculates Renal Vol.

3 Use the method of Distance measurement of 2D General Measurements to measure Cortex.

10.4.3.4 Adrenal

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

Hint: measure Left or Right side respectively.

1 Select [Adrenal] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Adrenal L, Adrenal H and Adrenal W.

10.4.3.5 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 [Bladder] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Pre-BL L, Pre-BL H and Pre-BL W. The system calculates Pre-BL Vol.

3 Use the method of Distance measurement of 2D General Measurements to measure Post-BL L, Post-BL H and Post-BL W. The system calculates Post-BL Vol and Mictur. Vol.

10.4.3.6 Testis

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

Hint: measure Left or Right side respectively.

1 Select [Testis] in the menu.

2 Use the method of Distance measurement of 2D General Measurements to measure Testis L, Testis H and Testis W. The system calculates Testis Vol.

10.5 Urology Exam Report

During the measurements or after a measurement, press the [Report] key on the Control Panel to browse the report. See “1.9 Report” for details on report browsing, printing and etc.

10.6 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

11 Orthopedics Measurements

HIP (Hip Joint Angle) measurement is used in pediatric orthopedics. Such measurement provides early diagnosis for infant hip joint dislocation. In clinical applications, dislocation type can be estimated based on the age and joint angle of the infant.

11.1 Orthopedics Measurement Tools

Measurement menus and reports can be preset. See the section “Measurement Preset” for details.

HIP

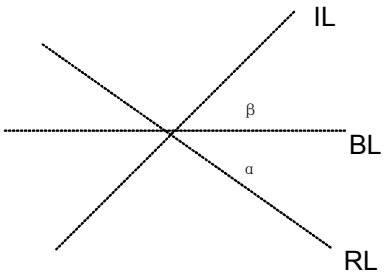
The HIP calculation assists in assessing the development of the infant hip. In this calculation, three straight lines are superimposed on the image and aligned with the anatomical features. The two angles are computed and displayed.

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 two 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	?????
	Others	Others	All ages	?????

11.2 Orthopedics Exam Preparations

Make the following preparations before performing an orthopedics exam:

- Confirm that the current transducer is appropriate.
- Check that the current date of the system is correct.
- Register patient information in the [Patient Info] → [PED] dialog box. See the section “Patient Information Input” in the *Basic Volume* for details.
- Switch to the proper exam mode.

11.3 Entering Orthopedics Measurements

To enter the Pediatrics Measurement menu,

Press the [Measure] key to enter the Application Measurements. If the current menu is not the one having Pediatrics Measurement tools, move the cursor to the menu title and select the package having Orthopedics Measurement tools.

11.4 HIP Measurement Operations

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

1 Select [HIP] in the [Orthopedics] menu and then press the [Set] key to enter measurement.

2 A line appears. Use the trackball to move the line to the position of the hip joint. Then rotate the Multifunctional Knob to fix the baseline and press the [Set] key.

3 A second line appears immediately. Use the method for adjusting the first line to anchor the RL. Press the [Set] key to fix the RL.

4 Use the same method to fix the third line IL. The angles of α and β also come out. If patient age is entered, dislocation type is also displayed.

11.5 Orthopedics Exam Report

During the measurements or after a measurement, press the [Report] key on the Control Panel to browse the report. See “1.9 Report” for details on report browsing, printing and etc.

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):9-13.

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.

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