

Volume 1
Operation Manual

SONOACE R3



WARRANTY

Samsung Medison provides the following warranty to the purchaser of this unit. This warranty is valid for a period of one year from the date of installation and covers all problems caused by faulty workmanship or faulty material. Samsung Medison will, as sole and exclusive remedy and at no charge, replace any such defective unit returned to Samsung Medison within the designated warranty period.

The warranty does not cover damages and loss caused by outside factors including, but not limited to, fire, flood, storm, tidal wave, lightning, earthquake, theft, abnormal conditions of operation, and intentional destruction of the equipment. Damage caused by equipment relocation is not covered.

The warranty is void in cases where the equipment has been damaged as a result of an accident, misuse, abuse, dropping, or when attempts to modify or alter any part or assembly of the equipment have taken place.

Parts with cosmetic defects or deterioration will not be replaced. Replacement of batteries, training materials, and supplies are not covered.

Samsung Medison will not be responsible for incidental or consequential damages of any kind arising from or connected with the use of the equipment.

Samsung Medison will not be responsible for any loss, damage, or injury resulting from a delay in services rendered under the warranty.

This limited warranty is in lieu of all other warranties expressed or implied, including warranties of merchant ability or fitness for any particular use. No representative or other person is authorized to represent or assume for Samsung Medison any warranty liability beyond that set forth herein.

Defective equipment shipped from you to Samsung Medison must be packed in the replacement cartons. Shipping and insurance costs are the responsibility of the customer. To return defective material to Samsung Medison contact the Samsung Medison Customer Service Department.

Samsung Medison or a local distributor will make available, upon request, circuit diagrams, a component parts list, descriptions, calibration instructions and other information which will assist your appropriately qualified technical personnel to repair those parts of the equipment which are designed by Samsung Medison as repairable.

CAUTION: United State federal law restricts this device to sale by or on the order of physicians.



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SONOACER3

Diagnostic Ultrasound System

Operation Manual

VERSION 2.01.00

English

MI68-02771A

PROPRIETARY INFORMATION AND SOFTWARE LICENSE

The Customer shall keep confidential all proprietary information furnished or disclosed to the Customer by Samsung Medison, unless such information has become part of the public domain through no fault of the Customer. The Customer shall not use such proprietary information, without the prior written consent of Samsung Medison, for any purpose other than the maintenance, repair or operation of the goods.

Samsung Medison's systems contain Samsung Medison's proprietary software in machine-readable form. Samsung Medison retains all its rights, title and interest in the software except that purchase of this product includes a license to use the machine-readable software contained in it. The Customer shall not copy, trace, disassemble or modify the software. Transfer of this product by the Customer shall constitute a transfer of this license that shall not be otherwise transferable. Upon cancellation or termination of this contract or return of the goods for reasons other than repair or modification, the Customer shall return to Samsung Medison all such proprietary information.

:: Safety Requirements

■ Classification:

- ▶ Type of protection against electrical shock: Class I
- ▶ Degree of protection against electrical shock (Patient connection): Type BF applied part
- ▶ Degree of protection against harmful ingress of water: Ordinary equipment
- ▶ Degree of safety of application in the presence of a flammable anesthetic material with air or with oxygen or nitrous oxide: Equipment not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.
- ▶ Mode of operation: Continuous operation

■ Electromechanical safety standards met:

- ▶ Medical Electrical Equipment, Part 1: General Requirements for Basic Safety and Essential Performance [**IEC 60601-1: 2005**]
- ▶ Medical Electrical Equipment, Part 1-2: General Requirements for Basic Safety and Essential Performance- Collateral Standard: Electromagnetic Compatibility - Requirements and Tests [**IEC 60601-1-2: 2007**]
- ▶ Medical Electrical Equipment, Part 1-6: General Requirements for Basic Safety and Essential Performance- Collateral Standard: Usability [**IEC 60601-1-6: 2010**]
- ▶ Medical Electrical Equipment, Part 2-37: Particular Requirements for the Basic Safety and Essential Performance of Ultrasonic Medical Diagnostic and Monitoring Equipment [**IEC 60601-2-37: 2007**]
- ▶ Medical Electrical Equipment, Part 1: General Requirements for Safety [**IEC 60601-1: 1988 with A1: 1991 and A2: 1995**]
- ▶ Medical Electrical Equipment, Part 1-1: General Requirements for Safety - Collateral Standard: safety Requirement for Medical Electrical Systems [**IEC 60601-1-1: 2000**]
- ▶ Medical Electrical Equipment, Part 1-2: General Requirements for Safety - Collateral Standard: Electromagnetic Compatibility - Requirements and Test [**IEC 60601-1-2: 2001, A1: 2004**]
- ▶ Medical Electrical Equipment, Part 1-4: General Requirements for Safety - Collateral Standard: Programmable Electrical Medical Systems [**IEC 60601-1-4: 1996, A1: 1999**]

- ▶ Medical Electrical Equipment, Part 2-37: Particular Requirements for Safety - Ultrasonic Medical Diagnostic and Monitoring Equipment [**IEC 60601-2-37: 2001 with A1: 2004, A2: 2005**]
- ▶ Medical Devices – Application of Risk Management to Medical Devices [**ISO 14971: 2007**]
- ▶ Medical Electrical Equipment, Part 1: General Requirements for Safety [**UL 60601-1: 2003**]
- ▶ Medical Electrical Equipment - Part 1: General Requirements for Safety [**CAN/CSA C22.2 No. 601.1-M90: 1990, with R2003, with R2005**]
- ▶ Biological Evaluation of Medical Devices, Part 1: Evaluation and Testing within a risk management process [**ISO 10993-1: 2009**]
- ▶ Standard Means for the Reporting of the Acoustic Output of Medical Diagnostic Ultrasonic Equipment [**IEC 61157: 2007**]

■ **Declarations:**



This is CSA symbol for Canada and United States of America



This is manufacturer's declaration of product compliance with applicable EEC directive(s) and the European notified body.



This is manufacturer's declaration of product compliance with applicable EEC directive(s).

READ THIS FIRST

▣ How to Use Your Manual

This manual addresses the reader who is familiar with ultrasound techniques. Only medical doctors or persons supervised by medical doctors should use this system. Sonography training and clinical procedures are not included here. This manual is not intended to be used as training material for the principles of ultrasound, anatomy, scanning techniques, or applications. You should be familiar with all of these areas before attempting to use this manual or your ultrasound system.

This manual does not include diagnosis results or opinions. Also, check the measurement reference for each application's result measurement before the final diagnosis.

It is useless to make constant or complex adjustments to the equipment controls. The system has been preset at the factory to produce an optimum image in the majority of patients. User adjustments are not usually required. If the user wishes to change image settings, the variables may be set as desired. Optimal images are obtained with little difficulty.

We are not responsible for errors that occur when the system is run on a user's PC.

Non-Samsung Medison product names may be trademarks of their respective owners.

Please keep this operation manual close to the product as a reference when using the system.

For safe use of this product, you should read 'Chapter1. Safety' in this manual, prior to starting to use this system.



NOTE: Some features are not available in some countries. The features with options, and specifications that this manual present can be changed without notice. Government approval is still pending in some nations.

Conventions Used in This Manual



DANGER: Describes precautions necessary to prevent user hazards of great urgency. Ignoring a DANGER warning will risk life-threatening injury.



WARNING: Used to indicate the presence of a hazard that can cause serious personal injury, or substantial property damage.



CAUTION: Indicates the presence of a hazard that can cause equipment damage.



NOTE: A piece of information useful for installing, operating and maintaining a system. Not related to any hazard.

If You Need Assistance

If you need any assistance with the equipment, like the service manual, please contact the Samsung Medison Customer Service Department or one of their worldwide customer service representatives, immediately.

Revision History

VERSION	DATE	NOTE
v2.01.00-00	2013-04-19	Initial Release
v2.01.00-01	2013-11-28	Add State of California Proposition 65 Warning (US Only)

System Upgrades and Manual Set Updates

Samsung Medison Ultrasound is committed to innovation and continued improvement. Upgrades may be announced that consist of hardware or software improvements. Updated manuals will accompany those system upgrades.

Verify that Check if this version of the manual is correct for the system version. If not, please contact the Customer Service Department.

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** Reference Manual

Samsung Medison is providing an additional SONOACE R3 Reference Manual. GA tables and references for each application are included in the Reference Manual.

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•• Indication for Use

The SONOACE R3 Diagnostic Ultrasound System and transducers are intended for diagnostic ultrasound imaging and fluid analysis of the human body.

The clinical applications include: Gynecology, Abdomen, OB, Renal, Urology, Vascular, Small Part, Fetal Heart, Breast, Musculoskeletal, Pediatric, Neonatal, and Cardiac.

Contraindications

The SONOACE R3 system is not intended for ophthalmic use or any use causing the acoustic beam to pass through the eye.

**CAUTION:**

- ▶ Federal law restricts this device to sale by or on the order of a physician.
- ▶ The method of application or use of the device is described in the manual 'Chapter 3. Starting Diagnosis' and 'Chapter 4. Diagnosis Modes'.















⚡ Safety Signs







Please read this chapter before using the Samsung Medison ultrasound system. It is relevant to the ultrasound system, the probes, the recording devices, and any of the optional equipment.

SONOACE R3 is intended for use by, or by the order of, and under the supervision of, a licensed physician who is qualified for direct use of the medical device.



Safety Symbols

The International Electro Technical Commission (IEC) has established a set of symbols for medical electronic equipment, which classify a connection or warn of potential hazards. The classifications and symbols are shown below.

Symbols	Description	Symbols	Description
	AC (alternating current) voltage source		Output port (DVI, RGB, B/W, S-VHS, SOUND)
	Indicates a caution for risk of electric shock.		Print Remote Output
	Isolated patient connection (Type BF applied part).		Protection against the effects of immersion.
	On/Off button		Protection against dripping water.
	WARNING: The accompanying information must be followed to prevent serious accidents and/or damage to property.		Probe port
	CAUTION: The accompanying information helps to avoid accidents and/or damage to property.		ESD-related warning
	Refer to the operation manual		Do not sit on control panel

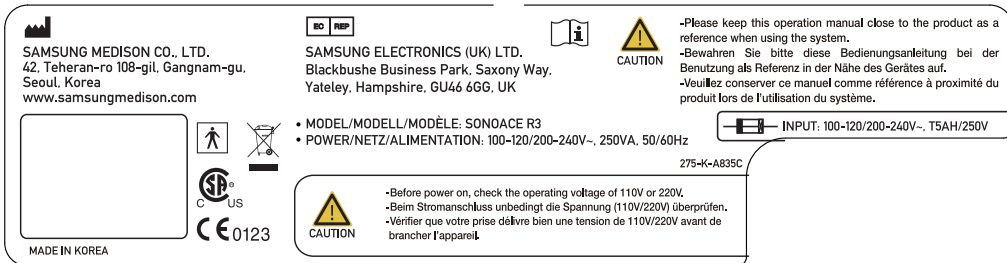
Symbols	Description	Symbols	Description
	Indicates dangerous voltages over 1000V AC or over 1500V DC.		Do not push the product
	Network port		Do not lean against the product
	USB port		Follow the operation manual

Symbols

Symbols	Description	Symbols	Description
	Authorised Representative In The European Community		Manufacturer

Labels

Warning and Caution labels are attached to the surface for protecting the product.



[Label 1. ID label]



[Label 2. Prohibition of seating on control panel and "Tip-Over"]

⚡ Electrical Safety

This equipment has been verified as a Class I device.



CAUTION: As for US requirement, the LEAKAGE CURRENT might be measured from a center-tapped circuit when the equipment connects in the United States to 240V supply system.

Prevention of Electric Shock

Additional equipment connected to medical electrical equipment must comply with the respective IEC or ISO standards (e.g. IEC 60950/EN 60950 for data processing equipment). Furthermore all configurations shall comply with the requirements for medical electrical systems (see IEC 60601-1-1/EN 60601-1-1 or clause 16 of the 3 Ed. of IEC 60601-1, respectively). Anybody connecting additional equipment to medical electrical equipment configures a medical system and is therefore responsible that the system complies with the requirements for medical electrical systems. Attention is drawn to the fact that local laws take priority over the above-mentioned requirements. If in doubt, consult your local representative or the technical service department.



WARNING:

- ▶ Electric shock may exist result if this system, including and all of its externally mounted recording and monitoring devices, is not properly grounded.
- ▶ Do not remove the covers on the system; hazardous voltages are present inside. Cabinet panels must be in place while the system is in use. All internal adjustments and replacements must be made by a qualified Samsung Medison Customer Service Department.
- ▶ Check the face, housing, and cable before use. Do not use and disconnect the power source, if the face is cracked, chipped, or torn, the housing is damaged, or if the cable is abraded.
- ▶ Always disconnect the system from the wall outlet prior to cleaning the system.
- ▶ All patient contact devices, such as probes and ECG leads, must be removed from the patient prior to application of a high voltage defibrillation pulse.
- ▶ Never use the product in proximity to any flammable anesthetic gases (N₂O) or oxidizing gases. There is a risk of explosion.
- ▶ Avoid places where the system is likely to be difficult to operate the disconnection device.
- ▶ Do not use together with HF surgical equipment. HF surgical equipment may be damaged, which may result in fire.
- ▶ The System must only be connected to a mains supply with protective earth to avoid risk of electric shock.

**CAUTION:**

- ▶ The system has been designed for 100-120VAC and 200-240VAC; you should select the input voltage of printer and VCR. Prior to connecting a peripheral power cord, verify that the voltage indicated on the power cord matches the voltage rating of the peripheral device.
- ▶ An isolation transformer protects the system from power surges. The isolation transformer continues to operate when the system is in standby.
- ▶ Do not immerse the cable in liquids. Cables are not waterproof.
- ▶ Do not touch SIP/SOP and the patient simultaneously. There is a risk of electric shock from leakage current.

ESD

Electrostatic discharge (ESD), commonly referred to as a static shock, is a naturally occurring phenomenon. ESD is most prevalent during conditions of low humidity, which can be caused by heating or air conditioning. During low humidity conditions, electrical charges naturally build up on individuals, creating static electricity. An ESD occurs when an individual with an electrical energy build-up comes in contact with conductive objects such as metal doorknobs, file cabinets, computer equipment, and even other individuals. The static shock or ESD is a discharge of the electrical energy build-up from a charged individual to a lesser or non-charged individual or object.



CAUTION:

- ▶ The level of electrical energy discharged from a system user or patient to an ultrasound system can be significant enough to cause damage to the system or probes.
- ▶ Always perform the pre-ESD preventive procedures before using connectors marked with the ESD warning label.
 - Apply anti-static spray on carpets or linoleum.
 - Use anti-static mats.
 - Ground the product to the patient table or bed.
- ▶ It is highly recommended that the user be given training on ESD-related warning symbols and preventive procedures.

EMI

Although this system has been manufactured in compliance with existing EMI(Electromagnetic Interference) requirements, use of this system in the presence of an electromagnetic field can cause momentary degradation of the ultrasound image.

If this occurs often, Samsung Medison suggests a review of the environment in which the system is being used, to identify possible sources of radiated emissions. These emissions could be from other electrical devices used within the same room or an adjacent room. Communication devices such as cellular phones and pagers can cause these emissions. The existence of radios, TVs, or microwave transmission equipment nearby can also cause interference.



CAUTION: In cases where EMI is causing disturbances, it may be necessary to relocate this system.

EMC

The testing for EMC(ElectroMagnetic Compatibility) of this system has been performed according to the international standard for EMC with medical devices (IEC 60601-1-2). This IEC standard was adopted in Europe as the European norm (EN 60601-1-2).

Guidance and manufacturer's declaration - electromagnetic emission

This product is intended for use in the electromagnetic environment specified below. The customer or the user of this product should assure that it is used in such an environment.

Emission test	Compliance	Electromagnetic environment -guidance
RF Emission CISPR 11	Group 1	The Ultrasound System uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF Emission CISPR 11	Class B	The Ultrasound System is suitable for use in all establishments, other than domestic and those directly connected to the public low-voltage power supply network that supplies building used for domestic purpose.
Harmonic Emission IEC 61000-3-2	Class A	
Flicker Emission IEC 61000-3-3	Complies	

Approved Cables, Transducers and Accessories for EMC

Approved Cable for Electromagnetic Compliance

Cables connected to this product may affect its emissions;
Use only the cable types and lengths listed below table.

Cable	Type	Length
DVI	Shielded	Normal
Parallel	Shielded	Normal
RS232C	Shielded	Normal
USB	Shielded	Normal
LAN(RJ45)	Twisted pair	Any
S-Video	Shielded	Normal
Foot Switch	Shielded	2.5m
B/W Printer	Unshielded Coaxial	Normal
Printer Remote	Unshielded	Any
Audio R.L	Shielded	Normal
VHS	Shielded	Normal

Approved Transducer for Electromagnetic Compliance

The image transducer used with this product may affect its emission. The transducer listed in 'Chapter 9. Probes' when used with this product, have been tested to comply with the group1 class B emission as required by International Standard CISPR 11.

Approved Accessories for Electromagnetic Compliance

Accessories used with this product may effect its emissions.




CAUTION: When connecting other customer-supplied accessories to the system, it is the user's responsibility to ensure the electromagnetic compatibility of the system. Use only CISPR 11 or CISPR 22, CLASS B compliant devices.



WARNING: The use of cables, transducers, and accessories other than those specified may result in increased emission or decreased Immunity of the Ultrasound System

Immunity test	IEC 60601 Test level	Compliance level	Electromagnetic environment -guidance
Electrostatic discharge (ESD) IEC 61000-4-2	±6KV Contact ±8KV air	±6KV Contact ±8KV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2KV for power supply lines ±1KV for input/output lines	±2KV for power supply lines ±1KV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1KV differential mode ±2KV common mode	±1KV differential mode ±2KV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5% U _T for 0.5 cycles (>95% dip in U _T) 40% U _T for 5 cycles (60% dip in U _T) 70% U _T for 25 cycles (30% dip in U _T) <5% U _T for 5 s (<95% dip in U _T)	<5% U _T for 0.5 cycles (>95% dip in U _T) 40% U _T for 5 cycles (60% dip in U _T) 70% U _T for 25 cycles (30% dip in U _T) <5% U _T for 5 s (<95% dip in U _T)	Mains power quality should be that of a typical commercial or hospital environment. If the user of this product requires continued operation during power mains interruptions, it is recommended that this product be powered from an uninterruptible power supply or a battery.
Power frequency (50/60Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE U _T is the a.c. mains voltage prior to application of the test level.			

Immunity test	IEC 60601 Test level	Compliance level	Electromagnetic environment - guidance
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80MHz	0.01V	<p>Portable and mobile RF communications equipment should be used no closer to any part of the Ultrasound System, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.</p> <p>Recommended separation distance</p> $d = \left[\frac{3,5}{V_1} \right] \sqrt{P}$ $d = \left[\frac{3,5}{E_1} \right] \sqrt{P} \quad 80\text{MHz to } 800\text{MHz}$ $d = \left[\frac{7}{E_1} \right] \sqrt{P} \quad 800\text{MHz to } 2.5\text{GHz}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5GHz	3V/m	<p>where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m).</p> <p>Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,^a should be less than the compliance level in each frequency range.^b</p> <p>Interference may occur in the vicinity of equipment marked with the following symbol :</p> 
<p>NOTE 1) At 80MHz and 800MHz, the higher frequency range applies.</p> <p>NOTE 2) These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.</p>			
<p>^a Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the Ultrasound System is used exceeds the applicable RF compliance level above, the Ultrasound System should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the Ultrasound System or using a shielded location with a higher RF shielding effectiveness and filter attenuation.</p> <p>^b Over the frequency range 150kHz to 80MHz, field strengths should be less than [V₁] V/m.</p>			

❖ Recommended separation distances between portable and mobile RF communications equipment and the SONOACE R3

This product is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of this product can help Prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and this product as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter [W]	Separation distance according to frequency of transmitter [m]		
	150kHz to 80MHz $d = \left[\frac{3,5}{V_1} \right] \sqrt{P}$	80MHz to 800MHz $d = \left[\frac{3,5}{E_1} \right] \sqrt{P}$	800MHz to 2.5GHz $d = \left[\frac{7}{E_1} \right] \sqrt{P}$
	$V_1=0.01V_{rms}$	$E_1=3 V/m$	$E_1=3V/m$
0.01	35.00	0.11	0.23
0.1	110.68	0.36	0.73
1	350.00	1.16	2.33
10	1106.80	3.68	7.37
100	3500.00	11.66	23.33

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where p is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.
 NOTE 1) At 80MHz and 800MHz, the separation distance for the higher frequency range applies.
 NOTE 2) These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

❖ Electromagnetic environment – guidance

The Ultrasound System must be used only in a shielded location with a minimum RF shielding effectiveness and, for each cable that enters the shielded location. Field strengths outside the shielded location from fixed RF transmitters, as determined by an electromagnetic site survey, should be less than 3V/m.

It is essential that the actual shielding effectiveness and filter attenuation of the shielded location be verified to assure that they meet the minimum specification.



CAUTION: If the system is connected to other customer-supplied equipment, such as a local area network (LAN) or a remote printer, Samsung Medison cannot guarantee that the remote equipment will work correctly in the presence of electromagnetic phenomena.

❏ Avoiding Electromagnetic Interference

Typical interference on Ultrasound Imaging Systems varies depending on Electromagnetic phenomena. Please refer to following table:

Imaging Mode	ESD ¹	RF ²	Power Line ³
2D or 3D	Change of operating mode, system settings, or system reset. Brief flashes in the displayed or recorded image.	For sector imaging probes, white radial bands or flashes in the centerlines of the image. For linear imaging probes, white vertical bands, sometimes more pronounced on the sides of the image.	White dots, dashes, diagonal lines, or diagonal lines near the center of the image.
M		Increase in the image background noise or white M mode lines.	White dots, dashes, diagonal lines, or increase in image background noise
Color		Color flashes, radial or vertical bands, increase in background noise, or changes in color image.	Color flashes, dots, dashes, or changes in the color noise level.
Doppler		Horizontal lines in the spectral display or tones, abnormal noise in the audio, or both.	Vertical lines in the spectral display, popping type noise in the audio, or both.
ESD caused by discharging of electric charge build-up on insulated surfaces or persons. RF energy from RF transmitting equipment such as portable phones, hand-held radios, wireless devices, commercial radio and TV, and so on. Conducted interference on powerlines or connected cables caused by other equipment, such as switching power supplies, electrical controls, and natural phenomena such as lightning.			

A medical device can either generate or receive electromagnetic interference. The EMC standards describe tests for both emitted and received interference.

Samsung Medison Ultrasound System do not generate interference in excess of the referenced standards.

An Ultrasound System is designed to receive signals at radio frequency and is therefore susceptible to interference generated by RF energy sources. Examples of other source of interference are medical device, information technology products, and radio and television transmission towers. Tracing the source of radiated interference can be a difficult task. Customers should consider the following in an attempt to locate the source:

- ▶ Is the interference intermittent or constant?
- ▶ Does the interference show up only with one transducers operating at the same frequency or with several transducer?
- ▶ Do two different transducer operating at the same frequency have the same problem?
- ▶ Is the interference present if the system is moved to a different location in the facility?

The answers to these questions will help determine if the problem reside with the system or the scanning environment. After you answer the question, contact your local Samsung Medison customer service department.

⚠ Mechanical Safety

Safety Note



CAUTION:

- ▶ Do not apply excessive force to the product.
- ▶ Be sure to install the console on a stable surface. Samsung Medison recommends SONOACE R3 CART (optional).
- ▶ Never attempt to modify the product in any way.
- ▶ Check the operational safety when using the product after a prolonged break in service.
- ▶ Make sure that foreign bodies, such as bits of metal, do not get into the system.
- ▶ Do not block the ventilation slots.
- ▶ Do not keep this equipment in the closed space, such as a bag or a case, with turing it on.
- ▶ Do not unplug the power cable by pulling the cable. The cable may be damaged, resulting in short circuit or disconnection. Always unplug it by holding the plug body.
- ▶ Excessive bending or twisting of cables on patient-applied parts may cause failure or intermittent operation of the system.
- ▶ Incorrect cleaning or sterilization of a patient-applied part may cause permanent damage.
- ▶ Repair or replacement of parts of this equipment must be performed by a qualified Samsung Medison service technician. Assuming that the equipment is maintained by a qualified service technician and meets the guideline of this provided manual, the expected service life of the equipment is approximately 7 years.

Please refer to “Chapter 8. Maintenance” for detailed information on protecting, cleaning and disinfecting the equipment.

Moving the Equipment

Use the handle on the product, and move the product slowly. You can also move the product by using the SONOACE R3 CART (optional).



CAUTION: Always turn the power off and disconnect the cables before moving the product.



NOTE: When using the SONOACE R3 CART, try to avoid parking it on a slope. If this is necessary for a while, please lock the wheel brakes.

⚠ Biological Safety

Verify the alignment of the biopsy guide before use. See the “Chapter 9. Probes” section of this manual.

**WARNING:**

- ▶ Ultrasound waves may have damaging effects on cells and, therefore, may be harmful to the patient. If there is no medical benefit, minimize the exposure time and maintain the ultrasound wave output level at low. Please refer to the ALARA principle.
- ▶ Do not use the system if an error message appears on the video display indicating that a hazardous condition exists. Note the error code, turn off the power to the system, and call your local Samsung Medison Customer Service Department.
- ▶ Do not use a system that exhibits erratic or inconsistent updating. Discontinuities in the scanning sequence are indicative of a hardware failure that should be corrected before use.
- ▶ The system limits the maximum contact temperature to 43 degree Celsius, and the ultrasonic waves output observes American FDA regulations.

ALARA Principle

Guidance for the use of diagnostic ultrasound is defined by the “as low as reasonably achievable” (ALARA) principle. The decision as to what is reasonable has been left to the judgment and insight of qualified personnel. No set of rules can be formulated that would be sufficiently complete to dictate the correct response for every circumstance. By keeping ultrasound exposure as low as possible, while obtaining diagnostic images, users can minimize ultrasonic bioeffects.

Since the threshold for diagnostic ultrasound bioeffects is undetermined, it is the sonographer’s responsibility to control the total energy transmitted into the patient. The sonographer must reconcile exposure time with diagnostic image quality. To ensure diagnostic image quality and limit exposure time, the ultrasound system provides controls that can be manipulated during the exam to optimize the results of the exam.

The ability of the user to abide by the ALARA principle is important. Advances in diagnostic ultrasound not only in the technology but also in the applications of the technology, have resulted in the need for more and better information to guide the user. The output indices are designed to provide that important information

There are a number of variables, which affect the way in which the output display indices can be used to implement the ALARA principle. These variables include mass, body size, location of the bone relative to the focal point, attenuation in the body, and ultrasound exposure time. Exposure time is an especially useful variable, because the user controls it. The ability to limit the index values over time support the ALARA principle.

❑ Applying ALARA

The system-imaging mode used depends upon the information needed. 2D-mode and M-mode imaging provide anatomical information, while Doppler, Power, and Color imaging provide information about blood flow. Scanned modes, like 2D-mode, Power, or Color, disperse or scatter the ultrasonic energy over an area, while an unscanned mode, like M-mode or Doppler, concentrates ultrasonic energy. Understanding the nature of the imaging mode being used allows the sonographer to apply the ALARA principle with informed judgment. The probe frequency, system set-up values, scanning techniques, and operator experience aid the sonographer in meeting the definition of the ALARA principle.

The decision as to the amount of acoustic output is, in the final analysis, up to the system operator. This decision must be based on the following factors: type of patient, type of exam, patient history, ease or difficulty of obtaining diagnostically useful information, and the potential localized heating of the patient due to probe surface temperatures. Prudent use of the system occurs when patient exposure is limited to the lowest index reading for the shortest amount of time necessary to achieve acceptable diagnostic results.

Although a high index reading does not mean that a bioeffect is actually occurring, a high index reading should be taken seriously. Every effort should be made to reduce the possible effects of a high index reading. Limiting exposure time is an effective way to accomplish this goal.

There are several system controls that the operator can use to adjust the image quality and limit the acoustic intensity. These controls are related to the techniques that an operator might use to implement ALARA. These controls can be divided into three categories: direct, indirect, and receiver control.

❑ Direct Controls

Application selection and the output intensity control directly affect acoustic intensity. There are different ranges of allowable intensity or output based on your selection. Selecting the correct range of acoustic intensity for the application is one of the first things required during any exam. For example, peripheral vascular intensity levels are not recommended for fetal exams. Some systems automatically select the proper range for a particular procedure, while others require manual selection. Ultimately, the user bears the responsibility for proper clinical use. The Samsung Medison system provides both automatic and user-definable settings.

Output has direct impact on acoustic intensity. Once the application has been established, the output control can be used to increase or decrease the intensity output. The output control allows you to select intensity levels less than the defined maximum. Prudent use dictates that you select the lowest output intensity consistent with good image quality.

❏ Indirect Controls

The indirect controls are those that have an indirect effect on acoustic intensity. These controls affect imaging mode, pulse repetition frequency, focus depth, pulse length, and probe selection.

The choice of imaging mode determines the nature of the ultrasound beam. 2D-mode is a scanning mode, Doppler is a stationary or unscanned mode. A stationary ultrasound beam concentrates energy on a single location. A moving or scanned ultrasound beam disperses the energy over a wide area and the beam is only concentrated on a given area for a fraction of the time necessary in unscanned mode.

Pulse repetition frequency or rate refers to the number of ultrasound bursts of energy over a specific period of time. The higher the pulse repetition frequency, the more pulses of energy in a given period of time. Several controls affect pulse repetition frequency: focal depth, display depth, sample volume depth, color sensitivity, number of focal zones, and sector width controls.

Focus of the ultrasound beam affects the image resolution. To maintain or increase resolution at a different focus requires a variation in output over the focal zone. This variation of output is a function of system optimization. Different exams require different focal depths. Setting the focus to the proper depth improves the resolution of the structure of interest.

Pulse length is the time during which the ultrasonic burst is turned on. The longer the pulse, the greater the time-average intensity value. The greater the time-average intensity, the greater the likelihood of temperature increase and cavitations. Pulse length or burst length or pulse duration is the output pulse duration in pulsed Doppler. Increasing the Doppler sample volume increases the pulse length.

Probe selection affects intensity indirectly. Tissue attenuation changes with frequency. The higher the probe operating frequency, the greater the attenuation of the ultrasonic energy. Higher probe operating frequencies require higher output intensity to scan at a deeper depth. To scan deeper at the same output intensity, a lower probe frequency is required. Using more gain and output beyond a point, without corresponding increases in image quality, can mean that a lower frequency probe is needed.

❏ Receiver Controls

Receiver controls are used by the operator to improve image quality. These controls have no effect on output. Receiver controls only affect how the ultrasound echo is received. These controls include gain, TGC, dynamic range, and image processing. The important thing to remember, relative to output, is that receiver controls should be optimized before increasing output. For example; before increasing output, optimize gain to improve image quality.

❑ Additional Considerations

Ensure that scanning time is kept to a minimum, and ensure that only medically required scanning is performed. Never compromise quality by rushing through an exam. A poor exam will require a follow-up, which ultimately increases the time. Diagnostic ultrasound is an important tool in medicine, and, like any tool, should be used efficiently and effectively.

❑ Output Display Features

The system output display comprises two basic indices: a mechanical index and a thermal index. The thermal index consists of the following indices: soft tissue (TI_s) and bone (TI_b). One of these three thermal indices will be displayed at all times. Which one depends upon the system preset or user choice, depending upon the application at hand.

The mechanical index is continuously displayed over the range of 0.0 to 1.9, in increments of 0.1.

The thermal index consists of the three indices, and only one of these is displayed at any one time. Each probe application has a default selection that is appropriate for that combination. The TI_b or TI_s is continuously displayed over the range of 0.0 to maximum output, based on the probe and application, in increments of 0.1.

The application-specific nature of the default setting is also an important factor of index behavior. A default setting is a system control state which is preset by the manufacturer or the operator. The system has default index settings for the probe application. The default settings are invoked automatically by the ultrasound system when power is turned on, new patient data is entered into the system database, or a change in application takes place.

The decision as to which of the three thermal indices to display should be based on the following criteria:

Appropriate index for the application: TI_s is used for imaging soft tissue; and TI_b for a focus at or near bone.

Some factors might create artificially high or low thermal index readings e.g. presence of fluid or bone, or the flow of blood. A highly attenuating tissue path, for example, will cause the potential for local zone heating to be less than the thermal index displays.

Scanned modes versus unscanned modes of operation affect the thermal index. For scanned modes, heating tends to be near the surface; for unscanned modes, the potential for heating tends to be deeper in the focal zone.

Always limit ultrasound exposure time. Do not rush the exam. Ensure that the indices are kept to a minimum and that exposure time is limited without compromising diagnostic sensitivity.

■ Mechanical Index (MI) Display

Mechanical bioeffects are threshold phenomena that occur when a certain level of output is exceeded. The threshold level varies, however, with the type of tissue. The potential for mechanical bioeffects varies with peak pressure and ultrasound frequency. The MI accounts for these two factors. The higher the MI value, the greater the likelihood of mechanical bioeffects occurring but there is no specific MI value that means that a mechanical effect will actually occur. The MI should be used as a guide for implementing the ALARA principle.

■ Thermal Index (TI) Display

The TI informs the user about the potential for temperature increase occurring at the body surface, within body tissue, or at the point of focus of the ultrasound beam on bone. The TI is an estimate of the temperature increase in specific body tissues. The actual amount of any temperature rise is influenced by factors such as tissue type, vascularity, and mode of operation etc. The TI should be used as a guide for implementing the ALARA principle.

The bone thermal index (Tlb) informs the user about potential heating at or near the focus after the ultrasound beam has passed through soft tissue or fluid, for example, at or near second or third trimester fetal bone.

The cranial bone thermal index (Tlc) informs the user about the potential heating of bone at or near the surface, for example, cranial bone.

The soft tissue thermal index (TIs) informs the user about the potential for heating within soft homogeneous tissue.

You can select either TIs or Tlb using the TIs/Tlb selection on the Miscellaneous system setups. Tlc is displayed when you select a trans-cranial application.

■ Mechanical and Thermal indices Display Precision and Accuracy

The Mechanical and Thermal Indices on the system are precise to 0.1 units.

The MI and TI display accuracy estimates for the system are given in the Acoustic Output Tables manual. These accuracy estimates are based on the variability range of probes and systems, inherent acoustic output modeling errors and measurement variability, as described below.

The displayed values should be interpreted as relative information to help the system operator achieve the ALARA principle through prudent use of the system. The values should not be interpreted as actual physical values investigated tissue or organs. The initial data that is used to support the output display is derived from laboratory measurements based on the AIUM measurement standard. The measurements are then put into algorithms for calculating the displayed output values.

Many of the assumptions used in the process of measurement and calculation are conservative in nature. Over-estimation of actual in situ exposure, for the vast majority of tissue paths, is built into the measurement and calculation process. For example:

The measured water tank values are de-rated using a conservative, industry standard, attenuation coefficient of 0.3dB/cm-MHz.

Conservative values for tissue characteristics were selected for use in the TI models. Conservative values for tissue or bone absorption rates, blood perfusion rates, blood heat capacity, and tissue thermal conductivity were selected.

Steady state temperature rise is assumed in the industry standard TI models, and the assumption is made that the ultrasound probe is held steady in one position long enough for steady state to be reached.

A number of factors are considered when estimating the accuracy of display values: hardware variations, algorithm accuracy estimation and measurement variability. Variability among probes and systems is a significant factor. Probe variability results from piezoelectric crystal efficiencies, process-related impedance differences, and sensitive lens focusing parameter variations. Differences in the system pulse voltage control and efficiencies are also a contributor to variability. There are inherent uncertainties in the algorithms used for estimating acoustic output values over the range of possible system operating conditions and pulse voltages. Inaccuracies in laboratory measurements are related to differences in hydrophone calibration and performance, positioning, alignment and digitization tolerances, and variability among test operators.

The conservative assumptions of the output estimation algorithms of linear propagation, at all depths, through a 0.3dB/cm-MHz attenuated medium are not taken into account in calculation of the accuracy estimate displayed. Neither linear propagation, nor uniform attenuation at the 0.3dB/cm-MHz rate, occur in water tank measurements or in most tissue paths in the body. In the body, different tissues and organs have dissimilar attenuation characteristics. In water, there is almost no attenuation. In the body, and particularly in water tank measurements, non-linear propagation and saturation losses occur as pulse voltages increase.

The display accuracy estimates take into account the variability ranges of probes and systems, inherent acoustic output modeling errors, and measurement variability. Display accuracy estimates are not based on errors in, or caused by measuring according to, the AIUM measurement standards. They are also independent of the effects of non-linear loss on the measured values.

Control affecting the indices

As various system controls are adjusted, the TI and MI values may change. This will be most apparent as the POWER control is adjusted; however, other system controls will affect the on-screen output values.

■ Power

Power controls the system acoustic output. Two real-time output values are on the screen: a TI and a MI. They change as the system responds to POWER adjustments.

In combined modes, such as simultaneous Color, 2D-mode and pulsed Doppler, the individual modes each add to the total TI. One mode will be the dominant contributor to this total. The displayed MI will be from the mode with the largest peak pressure.

2D-mode Controls

2D-mode size

Narrowing the sector angle may increase the frame rate. This action will increase the TI. Pulse voltage may be automatically adjusted down with software controls to keep the TI below the system maximums. A decrease in pulse voltage will decrease MI.

Zoom

Increasing the zoom magnification may increase frame rate. This action will increase the TI. The number of focal zones may also increase automatically to improve resolution. This action may change MI since the peak intensity can occur at a different depth.

Persistence

A lower persistence will decrease the TI. Pulse voltage may be automatically increased. An increase in pulse voltage will increase MI.

Focal no.

More focal zones may change both the TI and MI by changing frame rate or focal depth automatically. Lower frame rates decrease the TI. MI displayed will correspond to the zone with the largest peak intensity.

Focus

Changing the focal depth will change the MI. Generally, higher MI values will occur when the focal depth is near the natural focus of the transducer.

Color and Power Controls

Color Sensitivity

Increasing the color sensitivity may increase the TI. More time is spent scanning for color images. Color pulses are the dominant pulse type in this mode.

Color Sector Width

Narrower color sector width will increase color frame rate and the TI will increase. The system may automatically decrease pulse voltage to stay below the system maximum. A decrease in pulse voltage will decrease the MI. If pulsed Doppler is also enabled then pulsed Doppler will remain the dominant mode and the TI change will be small.

■ Color Sector Depth

Deeper color sector depth may automatically decrease color frame rate or select a new color focal zone or color pulse length. The TI will change due to the combination of these effects. Generally, the TI will decrease with increased color sector depth. MI will correspond to the peak intensity of the dominant pulse type, which is a color pulse. However, if pulsed Doppler is also enabled then pulsed Doppler will remain the dominant mode and the TI change will be small.

■ Scale

Using the SCALE control to increase the color velocity range may increase the TI. The system will automatically adjust pulse voltage to stay below the system maximums. A decrease in pulse voltage will also decrease MI.

■ Sec Width

A narrower 2D-mode sector width in Color imaging will increase color frame rate. The TI will increase. MI will not change. If pulsed Doppler is also enabled, then pulsed Doppler will remain as the primary mode and the TI change will be small.

■ M-mode and Doppler Controls

■ Speed

M-mode and Doppler sweep speed adjustments will not affect the MI. When M-mode sweep speed changes, TI changes.

■ Simultaneous and Update Methods

Use of combination modes affects both the TI and MI through the combination of pulse types. During simultaneous mode, the TI is additive. During auto-update and duplex, the TI will display the dominant pulse type. The displayed MI will be from the mode with the largest peak pressure.

■ Sample Volume Depth

When Doppler sample volume depth is increased the Doppler PRF may automatically decrease. A decrease in PRF will decrease the TI. The system may also automatically decrease the pulse voltage to remain below the system maximum. A decrease in pulse voltage will decrease MI.

✚ Doppler, M-mode, and Color Imaging Controls

When a new imaging mode is selected, both the TI and the MI will change to default settings. Each mode has a corresponding pulse repetition frequency and maximum intensity point. In combined or simultaneous modes, the TI is the sum of the contribution from the modes enabled and MI is the MI for the focal zone and mode with the largest derated intensity. If a mode is turned off and then reselected, the system will return to the previously selected settings.

■ Probe

Each probe model available has unique specifications for contact area, beam shape, and center frequency. Defaults are initialized when you select a probe. Samsung Medison factory defaults vary with probe, application, and selected mode. Defaults have been chosen below the FDA limits for intended use.

■ Depth

An increase in 2D-mode depth will automatically decrease the 2D-mode frame rate. This would decrease the TI. The system may also automatically choose a deeper 2D-mode focal depth. A change of focal depth may change the MI. The MI displayed is that of the zone with the largest peak intensity.

■ Application

Acoustic output defaults are set when you select an application. Samsung Medison factory defaults vary with probe, application, and mode. Defaults have been chosen below the FDA limits for intended use.

✚ Related Guidance Documents

For more information about ultrasonic bioeffects and related topics refer to the following;

AIUM Report, January 28, 1993, "Bioeffects and Safety of Diagnostic Ultrasound"

Bioeffects Considerations for the Safety of Diagnostic Ultrasound, J Ultrasound Med., Sept. 1998: Vol. 7, No. 9 Supplement

Acoustic Output Measurement Standard for Diagnostic Ultrasound Equipment. (AIUM, NEMA. 1998)

Acoustic Output Labeling Standard for Diagnostic Ultrasound Equipment (AIUM, 1998)

Second Edition of the AIUM Output Display Standard Brochure, Dated March 10, 1994. (A copy of this document is shipped with each system.)

Information for Manufacturer Seeking Marketing Clearance of Diagnostic Ultrasound Systems and Transducers. FDA. September 1997. FDA.

Standard for Real-Time Display of Thermal and Mechanical Acoustic Output Indices on Diagnostic

Ultrasound Equipment. (Revision 1, AIUM, NEMA. 1998)

WFUMB. Symposium on Safety of Ultrasound in Medicine: Conclusions and Recommendations on Thermal and Non-Thermal Mechanisms for Biological Effects of Ultrasound, *Ultrasound in Medicine and Biology*, 1998: Vol. 24, Supplement 1.

Acoustic Output and Measurement

Since the first usage of diagnostic ultrasound, the possible human biological effects (bioeffects) of ultrasound exposure have been studied by various scientific and medical institutions. In October 1987, the American Institute of Ultrasound in Medicine (AIUM) ratified a report prepared by its Bioeffects Committee (Bioeffects Considerations for the Safety of Diagnostic Ultrasound, *J Ultrasound Med.*, Sept. 1988: Vol.7, No.9 Supplement), sometimes referred to as the Stowe Report, which reviewed available data on possible effects of ultrasound exposure. Another report "Bioeffects and Safety of Diagnostic Ultrasound," dated January 28, 1993 provides more up to date information.

The acoustic output for this system has been measured and calculated in accordance with the December 1985 "510(K) Guide for Measuring and Reporting Acoustic Output of Diagnostic Ultrasound Medical Devices," except that the hydrophone meets the requirements of "Acoustic Output Measurement Standard for Diagnostic Ultrasound Equipment" (NEMA UD 2-1992)

In Situ, Derated, and Water Value Intensities

All intensity parameters are measured in water. Since water does not absorb acoustic energy, these water measurements represent a worst case value. Biological tissue does absorb acoustic energy. The true value of the intensity at any point depends on the amount and type of tissue and the frequency of the ultrasound that passes through the tissue. The intensity value in the tissue, In Situ, has been estimated using the following formula:

$$\text{In Situ} = \text{Water} [e^{-(0.23 af)}]$$

where: In Situ = In Situ Intensity Value

Water = Water Value Intensity

$$e = 2.7183$$

a = Attenuation Factor

Tissue a(dB/cm-MHz)

Brain .53

Heart .66

Kidney .79

Liver .43

Muscle .55

l = skin line to measurement depth (cm)

f = Center frequency of the transducer/system/mode combination(MHz)

Since the ultrasonic path during an examination is likely to pass through varying lengths and types of tissue, it is difficult to estimate the true In Situ intensity. An attenuation factor of 0.3 is used for general reporting purpose; therefore, the In Situ value which is commonly reported uses the formula:

$$\text{In Situ (derated)} = \text{Water} [e^{-0.069lf}]$$

Since this value is not the true In Situ intensity, the term “derated” is used.

The maximum derated and the maximum water values do not always occur at the same operating condition; therefore, the reported maximum water and derated values may not be related to the In Situ (derated) formula. Take for example a multi-zone array transducer that has maximum water value intensities in its deepest zone: the same transducer may have its largest derated intensity in one of its shallowest focal zones.

Acoustic Output and Measurement

The terms and symbols used in the acoustic output tables are defined in the following paragraphs.

ISPTA.3 The derated spatial-peak temporal-average intensity (milliwatts per square centimeter).

ISPPA.3 The derated spatial-peak pulse-average intensity (watts per square centimeter). The value of IPA.3 at the position of global maximum MI (IPA.3@MI) may be reported instead of ISPPA.3 if the global maximum MI is reported.

MI The Mechanical Index. The value of MI at the position of ISPPA.3, (MI@ISPPA.3) may be reported instead of MI (global maximum value) if ISPPA.3 is 190W/cm²

Pr.3 The derated peak rarefactional pressure (megapascals) associated with the transmit pattern giving rise to the reported MI value.

WO The ultrasonic power (milliwatts). For the operating condition giving rise to ISPTA.3, WO is the total time-average power;. For operating conditions subject to reporting under ISPPA.3, WO is the ultrasonic power associated with the transmit pattern giving rise to the value reported under ISPPA.3

Fc The center frequency (MHz). For MI and ISPPA.3, Fc is the center frequency associated with the transmit pattern giving rise to the global maximum value of the respective parameter. For ISPTA.3, for combined modes involving beam types of unequal center frequency, Fc is defined as the overall range of center frequencies of the respective transmit patterns.

- ZSP** The axial distance at which the reported parameter is measured (centimeters).
- x-6,y-6** are respectively the in-plane (azimuth) and out-of-plane (elevation) -6 dimensions in the x-y plane where ZSP is found (centimeters).
- PD** The pulse duration (microseconds) associated with the transmit pattern giving rise to the reported value of the respective parameter.
- PRF** The pulse repetition frequency (Hz) associated with the transmit pattern giving rise to the reported value of the respective parameter.
- EBD** The entrance beam dimensions for the azimuth and elevation planes (centimeters).
- EDS** The entrance dimensions of the scan for the azimuth and elevation planes (centimeters).

■ Acoustic Measurement Precision and Uncertainty

The Acoustic Measurement Precision and Acoustic Measurement Uncertainty are described below.

Quantity	Precision	Total Uncertainty
PII.3 (derated pulse intensity integral)	3.2 %	+21 % to - 24 %
Wo (acoustic power)	6.2 %	+/- 19 %
Pr.3 (derated rarefaction pressure)	5.4 %	+/- 15 %
Fc (center frequency)	< 1 %	+/- 4.5 %

■ Systematic Uncertainties.

For the pulse intensity integral, derated rarefaction pressure Pr.3, center frequency and pulse duration, the analysis includes considerations of the effects on accuracy of:

Hydrophone calibration drift or errors.

Hydrophone / Amp frequency response.

Spatial averaging.

Alignment errors.

Voltage measurement accuracy, including.

- ▶ Oscilloscope vertical accuracy.
- ▶ Oscilloscope offset accuracy.
- ▶ Oscilloscope clock accuracy.
- ▶ Oscilloscope Digitization rates.
- ▶ Noise.

The systematic uncertainties Acoustic power measurements using a Radiation Force are measured through the use of calibrated NIST acoustic power sources.

We also refer to a September 1993 analysis done by a working group of the IEC technical committee 87 and prepared by K. Beissner, as a first supplement to IEC publication 1161.

The document includes analysis and discussion of the sources of error / measurement effects due to:

- ▶ Balance system calibration.
- ▶ Absorbing (or reflecting) target suspension mechanisms.
- ▶ Linearity of the balance system.
- ▶ Extrapolation to the moment of switching the ultrasonic transducer (compensation for ringing and thermal drift).
- ▶ Target imperfections.
- ▶ Absorbing (reflecting) target geometry and finite target size.
- ▶ Target misalignment.
- ▶ Ultrasonic transducer misalignment.
- ▶ Water temperature.
- ▶ Ultrasonic attenuation and acoustic streaming.
- ▶ Coupling or shielding foil properties.
- ▶ Plane-wave assumption.
- ▶ Environmental influences.
- ▶ Excitation voltage measurement.
- ▶ Ultrasonic transducer temperature.
- ▶ Effects due to nonlinear propagation and saturation loss.

The overall findings of the analysis give a rough Acoustic Power accuracy figure of +/- 10% for the frequency range of 1 - 10 MHz.

Training

The operator of this equipment must become thoroughly familiar with the correct use of the equipment in order to optimize its performance and recognize possible malfunctions. It is recommended that all users receive proper training before operation. Applications training is available through the Samsung Medison Customer Service Department, or from one of their worldwide customer service representatives.

⚠ Environmental Protection



CAUTION:

- ▶ The console and peripherals could be sent back to manufacturers for recycling or proper disposal after their useful lives.
- ▶ Disposal of waste shall be disposed in accordance with national laws.
- ▶ The lithium ion battery used in the product must be replaced by a Samsung Medison service engineer or an authorized dealer.



Correct Disposal of This Product (Waste Electrical & Electronic Equipment)

Applicable in countries with separate collection systems

This marking on the product, accessories or literature indicates that the product and its electronic accessories (e.g. charger, headset, USB cable) should not be disposed of with other household waste at the end of their working life. To prevent possible harm to the environment or human health from uncontrolled waste disposal, please separate these items from other types of waste and recycle them responsibly to promote the sustainable reuse of material resources.

Household users should contact either the retailer where they purchased this product, or their local government office, for details of where and how they can take these items for environmentally safe recycling.

Business users should contact their supplier and check the terms and conditions of the purchase contract. This product and its electronic accessories should not be mixed with other commercial wastes for disposal.

State of California Proposition 65 Warning (US only)



WARNING: This product contains chemicals known to the State of California to cause cancer and reproductive toxicity.

Introduction

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⚙️ Specifications

Physical Dimensions	Height: 375mm (with handle) Width: 402mm (with probe holder) Depth: 188mm (with control panel) Weight: More than 8.7kg
Imaging modes	2D real-time Dual 2D real-time 2D/M-mode Power Doppler Color Doppler for Option Pulsed-wave Doppler for Option 3D-mode (Freehand) for Option Simultaneous
Gray Scale	256 (8 bits)
Focusing	Dynamic transmit focusing, maximum of eight points (four points simultaneously selectable) Digital dynamic receive focusing (continuous)
Probes (Type BF / IPX7)	Curved Linear Array C2-4/20, C2-5, C2-8, CN2-8, CN4-9 Linear Array L5-12/60, LE5-12, LN5-12, LN5-12/40 Endocavity Curved Linear Array EC4-9, EVN4-9
Probe connections	One probe connectors Two probe connectors for option
Monitor	15 inch LCD Monitor (LED backlight unit) called "LCD monitor" henceforth
Rear Panel Input Connections	USB 3ports LAN (10/100 BASE-T) DVI Output BW Printer remote control BW Output S-VHS Output Sound Output
Image Storage	Maximum 512 frames for CINE memory Maximum 4096 Lines for LOOP memory Image filing system

Application	Gynecology, Abdomen, OB, Renal, Urology, Vascular, Small Part, Fetal Heart, Breast, Musculoskeletal, Pediatric, Neonatal, Cardiac
Electrical Parameters	100~120V/200~240V, 250VA, 50/60Hz
Automatic Calculation and Quantification	Obstetrics Gynecology Cardiology Fetal Echo Vascular Urology * Refer the Chapter 5 for additional information
Signal processing (Pre-processing)	TGC control Mode-independent gain control Acoustic power control (adjustable) Dynamic aperture Dynamic apodization Dynamic range control (adjustable) Image view area control M-mode sweep speed control HD zoom
Signal processing (Post-processing)	Frame average Gamma-scale windowing Image orientation (left/right and up/down) White on black/black on white
Measurement	Trackball operation of multiple cursors 2D: Linear measurements and area measurements using elliptical approximation or trace M-mode: Continuous readout of distance, time, and slope rate Doppler: Velocity and trace
Auxiliary	Black-and white printer Color printer VCR Monitor Foot switch (IPX1)
User Interface	English, German, French, Italian, Spanish, Russian, Simplified Chinese
Pressure Limits	Operating: 700hPa to 1060hPa Storage: 700hPa to 1060hPa
Humidity Limits	Operating: 30% to 75% Storage & Shipping: 20% to 90%
Temperature Limits	Operating: 10°C ~ 35°C Storage & Shipping: -25°C ~ 60°C

Product Configuration

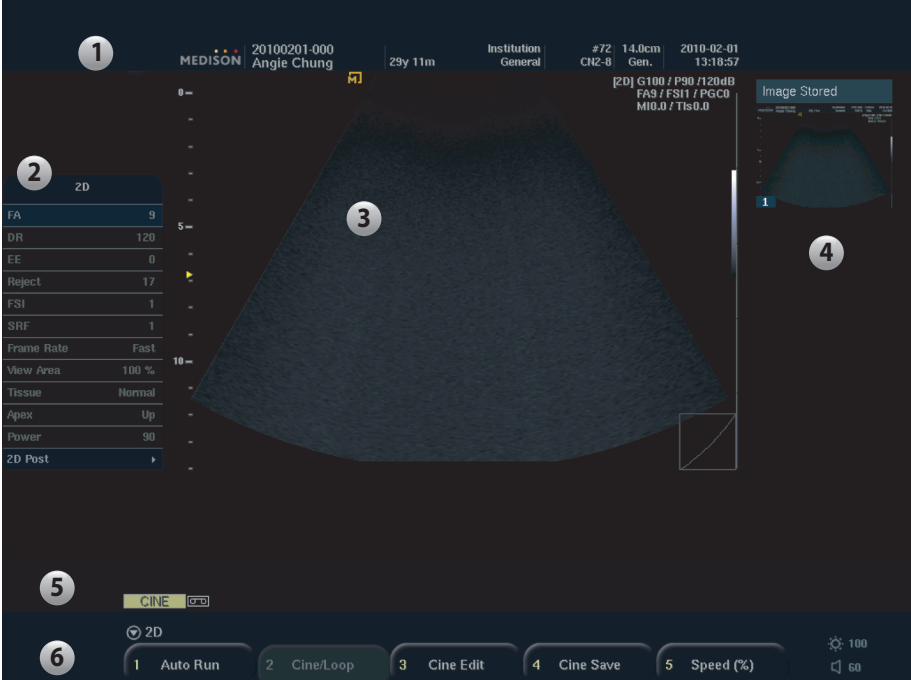
The SONOACE R3 consists of the monitor, the control panel, the console, the peripheral devices, and the probes.

Monitor

The monitor of this system is a color VGA monitor, which displays ultrasound images and additional information. This monitor is connected to the main body through a central pivot, allowing it to be tilted to the optimal viewing angle.

Monitor Display

The monitor displays ultrasound images, operation menus and a variety of other information. The screen is divided into six sections: ①Title, ②Menu, ③Image, ④Thumbnail, ⑤User Information, and ⑥ Softmenu sections.



[Figure 2.1 Monitor Display]

■ Title Area

This section displays the Logo, Patient Name, Hospital Name, Application, Frame Rate & Depth, Probe Information, Acoustic Output Information and Date & Time.

■ Menu Area

The menu is divided into 3 kinds: Image adjustment menu, Measurement menu, and Utility menu. Use **Menu** dial-button to select an item from the menu.

■ Image Area

The ultrasound image, image information, annotation, and measurement information are displayed in the image area.

■ Thumbnails Area

Saved images, by pressing the **Save** button on the control panel, are displayed in the thumbnails area. Thumbnails are showed when you check 'on' in **Setup > System > Misc**. This area shows up to four images.



NOTE: Refer to 'Chapter 7. Utilities' for detail.

■ User Information Area

A variety of information necessary for system use e.g. current system status and BodyMarkers.

■ Softmenu

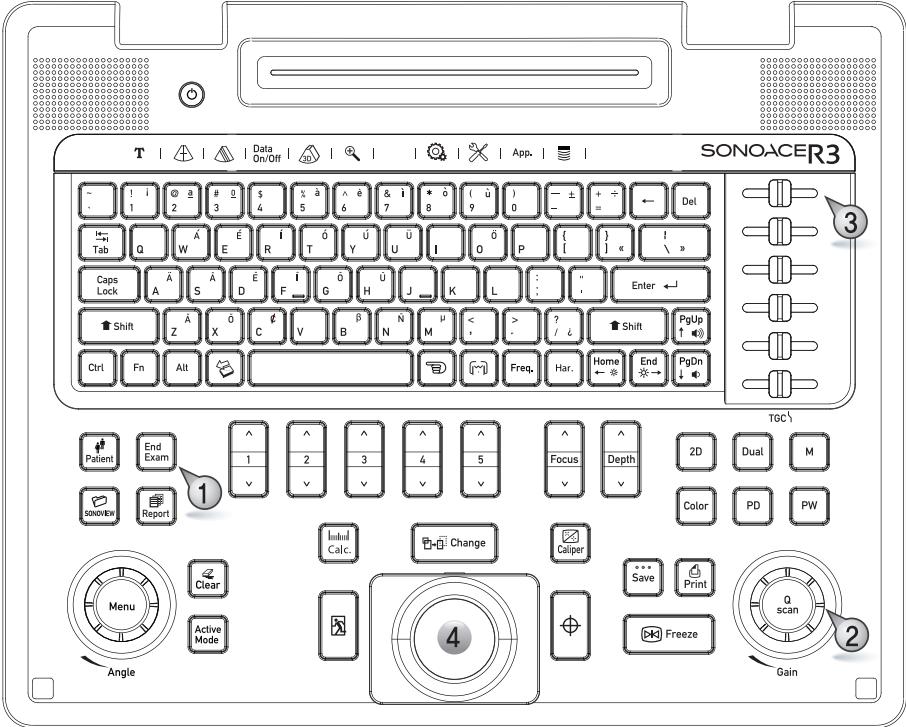
Available menu items may vary depending on the current system state. To set or change a Soft Menu item, use the corresponding dial-button on the control panel.

▣ Adjusting Brightness

Use the left/right arrow keys on the keyboard. However, brightness cannot be adjusted in Text Mode.

Control Panel

The control panel can be used for controlling the system.














[Figure 2.2 [Figure 2.2 Control Panel]

The user can manipulate the control panel using ① Button, ② Dial-Button, ③ Slide, ④ Trackball. The dial-button can be used both as a dial and a button.

Control Panel Map

The following are descriptions and instructions for the controls on the control panel. For more information on the buttons with multiple functions, see 'Chapter 3' and later of this manual.

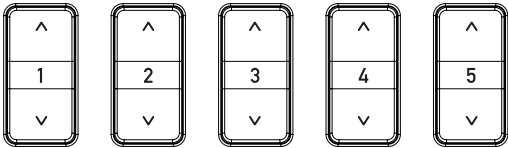
On/Off	Turns the system on/off.
 Patient	Displays the Patient Information screen for patient selection and information entry.
End Exam	Finishes the exam of the currently selected patient and resets the related data.
 SONOVUE	Runs SONOVUE which is the image filing program.
 Report	Displays the Report screen that shows the measurement results of the current application and other information.
2D / Single	Allows you to select the 2D or Single function - 2D: Use this button to enable 2D Mode. Pressing this button in 2D mode does not disable the mode. Pressing it in Combined Mode switches to 2D Mode. - Single: In Dual Mode, press this button to switch to 2D Mode.
M	Use this button to enable/disable M Mode.
Color	Use this button to enable/disable Color Doppler Mode.
PD	Use this button to enable/disable Power Doppler Mode.
PW (Option)	Use this button to enable/disable PW Spectral Doppler Mode.
Dual	Use this button to enable Dual Mode.
Focus	Use this switch to adjust the focus position. The focus position changes on the ruler as you adjust its position
Depth	Use this switch to adjust the scanning depth for the selected image. The depth information changes in the Title area as you adjust the depth.
 Calc	Starts measurements by application. The measurement menu is displayed on the left side of the screen.
 Caliper	Starts to measure distance, circumference, area, and volume. The current measurement item is displayed on the left side of the screen.
Trackball	Use the trackball to move the cursor on the screen. It can also be used to search through Cine or Loop images when Freeze is enabled.
 Change	Use this button to change the function of the trackball.

 Set	Use this option to select an item or value. In Spectral Doppler Mode and 3D mode, it is also used as update function.
 Exit	Exits the currently used function and returns to the previous status.
Menu / Angle	Carries out the Menu or Angle function. Menu: Press dial button to activate the available menu item of current scan mode. Angle: Rotate the dial-button to adjust the angle. Adjust the angle of sample volume in PW Spectral Doppler Mode. It is also used to adjust the Indicator angle or the Probe angle of BodyMarker.
 Clear	Deletes text, Indicator, BodyMarker, and measurement result, etc. displayed on an image.
Active Mode	Changes the menu or soft menu on the screen.
Save	Use this button to save the selected image or report in a database.
 Print	Use this button to print the image on the screen via a printer.
 Freeze	Use this button to freeze the image that is being scanned. Press it again to return to scan mode.
Q Scan / Gain	Carries out the Q Scan or Gain function. - Q Scan: Press this dial-button to enable Quick Scan. If Quick Scan is enabled, 'Q' mark is shown in the right hand side of the screen. - Gain: Rotate this dial-button to adjust Gain in each mode.
TGC	Adjusts TGC values for each depth using 6 slides. TGC stands for Time Gain Control.



CAUTION: Too large a difference in the gain value settings of adjacent TGC slides may lead to the generation of stripes in an image.

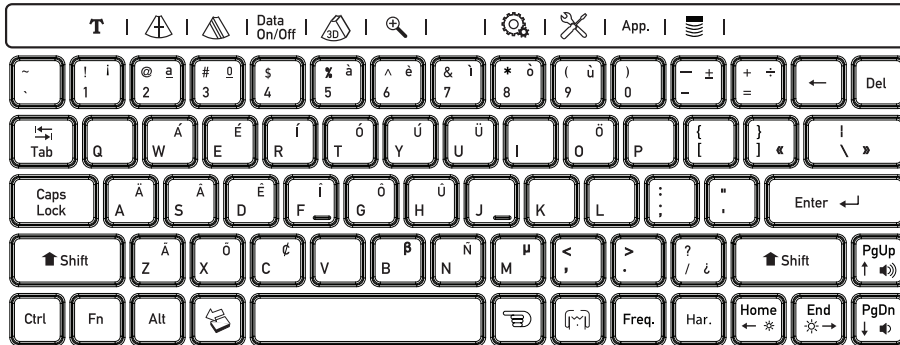
Soft menu buttons (1~5)	Use the Soft Menu that appears on the screen. Available menu items may vary depending on the current system state.
--------------------------------	--



[Figure 2.3 [Figure 2.3 Soft menu button]]

Keyboards







This product comes with an alphanumeric keyboard, which can be used to enter text and run a variety of functions by using function keys










[Figure 2.4 keyboards]

Note for Using Russian

If you set the language in Russian, you cannot use function keys under Caps Lock is on.

 Text	This is used to start Text mode.
 M Cursor	This is used to display M line or hide.
 Biopsy	This is used to start the biopsy.
Data on / off	This button is used to display information of image on the upper right side of screen or hide.
 3D	This is used to start or finish the 3D Mode.
 Zoom	This is used to start or finish the Zoom Mode. The Zoom Navigation Box is displayed on the user information area.
 Setup	This button is used to appear the Setup screen for setting system parameters.

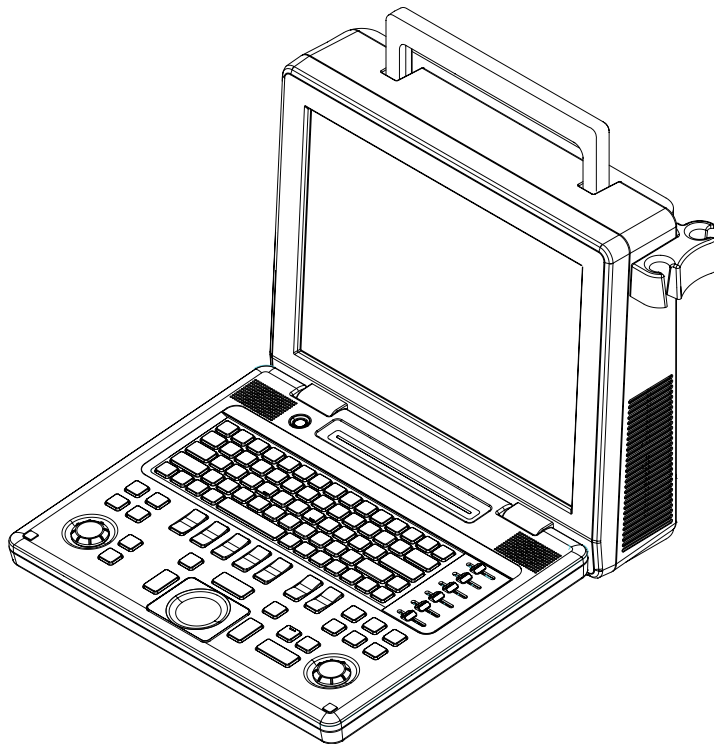
 Utility	This button is used to appear the utility menu.
App.	This is used to appear Application screen to select/change probes and applications.
 Probe	This is used to change another probe. This button is available when you use the two probe connector (optional).
 Storage Manager	This button is used to appear the Storage Manager window.
 Indicator	This is used to start or finish the indicator Mode.
 BodyMarker	This is used to start or finish the BodyMarker Mode.
Freq.	Press the button to change frequency for the probe. Select Res, Pen or Gen. The selected frequency will be displayed in the title area.
Har.	This is used to turn Harmonic Imaging on. Press this button again to turn the mode off. This button is only activated with the specific probe.
	Allows you to adjust the monitor brightness.
	Allows you to adjust volume in Spectral Doppler Mode.

■ **Measurement function keys**

You can start the specific OB measurement with Q, W, E, R, T, Y, or U key on the keyboards. Refer to ‘Setting System’ in ‘Chapter 7. Utilities’ for detailed information.

Console

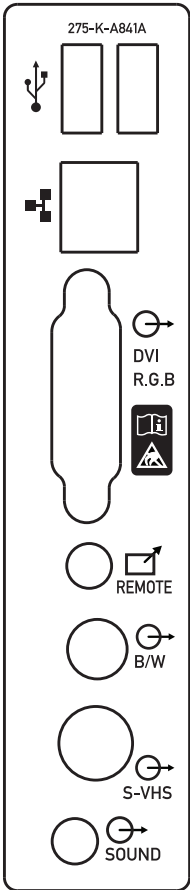
Whilst the inside of the console consists of devices enabling the implementation of ultrasound images, the outside of the console consists of various connection ports and handles.



[Figure 2.5 Console]

Rear Panel

A monitor, printer, VCR, etc. are connected via the rear panel at the back of the system.

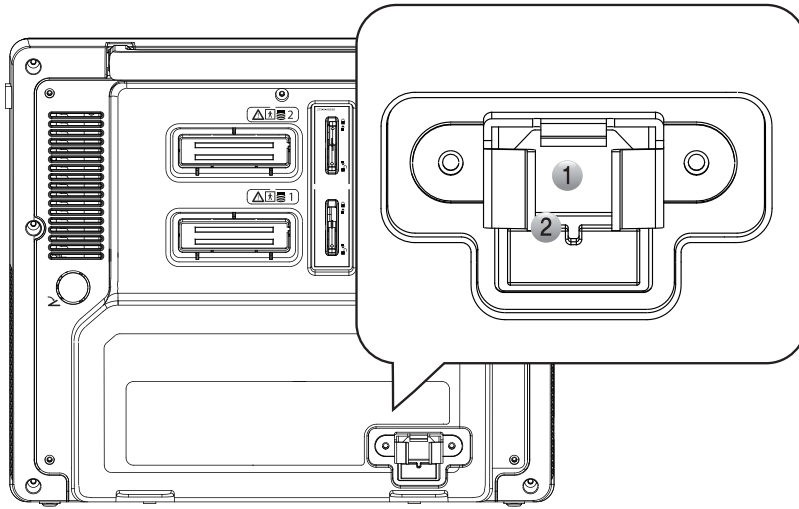


- USB Port: Connect the USB peripherals.
- Network Port: Connect the Network. Patient information is transferred to another server via the DICOM network.
- DVI port (Output): Outputs digital signals to the monitor.
- Print Remote port (Output): Connect an echo printer to this port for remote printing.
- S-VHS port (Output): Connects the VCR in S-VHS mode.
- Sound (Output): Used to input and output audio signals.

[Figure 2.6 Rear Panel]

Power Connection Part

The power connection part is located at the back of the system.



[Figure 2.7 Power Connection Part]

- ① Power Inlet: Connects the power cable to an external power source.
- ② Fuse Holder: Holds the inlet fuse.



NOTE: Cover the power inlet area with a plug bracket and secure it with screws.

Probe Holder

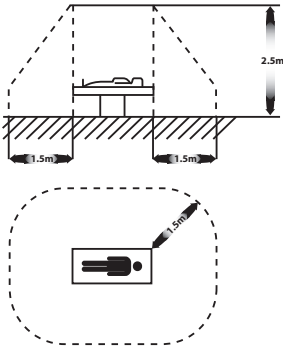
A probe holder is mounted at the right side of the control panel.

Peripheral Devices

Based on needs, various peripheral devices can be connected via the corresponding ports located on the rear panel.



CAUTION: Do not place peripheral devices, not listed in this manual, inside the patient environment. If you place them in the patient environment, it may cause electrical hazard.



[Figure 2.8 The patient environment]



CAUTION:

- ▶ When using a peripheral device from a USB port, always turn the power off before connecting/ disconnecting the device. Connection/disconnection of USB devices during power-on may lead to malfunction of the system and USB devices.
- ▶ Do not connect additional Peripheral Devices to the auxiliary socket outlets. When connecting, the level of safety may be reduced.



NOTE: Refer to the operation manual of peripheral device about its operating.

The following products are recommended:

■ **DVD**

DVD-RW, DVD-RAM, DVD-R, DVD+R, DVD-ROM, CD-R, CD-RW, CD-ROM

■ **Video Page printer**

- ▶ Black and White: SONY UP-D897, SONY UP-897MD, Mitsubishi P-91, Mitsubishi P-93W
- ▶ Color : SONY UP-D23MD, SONY UP-20, SONY UP-23MD, Sony UP-D25MD

■ Inkjet Printer



NOTE: Contact Samsung Medison Local sales or service representative about available printers.



CAUTION: Contact Samsung Medison Customer Service Center for inquiries about printer driver installation.

■ USB Magnetic Optical (MO) Disk Drive

1 Fujitsu DynaMO 1300U2B or later version



CAUTION: The USB MO Drive should not be used with other USB storage devices simultaneously.

■ USB to RS-232C Serial Cable

USB to Serial (RS-232C) Converter with FTDI Chipset (FTDI FT232BM Compatible)



NOTE: For more information about the Open Line Transfer, refer to 'Chapter 5. Measurements and Calculations.'

■ Foot Switch

Set the function of the foot switch in **Setup > Peripherals > Foot Switch**; Dual, Freeze, Update, or Store.

■ Others

Flash Memory media



NOTE:

- ▶ If you use the USB 1.1 flash memory, the system cannot recognize it. In the case of this, delete the flash memory from the console and quip again.
- ▶ When remove the removable disk, use Storage manager.
- ▶ USB ports are located both on the front panel and the rear panel of the console.
We recommend that you connect USB storage devices (MO drive, flash memory media, etc.) to the ports on the front panel and other USB peripheral devices to the rear panel for added convenience.

Probe

Probes are devices that generate ultrasound waves and process reflected wave data for the purpose of image formation.



NOTE: For more information, refer to 'Chapter 9 Probes.'

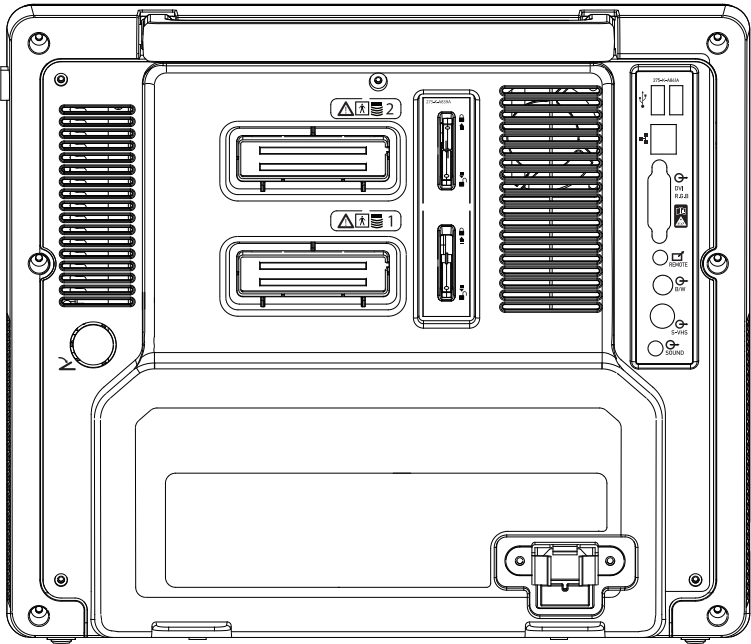
Connecting probes

For the safety of the console and probe, be sure to power off the console before connecting or disconnecting a probe to/from the probe port on the console.

1. Disconnect the probe by depressing the probe lock switch.
2. Connect the probe to the probe port on the back side of the console.
3. Mount the probe by lifting the probe lock switch.

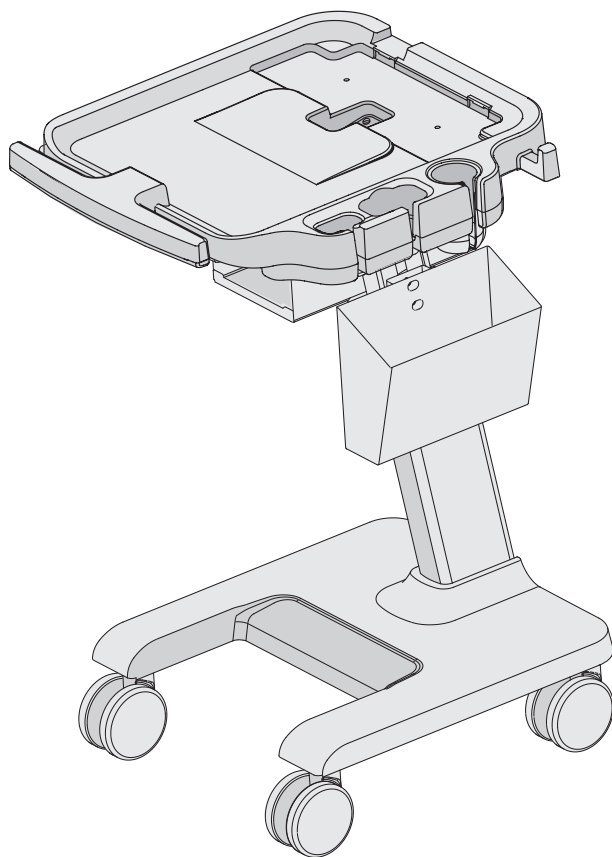


NOTE: If the probe does not connect properly, try reconnecting it after removing any foreign objects.



[Figure 2.9 Probe Connector]

SONOACE R3 Cart (Optional)

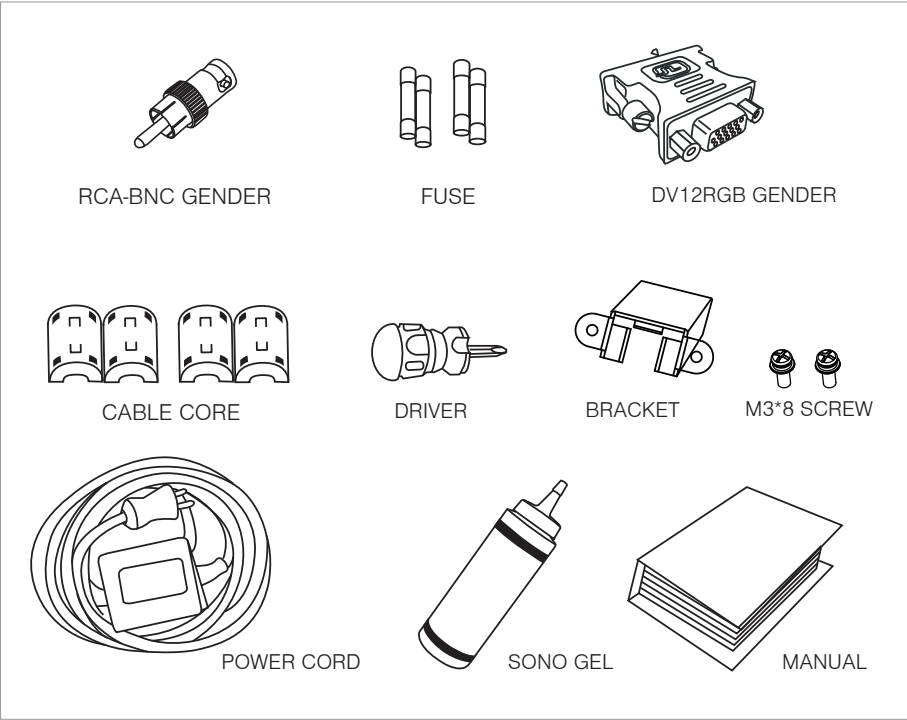


[Figure 2.10 SONOACE R3 Cart]

The SONOACE R3 System can be placed on a cart during use or for transport. For more information on installing and using the SONOACE R3, please refer to the installation guide that comes with it.

Accessory

This system provides a box including accessories.



[Figure 2.11 Accessory]



CAUTION: Main cord set, separately certified according to the relevant standards, is to be used when supplied to EU and USA/CAN.



NOTE: Accessories can be different according to the country.

Options

The SONOACE R3 has the following optional functions:

- ▶ Image filing-SONOVIEW
- ▶ DICOM
- ▶ Freehand 3D
- ▶ Pulse wave Doppler
- ▶ Color Doppler
- ▶ Cardiac S/W Package

For further information about optional functions, please refer to the relevant chapters in this manual.

Starting Diagnosis

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- ▣ **Patient Information 3-9**
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:: Power Supply

Boot the system for use.



CAUTION: Make sure to connect the probe and peripheral devices that will be used before powering on the system. If you attempt to connect them during system use, it may lead to patient injury or fatal damage to the console.

Powering On

Press the **On/Off** button when the power is off. Booting begins, and the product logo appears on the screen. When booting is completed, the 2D mode screen appears in End Exam status.



CAUTION: Before starting the diagnosis, you must register the patient information.

Powering Off

Press the **On/Off** button while using the system, then disconnect AC adapter mains plug from the power outlet.



CAUTION: If you hold down the **On/Off** button for five seconds or longer, the product power is turned off forcibly. This may cause hard disk damage.



NOTE:

- ▶ During system booting, do not press any key on the keyboard. It may cause product malfunction.
- ▶ The product should be turned on about five seconds after the power switch at the back of the product is turned on.
- ▶ Disconnect the power cord from the wall outlet to ensure the system is disconnected from the power source.

:: Probes & Applications

Before scanning, select a probe and an application.

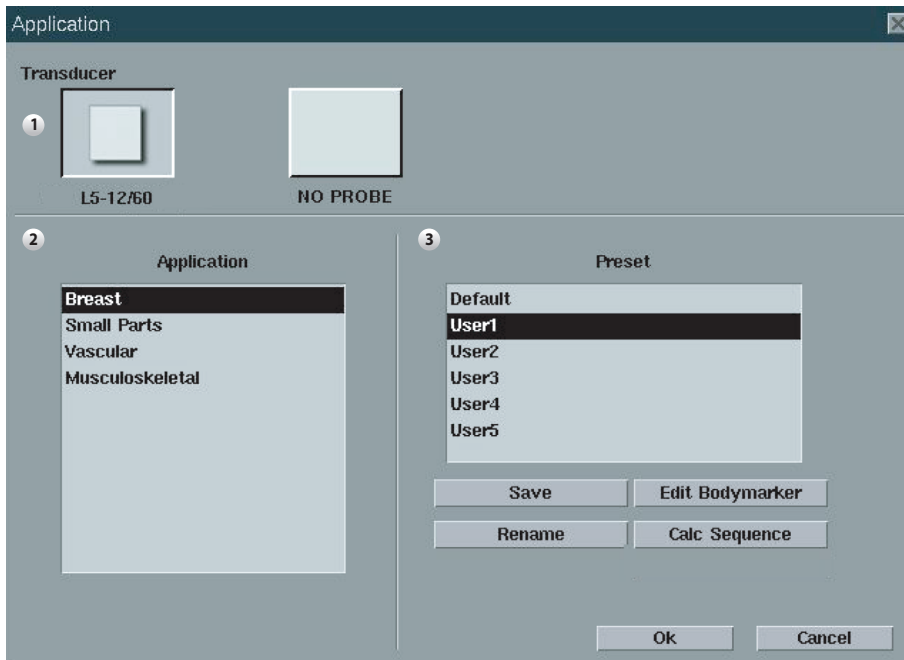


CAUTION: Please refer to 'Chapter 9. Probes' for more information about the probes supported by this system.

■ The Applications Screen

Press the **App.** key on the keyboard. The Applications screen will be displayed allowing you to select an application or change the probe preset as needed.

The Applications screen provides the following options:



[Figure 3.1 Application]

- ① The current probe attached to the system.
- ② The list of available applications.
- ③ The list of available presets and usersets.

Probe and Application Selection

Set a probe and an application in the *Applications* screen.

1. Select a probe and an application using the trackball and **Set** button.
2. After selecting them, click **Ok**. To cancel the selection, click **Cancel**.



Selecting a probe with the Probe button

To switch to another probe without using *Application* screen, press **Probe** button on the control panel. However, this button is available when you use the two probe connector (optional).

Probe Setting Change

Select a probe setting in the *Applications* screen.

While the probe settings are preset with the optimal values for each application, the user may change the preset values using the following method.

1. After checking the currently selected probe/application, change the probe setting using the trackball and **Set** button.
 - ▶ A userset such as **User1** and **User2** can be selected for each setting. Click **Save** to save the changed values. Change the names of the user-definable settings other than 'Default' values using the **Rename**.
2. Click **Ok** in the *Application Window*. To cancel the selection, click **Cancel**.



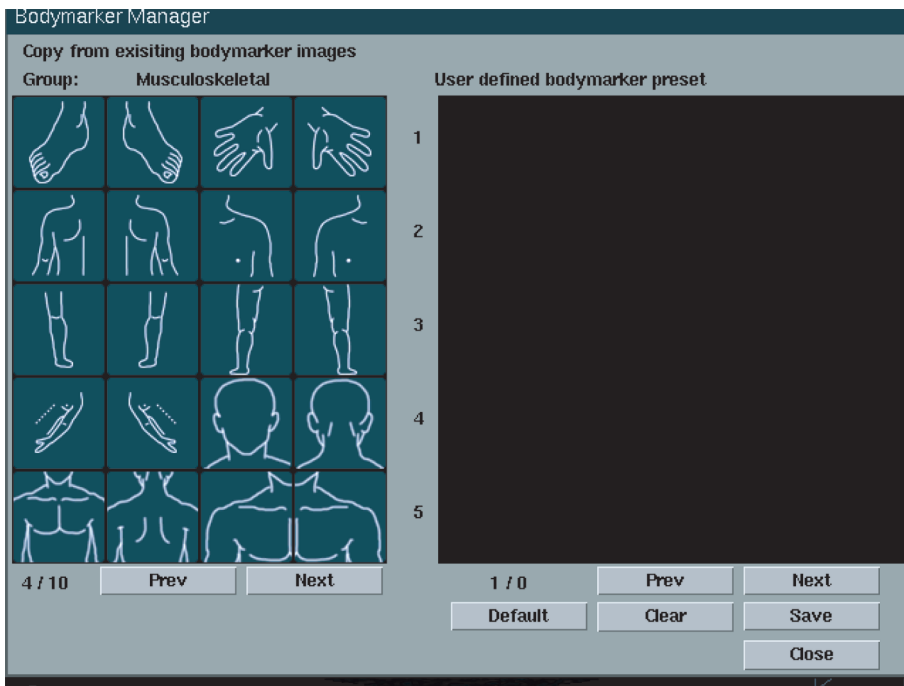
NOTE: For information on changing a userset for a probe, please refer to Chapter 7 'Utilities.'

Editing BodyMarker

Select some BodyMarkers to use in the system or change the order of BodyMarkers. Click **Edit BodyMarker** in the *Application* screen to bring up the *BodyMarker Manager* window.

'Group' shows system supporting BodyMarkers with the application. Use Prev or Next to display BodyMarkers of other applications.

'User defined BodyMarker preset' shows selected BodyMarkers.



[Figure 3.2 BodyMarker Manager]

✚ Add BodyMarkers

Select a BodyMarker on 'Group' using the trackball. Press **Set** button to add to the 'User defined BodyMarker preset'.

✚ Delete BodyMarkers

Select a BodyMarker on 'User defined BodyMarker preset' using the trackball. Press **Set** button to delete.

❏ **Back to default BodyMarker**

Press the **Default** on 'User defined BodyMarker preset' to back to default BodyMarker.

❏ **Delete all BodyMarkers**

Press the **Clear** on 'User defined BodyMarker preset' to delete all BodyMarkers. It deletes BodyMarkers only in 'User defined BodyMarker preset'.

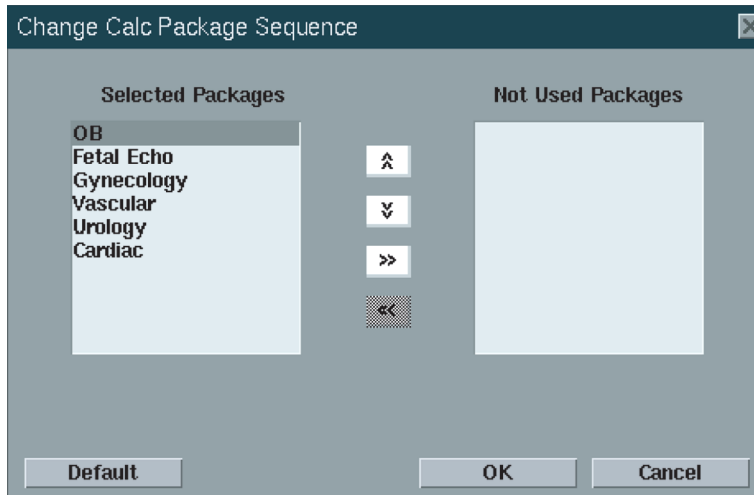
❏ **Save BodyMarkers**

Press the **Save** on 'User defined BodyMarker preset' to save current setting. When you press the BodyMarker key on the keyboard during using the system, this setting will be displayed.



NOTE: Refer to 'Chapter 6. Image managements' for more information about displaying BodyMarker.

Calc Sequence



[Figure 3.3 Calc Package Sequence Change]

To change the order and content of the Calculation Package of each application, click the **Calc Sequence**. If you want to return to the initial settings, click **Default** in the window.

⚡ Patient Information

Press the **Patient** key on the control panel and then the *Patient Information* screen will be displayed.

This screen allows you to enter, search or change patient information. Patient information includes basic information, such as patient ID, name, DOB and gender, and additional information for applications.



NOTE: ID and Name are required fields.

The screenshot shows the 'Patient Information' window with the following fields and controls:

- Buttons:** New, Search, Worklist, OK, Cancel.
- ID:** 20111107-000 (checked)
- Name:** (empty)
- Accession #:** (empty)
- Auto ID Creation:** (checked)
- Birth Date (Y-M-D):** (/ /)
- Age:** (y m)
- Gender:** Other (checked), Female, Male
- LMP:** (/ /)
- GA:** (w d)
- EDD:** (/ /)
- Gestations:** ()
- Gravida:** ()
- Para:** ()
- Aborta:** ()
- Exp.Ovul.:** (/ /)
- Day of cycles:** ()
- Height:** (cm)
- Weight:** (kg)
- PSA:** ()
- BSA:** ()
- HR:** ()
- Diag. Physician:** (dropdown)
- Ref. Physician:** (dropdown)
- Sonographer:** (dropdown)
- Indication:** ()
- Description:** ()


[Figure 3.4 the Patient Information]

Registering a New Patient

1. After clicking the **New** in the *Patient Information* screen, enter the patient name, ID and other information using the trackball, **Set** button and keyboard.
2. After entering patient information correctly, click **Ok**. Or click **Cancel** or X to cancel.

■ ID

Enter a patient ID.

- ▶ To enter it manually, enter an ID in the ID field.
- ▶ To enter it automatically, select Auto ID Creation and click New.
- ▶ If you enter an ID that exists already, the icon next to the ID field is changed to .

■ Name

Enter patient's full name. The name that you have entered will appear in the title area and reports.

■ Accession

When viewing the worklist for a patient via the DICOM server, this information is automatically filled.

■ Birth Date

Enter the patient's birth date in the specified format.

■ Age

Enter the patient's age in "yy-mm" format. When a birth date is specified in the Birth field, this information is automatically calculated and displayed.

■ Gender

Select the patient's gender.

■ LMP

Enter the last menstrual period for a patient.

You can enter it manually in the specified format, or have it automatically calculated and displayed with the GA entered.

■ GA

It indicates the gestational age of a patient.

You can enter it manually in the specified format, or have it automatically calculated and displayed with the LMP entered.

■ EDD

With the LMP or GA entered, EDD (Expected Date of Delivery) is calculated and displayed.

**Calculating EDD**

EDD can be calculated by entering LMP or GA.

- ▶ When LMP is entered: GA and EDD are automatically calculated and displayed on the screen.
- ▶ When GA is entered: LMP and EDD are automatically calculated and displayed on the screen.

■ Gestations

Enter the number of fetuses, up to maximum of 4.

■ Gravida

Enter the number of pregnancies.

■ Para

Enter the number of deliveries.

■ Aborta

Enter the number of abortions.

■ Exp. Ovul

Enter an ovulation date in the specified format.

■ Day of Cycle

Enter the number of days in the patient's cycle in the "dd" format.

■ Height

Enter the patient's height in inches or centimeters. Click the **unit** button to toggle the unit. If the unit is changed, the number entered is automatically converted and shown in the new unit.

■ Weight

Enter the patient's weight in oz., lb. or kg. Click the **unit** button to toggle the unit.

■ PSA

Enter the value of prostate specific antigen. It is interlock with PSA value in report.

■ BSA

If height and weight are entered, the body surface area (BSA) is automatically calculated and shown.

■ HR

Enter the patient's heart rate (HR).

■ Diag. Physician

Enter the name of the physician who has diagnosed the patient. When there is more than one name available, the combo button can be used to select one of them.

■ Ref. Physician

Enter the referring physician's name. When there is more than one name available, the combo button can be used to select one of them.

■ Sonographer

Enter the name of the sonographer who has scanned the patient. When there is more than one name available, the combo button can be used to select one of them.

■ Indication

Leave a note on the symptoms or disease.

■ Description

Leave a note on the diagnosis. If Description is entered, it can be searched for in SONOVUEW.

Searching for Patient Information

You can search the patient information with following three methods.

❏ Finding Patient Information using ID

Enter the Patient ID to change his or her information.

❏ Finding Patient Information using the Search Function

1. Click **Search** in the *Patient Information* screen, and the **Search** window shown below appears.

The screenshot shows a 'Search' dialog box. At the top, there is a title bar with the text 'Search' and a close button (X). Below the title bar, there are two input fields: 'ID' and 'Name'. To the right of the 'ID' field are two buttons: 'Show All' and 'Delete'. To the right of the 'Name' field are two buttons: 'Select All' and 'Select'. Below these buttons is a list area with a header row containing 'ID' and 'Name'. The list area is currently empty. At the bottom of the window are two buttons: 'Ok' and 'Cancel'.

[Figure 3.5 Search]

2. Type in patient ID or name, and the list of registered patients appears.

- ▶ If there is no ID or name that satisfies the search key, the Select and Ok are not activated.
- ▶ To display all registered ID, click **Show All**. To select all ID on the list, click **Select All**.
- ▶ To delete the ID and its all information, select the patient and click **Delete**.

3. After selecting ID, press **Select** or **Ok** to display information of the selected patient. To stop the search or close the current search dialog box, click **Cancel** or **X**.



WARNING: If a patient ID is deleted, all data and images stored in SONOVIEW™ are erased.

✚ Finding Patient Information using Worklist

The system connects to the hospital's DICOM Modality Worklist server and obtains information. Searching a patient by Worklist allows you to enter the patient information automatically.



NOTE: Use the DICOM tab in the Settings screen to select the Worklist server. Set the Worklist Server in **Setup > DICOM**. For more information, see 'DICOM Settings' section in 'Chapter 7. Utilities.'

1. Click **Worklist** in the *Patient Information* screen and the *Modality Worklist* window will appear. (If "Open MWL on Patient Key" is selected under the **Setup > DICOM**, pressing the **Patient** button opens the *Modality Worklist* window first.)
2. Select Worklist Server, enter one or more search conditions in "Search Criteria", and then click **Search**. A list of scheduled patients that match the *search conditions* will appear.
3. Select a patient and click **OK**. The *patient information* will appear.
4. Click **X** button on the window to quit searching patients and close the Modality Worklist window. If you wish to enter patient information directly without using Worklist data, click **Manual Entry**.



NOTE: ID, Name, Accession #, Birth, Age, or Gender cannot be changed when entering patient information by using Worklist.

Modality Worklist
✕

Search Criteria

Last Name <input style="width: 90%;" type="text"/>	Patient ID <input style="width: 90%;" type="text"/>
Accession # <input style="width: 90%;" type="text"/>	Procedure ID <input style="width: 90%;" type="text"/>

Last Updated Time: 00/00/ 0, 00:00:00
Items found: 0

Date/Time	Patient Name	ID	Accession #	Proc ID	Description

[Figure 3.6 Modality Worklist]

Modifying Patient Information

To modify information in the *Patient Information* screen:

1. Modify the information using the trackball, **Set** button and keyboard.
2. After modifying patient information correctly, click **Ok**. To cancel editing, click **Cancel** or **X**.



NOTE: For more details on patient backup, see the 'Information Management' section in 'Chapter 6. Image Managements'.

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Information

Diagnosis Mode Types

This product supports a variety of diagnosis modes including Basic Mode, Combined Mode, Multi-Image Mode, and 3D Mode.

- Basic Mode: Consists of different modes, each of which has a specific usage and function. By default, 2D Mode is applied together with other mode.
- Combined Mode: For an image, two or three Basic Modes are applied at the same time. By default, 2D Mode is applied together with other mode. An image is viewed in a single screen.
- Multi-Image Mode: The screen is divided into two (dual) sub screens, each of which is used to view an image. Since each sub screen can display a different image, it can be a very useful feature, allowing multilateral views of an organ.
- 3D Mode: Freehand 3D images can be obtained.

The types of diagnosis mode that are available with the product are shown below:

Mode	Type
Basic Mode	2D Mode Color Doppler Mode Power Doppler Mode M Mode PW Spectral Doppler Mode
Combined Mode	2D/C/PW Mode 2D/PD/PW Mode 2D/C/M Mode
Multi-Image Mode	Dual Mode
3D Mode	Freehand 3D Mode



NOTE: The functionalities for each mode may be restricted by the selected probe.

Basic Use

The items that can be used commonly in each diagnosis mode are shown below:

■ Gain

Use the **Gain** dial-button on the control panel. You can adjust the brightness of an image. If you rotate the **Gain** dial-button clockwise, its value increases.

■ TGC (Time Gain Compensation)

Use the TGC slide on the control panel.

In general, ultrasound penetration gets weaker with depth. TGC can be used to compensate for this effect.

The product provides six TGC slides for varying depths, allowing you to adjust Gain by area. Among the six slides, the top slide represents the shallowest area, while the lower slides represent the deeper ones.

Move the slide to the right (+) to increase Gain, brightening the image.



CAUTION: Too large a difference in the gain value settings of two adjacent slides may lead to inaccurate image generation.

■ Focus

Use the **Focus** button on the control panel. Press the upper button to position the focus shallower or press the lower button to position it deeper.

■ Depth

Use the **Depth** button on the control panel. Press the upper button to make it shallow or press the lower button to make it deeper. Adjustment range varies depending on the probe type selected.

■ Zoom

Press the **Zoom** key on the keyboards to start Read Zoom mode. This function allows you to zoom an image saved in a hard disk.

In HD Zoom mode, it is available to press the **Zoom** key on the keyboards to start the Read Zoom mode. However, in Read Zoom mode, you cannot enter the HD Zoom mode.

1. Press the **Zoom** key on the keyboards.
2. Use the Trackball to move the Zoom box. You can locate the Zoom box in an image with the Zoom Navigation box on the left side of the screen.


Tips!
Zoom Navigation Box

You can view the position of the magnified area through the Zoom Navigation Box on the screen.

Use the **Change** button to move and resize the Zoom box. Each time you press the **Change** button, the current state of the Zoom box is displayed in the screen.

- ▶ RZ Pos.: You can move the Zoom box. Use the trackball to move the Zoom box and press the **Set** button to specify its position.
- ▶ RZ Size: You can resize the Zoom box. Use the trackball to resize the Zoom box and press the **Set** button to specify its size.

3. View the magnified image.
4. To exit zoom mode, press the **Zoom** key again or press the **Exit** button. Changing the depth also exits Zoom Mode automatically.

■ QuickScan

Use the **Q Scan** dial-button on the control panel. The 'Q Scan' mark will appear at the top of an image.

In 2D Mode, it is used to optimize the contrast and brightness of an image by adjusting Gain and TGC automatically. In PW Spectral Doppler Mode, it is used to optimize the spectrum by adjusting Scale and Baseline automatically. Press the **Exit** button to quit the Quick Scan Mode.

■ Frequency

Use the **Freq.** key on the keyboards. Press the button to change the frequency of the current probe. Select from Res, Pen and Gen.

- ▶ Res (Resolution): High frequency
- ▶ Gen (General): General frequency
- ▶ Pen (Penetration): Low frequency

The selected frequency is displayed in the title area, allowing you to determine the state of the current frequency easily.

■ Harmonic

Press the **HAR** key on the keyboards to select On or Off. 'HGen', 'HRes', 'HPen' mark is displayed in the image information area.

This product provides the OHI (Optimal Harmonic Imaging) function that optimizes an image with high frequencies.



NOTE: The Harmonic function is available with specific probes only.

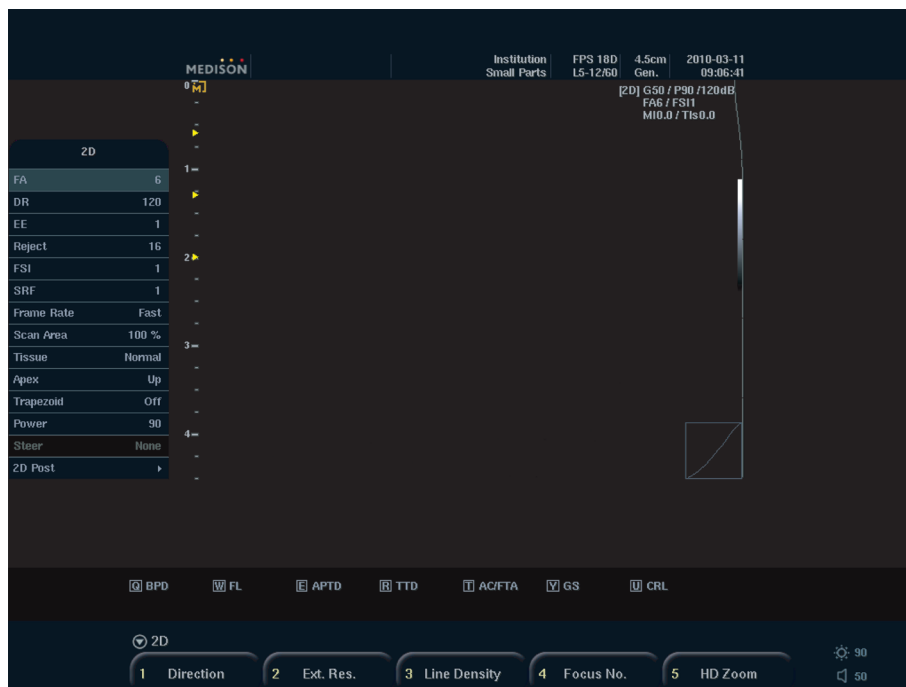
■ M Line

Press the **M Cursor** key on the keyboards. It shows M Line on the image.

Basic Modes

2D Mode

This basic mode, also referred to as B Mode (Brightness mode), provides scan planes of organs. This is used to view two-dimensional anatomical images in the direction of scanning in real time.



[Figure 4.1 2D Mode]

Starting 2D Mode



NOTE: As 2D Mode is included in all diagnosis modes, it cannot be closed.

Press the **2D** button on the control panel. Pressing the **2D** button in other modes will take you to 2D Mode, which is the basic diagnosis mode.

✚ 2D Mode Menu

Following items are displayed on menu when you press the **Menu** dial-button in 2D mode. Select the item and adjust the value with the **Menu** dial-button.

■ FA

FA stands for Frame Average.

When an image is updated, the current and previous images are averaged. Speckles may appear when the same diagnosis area is scanned continuously. This function is used to minimize such speckles. Select a value between 0- 9 with the **Menu** dial-button.

■ DR

DR stands for Dynamic Range.

Adjust contrast by changing the ratio of minimum/maximum input signal values. Select a value between 40 - 180 with the **Menu** dial-button. Increasing the ratio renders softer images.

■ EE

EE stands for Edge Enhance.

This emphasizes the edges of tissues or organs. Select a value between 0 - 9 with the **Menu** dial-button. Increase the Edge Enhance value to obtain clearer pictures of boundaries.

■ Reject

This function is used to eliminate noise or low level echoes for a clearer view of images. Select a value between 1 - 32 with the **Menu** dial-button.

■ FSI

FSI stands for Full Spectrum Imaging.

Select a value between 1 - 3 with the **Menu** dial-button. This function synthesizes images with data obtained with frequencies of different characteristics. Therefore, shallow observation depths yield higher resolution and deep observation depths yield higher penetration.

■ SRF

SRF stands for Speckle Reduction Filter.

This optimizes an image by minimizing any noise and automatically adjusting the brightness of outlines. Select a value between 0 - 9 with the **Menu** dial-button.

■ Frame Rate

This is the rate by which the image displayed is updated per second. Use the **Menu** dial-button to select Fast, Normal or Slow.

■ Scan Area

Set the width of the image. The bar for showing the scan area size will be displayed in the screen and the soft menu will be changed.

- ▶ Adjusting the position: Use the **[1] Pos.** button on the soft menu.
- ▶ Adjusting the size: Use the **[2] Size** button on the soft menu. Widening / narrowing the Scan Area, decreases/increases the frame rate (FPS).
- ▶ Exit: Use the **[5] Return** button on the soft menu.

■ Tissue

Select the desired ultrasound speed according to the patient's tissue type. Use the **Menu** dial-button to select Cystic, Adipose, Normal, or Solid.

■ Apex

Each time you press the **Menu** dial-button, the image is flipped upside down.

■ Trapezoid



NOTE: This item appears in the softmenu only when a Linear Probe is used.

In general, the rectangular frame provided by a Linear Probe is changed to a trapezoidal shape. This allows a wider view of an image. Press the **Menu** dial-button to select On/Off. When adjusting image depth, some depth values do not support the Trapezoid function.

■ Power

Power is the intensity of the acoustic output. Select a value between 10 - 100 with the **Menu** dial-button.

■ 2D Post

Brings up the sub-menu.



2D Post	
2D Map	Type1
2D Chroma	Off
Color	0
Edit	
Gamma	Off
Return	▶

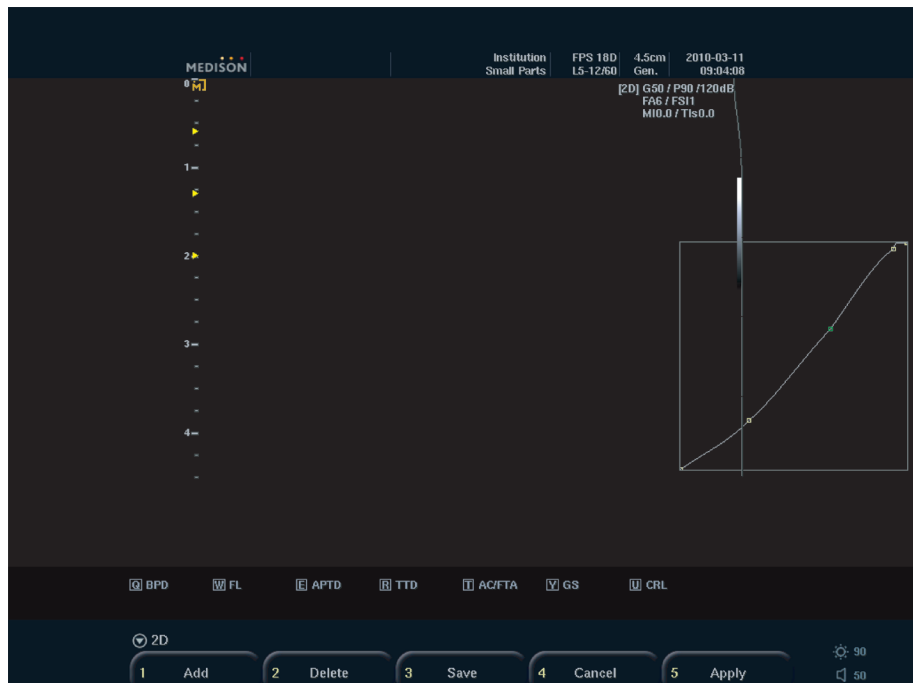
[Figure 4.2 2D Post]

- ▶ 2D Map: Select the post map to use. Select a map between Type 1 - 5 or User 1 – 3 with the **Menu** dial-button. When select User, you can make your own Map.
- ▶ 2D Chroma: Change the color of the image on the screen. Press the **Menu** dial-button to select On/Off.
- ▶ Color: Set the color of the image. Select a value between 0 - 280 with the **Menu** dial-button.
- ▶ Edit: Adjust a post curve.


Tips!
Editing a post map

You can edit the user post map with following two methods.

1. Select the each point of the map with the **Change** button on the control panel and set the curve with the trackball and the **Set** button.
2. Select *Edit* on the menu, the user post map and its soft menu will be displayed on the screen.
 - ▶ [Add]: Add a new point between the currently selected point and the adjacent point.
 - ▶ [Delete]: Delete the currently selected point.
 - ▶ [Save]: Save the map.
 - ▶ [Cancel]: Cancel Map editing and return to the original map.
 - ▶ [Apply]: Apply the Map setting to the image.



[Figure 4.3 2D Post Edit]

- ▶ Gamma: Specify the brightness and contrast. Select Off, Weak, Medium or Hard with the **Menu** dial-button.
- ▶ Return: Return to the previous step of the menu.

2D Mode Softmenu

Following items are displayed on soft menu in 2D mode. Select the item and adjust the value with the Softmenu button [1] – [5] on the control panel.

■ Direction

Use the Softmenu button [1]. Press the button to flip the left and right sides of an image.

■ Ext. Res.

Use the Softmenu button [2]. Ext. Res. Stands for Extended Resolution.

Increases the resolution by increasing the number of channels. Note that the frame rate falls in proportion to the number of channels.

■ Line Density

Use the Softmenu button [3]. Increase the number of scan lines and therefore increase the image resolution. However, the frame rate is reduced.

■ Focus No.

Use the Softmenu button [4]. Set the focus number.

■ HD Zoom

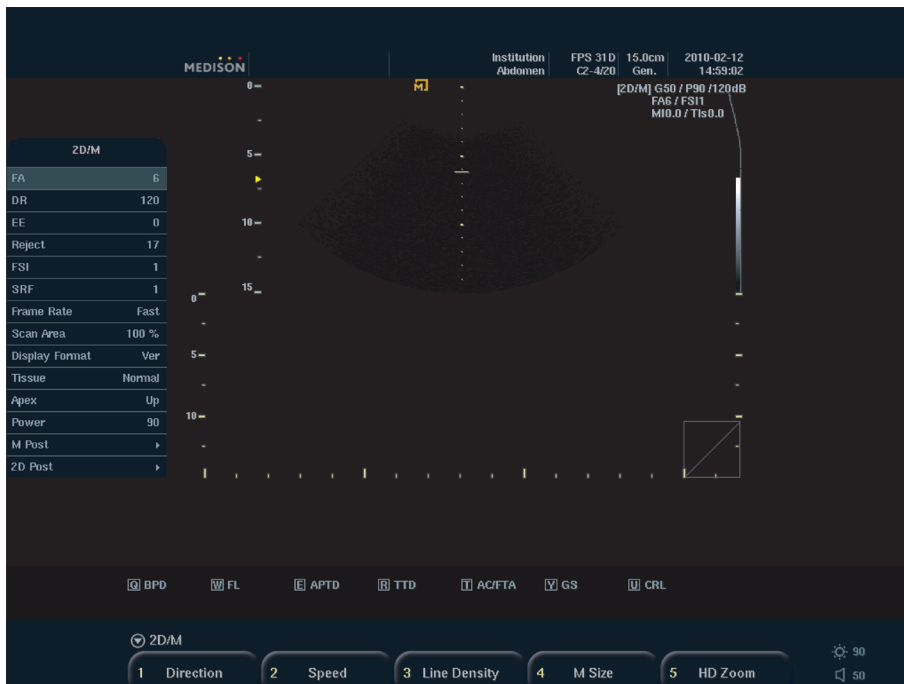
Use the softmenu button [5] to start Write Zoom mode. This function allows you to magnify and scan an image in real time.

1. Press the softmenu button [5]. The *Write Zoom box* will appear on the screen.
2. Use the **Change** button to move and resize the Zoom box. Each time you press the **Change** button, the current state of the Zoom box is displayed in the lower left of the screen.
 - ▶ Zm Pos.: You can move the Zoom box. The zoom box is displayed in a line. Use the Trackball to move the Zoom box and press the **Set** button to specify its position.
 - ▶ Zm Size: You can resize the Zoom box. The zoom box is displayed in a dotted line. Use the Trackball to resize the Zoom box and press the **Set** button to specify its size.
3. Press the **Set** button to start the Write Zoom function. Magnify an image and scan it.
4. Press the **Exit** button to exit Zoom Mode. Changing the depth also exits Zoom Mode automatically.

M Mode

By drawing the M line across a desired area within the 2D image, you can view changes over time.

This is useful for viewing organs with a lot of movement such as a heart valve. A 2D image is also displayed, so that you can view or change the location you are examining within the image.



[Figure 4.4 M Mode]

❏ Entering and Exiting M Mode

Press the **M** button on the control panel. Press it again to exit M Mode and return to 2D mode.

❏ M Mode Screen

■ M Line

Use the trackball on the control panel to move left or right. The M line indicates the relative position of the M Mode image in the 2D image. Move the M line to change the observation location.

✚ M Mode Menu

Following items are displayed on menu when you press the **Menu** dial-button in M mode. Select the item and adjust the value with the **Menu** dial-button.

■ Display Format

Set the screen layout for M and 2D images. Select Ver or Hor with the **Menu** dial-button.

- ▶ Ver: Ver stands for Vertical. It sets the 2D image and M image at the top and bottom of the screen.
- ▶ Hor: Hor stands for Horizontal. It sets the 2D image and M image in left and right side.

■ M Post

Brings up the sub-menu.

- ▶ M Map: Select the post map to use. Select a map between Map 0 – 15 with the **Menu** dial-button. When select User, you can make your own Map
- ▶ M Map Edit: Adjust a color map.
- ▶ Return: Return to the previous step of the menu.



NOTE: For information on other menu items, please refer to “2D Mode.”

✚ M Mode Soft Menu

Following items are displayed on soft menu in M mode. Select the item and adjust the value with the Softmenu button [1] – [5] on the control panel

■ Speed

Use the Softmenu button [2]. Adjust the sweep speed of the M image.

■ M Size

Use the Softmenu button [4]. Adjust the size of the 2D image and the M image.

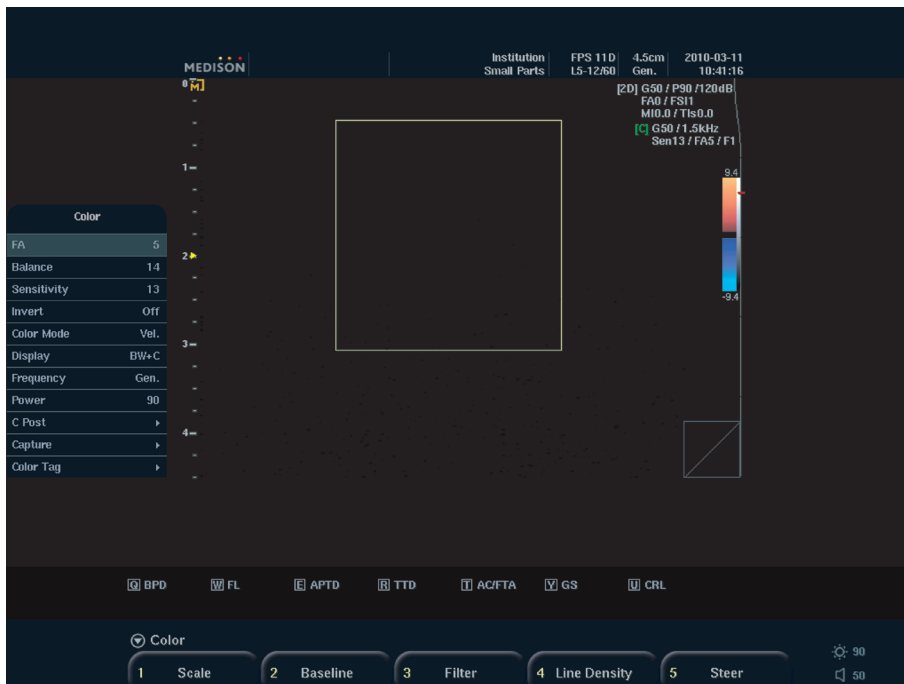


NOTE: For information on other softmenu items, please refer to “2D Mode.”

Color Doppler Mode

This mode displays the colored blood flow pattern of the ROI (Region of Interest) within the 2D image.

It is appropriate for examining the presence of the blood flow, its average speed and direction. The 2D Mode image is also shown allowing the marking and adjustment of the ROI within the entire image.



[Figure 4.5 Color Doppler Mode]

❏ Entering and Exiting C Mode

Press the **Color** button on the control panel. Press the button again, and C Mode will be terminated and the mode switched to 2D.

❏ C Mode Screen

■ ROI Box

ROI stands for Region Of Interest. In Color Doppler Mode, the ROI box outlines the area of the 2D image where color (blood flow) information is displayed.

Use the **Change** button to adjust the position and size of the ROI box. Each time you press the **Change** button, the status of the ROI box is shown in the lower left corner of the screen as follows:

- ▶ C Pos.: You can move the ROI box. Use the trackball to move the ROI box and press the **Set** button to confirm its new position.
- ▶ C Size: You can resize the ROI box. Use the trackball to resize the ROI box, press the **Set** button to confirm its new size.

■ Color Bar

In Color Doppler Mode, the color bar indicates the direction and speed of blood flow. Relative to the baseline in the middle, the red color indicates the direction and speed of blood flowing toward the probe. Conversely, the blue color indicates the direction and speed of blood flowing away from the probe.

❏ C Mode Menu

Following items are displayed on menu when you press the **Menu** dial-button in C mode. Select the item and adjust the value with the **Menu** dial-button.

■ Balance

Adjusts the range of the color image displayed by comparing the gray level of the 2D image with the Doppler signal value of the color image. If the Balance value increases, the color image is seen even where the 2D image signal is strong (bright), thereby increasing the color image range.

Select a value between 1 - 16 with the **Menu** dial-button.

■ Sensitivity

Set the sensitivity of the color image. Increasing the value enhances the color image, but reduces the frame rate. Select a value between 8 - 31 with the **Menu** dial-button.

■ Invert

Inverts the color bar in the opposite direction. Inverting the color bar also inverts the colors displayed on the image.

■ Color mode

Set the contents that are displayed in color. Select Vel., Power, Var., or VelVar. with the **Menu** dial-button. When Vel. or VelVar are selected, numbers will be displayed above and below the color bar, indicating the color scale values. When Var. is selected, +1 and -1 will be displayed. If Power is selected, no numbers will be displayed.

■ Display

Set how Color Doppler Mode is displayed. Select BW+C, C Only, or BW Only with the **Menu** dial-button.

■ Frequency

Adjust the frequency within the ROI box. Select Pen or Gen with the **Menu** dial-button.

■ C Post

Brings up the sub-menu.

- ▶ Color Map: Select the post map to use. Select a map between Map 0 – 15 with the **Menu** dial-button. When select User, you can make your own Map
- ▶ Color Map Edit: Adjust a color map.
- ▶ Return: Return to the previous step of the menu.

■ Capture

Capture an image with a user-defined frame for better observation of the image. The *Capture menu* will be displayed.

- ▶ Capture: Press the **Menu** dial-button to turn it on/off.
- ▶ Frame: It is available when Capture is on. Set the number of frame in one second. Use the **Menu** dial-button to select a value between 5 - 100.

■ Color Tag

A random color is applied to a certain area in an image. The *Color Tag menu* will be displayed.

- ▶ Color Tag: Press the **Menu** dial-button to turn it on/off.
- ▶ Tag Pos: It is available when Color Tag is on. Use the **Menu** dial-button to select the position of tags, from between 0 - 248. Tag Pos affect to Tag Width.

- ▶ **Tag Width:** It is available when Color Tag is on. Use the **Menu** dial-button to select the range of tags, from between 8 - 256. Tag Width affect to Tag Pos.



NOTE: For information on other menu items, please refer to "2D Mode."

✦ C Mode Softmenu

Following items are displayed on soft menu in C mode. Select the item and adjust the value with the Softmenu button [1] – [5] on the control panel.

■ Scale

Use the Softmenu button [1]. Pressing the upside of the button makes the PRF (Pulse Repetition Frequency) increase so that the speed range of the blood flow is widened, and vice versa.

■ Baseline

Use the Softmenu button [2]. When the display method for Color Mode is set to Var, the baseline cannot be adjusted.

■ Filter

Use the Softmenu button [3]. Filter is an electrical filter used to eliminate low-frequency Doppler signals caused by the motion of vessel walls. Adjust Cutoff Frequency to remove from the screen the Doppler signals for which the frequencies are lower than the Cutoff Frequency. Press the upside of the button to raise cutoff frequency, and vice versa.

■ Steer



NOTE: This item appears in the softmenu only when a Linear Probe is used.

Use the Softmenu button [5]. Adjust the angle of the ultrasound beam. This can minimize loss of color information based on the angle of the ultrasound beam. Press the button to select Left, None, or Right for ROI.

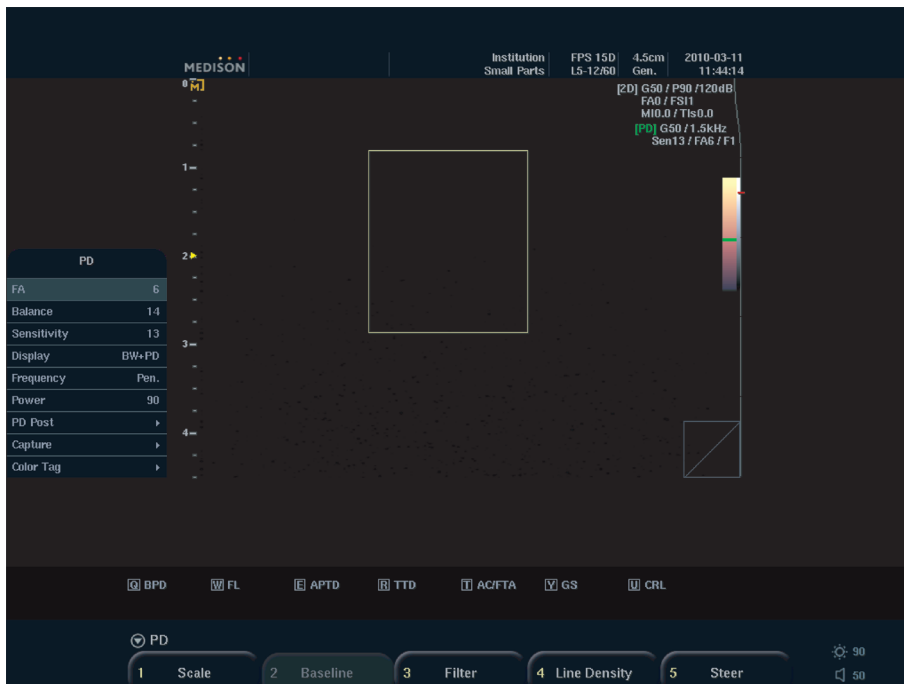


NOTE: For information on other softmenu items, please refer to "2D Mode."

Power Doppler Mode

This mode displays the color intensity of blood flow within the ROI in the 2D image.

It is appropriate for examining the presence and amount of blood flow. The 2D Mode image is also shown, allowing the marking and adjustment of the ROI within the entire image.



[Figure 4.6 Power Doppler Mode]

❏ Entering and Exiting PD Mode

Press the **PD** button on the control panel. Pressing **PD** button again turns PD Mode off, and 2D Mode on.

❏ PD Mode Screen

■ Color Bar

Colors show the existence and amount of blood flow in PD Mode. The top of the color bar is the brightest section, where the amount of blood flow is at its highest.

■ ROI Box

ROI stands for Region Of Interest. In Power Doppler Mode, ROI indicates the area of the 2D image where color (blood flow) information is displayed.

■ PD Mode Menu

Following items are displayed on menu when you press the **Menu** dial-button in PD mode. Select the item and adjust the value with the **Menu** dial-button.

■ Display

Select the screen display for Power Doppler Mode. Select BW+PD, PD Only, or BW Only with the **Menu** dial-button.

■ PD Post

Brings up the sub-menu.

- ▶ PD Map: Select the post map to use. Select a map between Map 0 – 15 with the **Menu** dial-button. When select User, you can make your own Map
- ▶ PD Map Edit: Adjust a color map.
- ▶ Return: Return to the previous step of the menu.



NOTE: For information on other menu items, please refer to “2D Mode.”

■ PD Mode Soft Menu

Select the item and adjust the value with the Softmenu button [1] – [5] on the control panel.



NOTE: For information on other softmenu items, please refer to “Color Doppler Mode.”

PW Spectral Doppler Mode

PW stands for Pulse Wave. PW Spectral Doppler Mode gives information on the speed of blood flow at a specific site in the form of a spectral trace and audio signal. Distance (depth) information can also be obtained by transmitting pulses over time frames.

This mode is useful for measuring low-speed blood flow such as in the abdomen and peripheral vessels. The 2D Mode image is also shown, allowing the marking and adjustment of an observation area within the entire image.



[Figure 4.7 PW Spectral Doppler Mode]

❏ Entering and Exiting PW Spectral Doppler Mode

Press the **PW** button on the control panel. Press it again to return to 2D Mode.

Press the **Set** button on the control panel to obtain a spectral doppler image.

❏ PW Spectral Doppler Mode Screen

On the Spectral Doppler Mode image, the horizontal axis represents time, and the vertical axis represents speed (or frequency).

■ Sample Volume

When Sample Volume is positioned over the blood flow in a 2D image, the Doppler Spectrum is displayed. Information on the size and depth of Sample Volume is displayed in [mm] units. The position is displayed in the 'xx.x@yy.y mm' format. This means that a Sample Volume of size 'xx.x mm' is located 'yy.y mm' deep. For example, '2.0@16.7mm' means that a Sample Volume of size 2.0 mm is located 16.7 mm deep.

Use the **Change** button to adjust the position and the size of the Sample Volume. Each time you press the **Change** button, the current status of the Sample Volume will be displayed on the lower left side of the screen.

- ▶ SV Pos.: You can change the position of the Sample Volume. Use the trackball to move the Sample Volume position.
- ▶ SV Size: You can change the size of the Sample Volume. Use the trackball to resize the Sample Volume and press the **Set** button.

■ HPRF

This function measures blood flow for which the speed exceeds the specified limit at a specified depth. It expands the scale into double the size of the original scale. This function is available only in PW Spectral Doppler Mode (PW Only). HPRF stands for High Pulse Repetition Frequency.



NOTE: To use HPRF function, select 'On' in the **Seup > System > Display tab**.

▶ Running HPRF

If you keep increasing the scale value at a certain depth, HPRF will be activated. The Phantom Gate will appear on the D Line at a position above the Sample Volume. Once HPRF starts, PRF does not increase even if you increase the scale value.

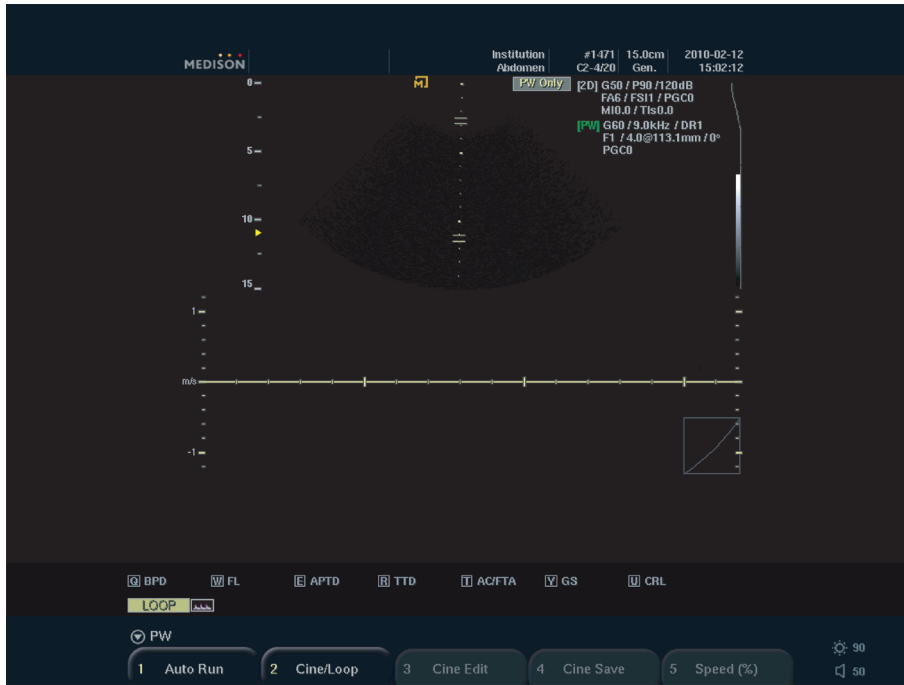
▶ Exiting HPRF

While HPRF is in use, decrease the scale value by one step to exit HPRF. The PRF value at this point will be the maximum value in PW Spectral Doppler Mode.

▶ Moving Sample Volume

If you move the Sample Volume in the D Only state, the system will calculate the PRF value and the Phantom Gate position and update the information on the spectral Doppler image accordingly. If you cannot activate HPRF, exit HPRF first.

If you move the Sample Volume in 2D Only state, the PRF value will remain unchanged.



[Figure 4.8 HPRF]



NOTE: HPRF cannot be activated in Simultaneous Mode. Also, HPRF cannot be activated if the PRF value X 2 is 23 KHz or greater before HPRF is activated.



CAUTION:

- ▶ The Phantom Gate position may be located outside the 2D image area in Zoom Mode.
- ▶ Make sure that Sample Volume and Phantom Gate are not placed together in the measuring area. If more than two SVs are located in the vessels, all Doppler components will appear in the spectrum, causing noise.

❏ PW Spectral Doppler Mode Menu

Following items are displayed on menu when you press the **Menu** dial-button in PW Spectral Doppler mode. Select the item and adjust the value with the **Menu** dial-button.

■ Average

Increases spectrum quality. Select Low, Middle or High with the **Menu** dial-button.

■ Spectrum Ehc.

Spectrum Ehc stands for Spectrum Enhancement. This function is used to compensate the signal of low gain Spectral Doppler Spectrum. Select the value between 1- 8 with the **Menu** dial-button.

■ Simultaneous

View the 2D image and Spectral Doppler image simultaneously in real time. Press the **Menu** dial-button to turn it on or off.

The Simultaneous function decreases Doppler PRF, thus decreasing the measurable speed range.



NOTE: This will appear on the PW menu only when **Setup > System > Display > Simultaneous Mode** is set to **Allow**.

■ PW Size

Set the size of the PW spectral Doppler image. To adjust the image position, the 2D image is shown together. Select Large, Normal, or Small with the **Menu** dial-button.

■ Speed

Adjust the sweep speed for the Doppler spectrum. Select 120Hz, 180Hz, 240Hz, or 300Hz with the **Menu** dial-button.

■ PW Post

Brings up the sub-menu.

- ▶ PW Map: Select the post map to use. Select a map between Map 0 – 15 with the **Menu** dial-button. When select User, you can make your own Map
- ▶ PW Map Edit: Adjust a color map.
- ▶ Return: Return to the previous step of the menu.



NOTE: For information on other menu items, please refer to “2D Mode” and “Color Doppler Mode.”

PW Spectral Doppler Mode Soft Menu

Following items are displayed on soft menu in PW Spectral Doppler mode. Select the item and adjust the value with the softmenu button [1] – [5] on the control panel

■ Baseline

Use the Softmenu button [2]. Press the button to adjust the baseline for Doppler spectrum.

■ Invert

Use the Softmenu button [4]. Press the dial-button to invert the + and - speed indicators for the spectrum.

■ Angle

Use the Softmenu button [5]. Adjust the angle of the Sample Volume. Press the button to adjust the angle in 10°.



Adjusting with the Angle dial-button

You can adjust the angle with the **Angle** dial-button on the control panel. Rotate the dial-button clockwise to increase the value between -60 ~ +60°.



NOTE: For information on other softmenu items, please refer to “2D Mode” and “Color Doppler Mode.”

:: Combined Modes

2D/C/PW Mode

Color Doppler Mode and PW Spectral Doppler Mode are displayed simultaneously.

Press the **PW** button on the control panel in Color Doppler Mode. In PW Spectral Doppler Mode press the **Color** button.

2D/PD/PW Mode

PD Mode and PW Spectral Doppler Mode are displayed simultaneously.

Press the **PW** button on the control panel in PD Mode. In PW Spectral Doppler Mode press the **PD** button.

2D/C/M Mode

Color Doppler Mode and M Mode are displayed simultaneously.

Press the **M** button on the control panel in Color Doppler Mode, or press the **Color** button on the control panel in M Mode. (Only available in Cardiac related application of specific probe)

❏ Changing Combined Mode Format

■ Changing Active Image

Press the **Set** button. The currently active image mode, such as 'PW Only' or '2D Only', is displayed on the menu on the screen.

A Combined Mode uses 2 or more image modes simultaneously. The image mode currently in use in a Combined Mode is referred to as the 'Active Image Mode'. For example, if moving the trackball moves the sample volume in 2D/C/PW Mode, then the current active image mode is PW Spectral Doppler Mode.

As each active image mode has its own set of menu items and buttons, you should press the **Set** button to change the active image mode. Note that when in Freeze state, pressing the **Set** button does not change the active image mode.

■ Changing Menu

Press the **Active Menu** button. Or press the space bar on the keyboards.

This only changes the soft menu without changing the active image mode. The buttons on the control panel are used for the active image mode.



NOTE: For information on optimizing an image in Combined Mode, please refer to "Basic Mode."

:: Dual Mode

The multi-image viewing function is only available when the images and conditions on both sides are identical. The current activated image mode is displayed in 'M' mark in orange color.

To change the active image, press the **Set** or **Dual** button.

Dual-2D Mode

This mode allows you to compare 2D images side by side.

Press the **Dual** button on the control panel in 2D Mode, M Mode and PW Spectral Doppler Mode. Press the **2D** button to exit Dual-2D Mode and return to the basic 2D Mode.

Dual-2D/C Mode

This mode allows you to compare Color Doppler Mode images side by side.

Press the **Dual** button on the control panel in Color Doppler Mode. In Dual-2D Mode press the **Color** button.

Dual-2D/PD Mode

This mode allows you to compare PD Mode images side by side.

Press the **Dual** button on the control panel in PD Mode. In Dual-2D mode press the **PD** button.

::3D Mode

3D

The 3D Mode displays tissues or objects in the human body as three-dimensional images instead of two-dimensional images.

The 3D mode uses the Volume data acquired by the probe as continuous 2D images for rendering, producing three-dimensional volume data displays of objects that can better assist in the diagnosis process.

Volume rendering refers to the calculation process used in formulating a 3D volume structure from 2D scans. Using the gray value of the light path through each pixel of the 2D image, the corresponding voxel, or volume element, of the 3D image is calculated. The rendering algorithm determines the way the way the 3D structure is visualized. Surface rendering is employed in the SONOACE R3.

❏ How to Improve 3D Image Quality

- ▶ Consider the direction, division and size of the viewpoint, as well as the visibility of an object.
- ▶ Before 3D scanning, adjust the contrast of the specific textures in 2D Mode.
- ▶ The ROI box determines the contents of the image box to be rendered. The images outside the ROI box, except for the ultrasound data, are not included in the rendering process and are cut out.
- ▶ The bigger the ROI box, the slower the rendering speed. Therefore, set an appropriate ROI box size.
- ▶ To determine surface contour, the surfaces of objects should be insulated with hypo-echoic textures - such as amniotic fluid - which don't generate echos.
- ▶ To obtain a high quality 3D surface, adjust the low-threshold value.
- ▶ In order to acquire a clear image from the ROI box start boundary to the specific surface, noise can be eliminated if the gray scale value is smaller than the surface value.
- ▶ High-threshold is generally set at the maximum value of 255. If the Surface Rendering Algorithm is higher than the threshold value, it marks the boundaries of the surface. The boundary can be adjusted with the threshold-high slider.

Acquiring a 3D Image

The following explains how to acquire a 3D image.

1. Press the **3D key** on the keyboard.
2. The *ROI box* appears. Set the required area using the trackball, and press the **Set** button. The position and size of the area can be changed by pressing the **Change** button before pressing **Set** button.
3. Pressing **Set** button starts the 3D scanning of the area. A maximum of 200 frames can be scanned at one time. A bar, indicating the scanning progress, appears at the bottom of the screen.
4. To scan the specific frame and finish scanning, press **Set** button again. To cancel the scanning during the process, press the **Exit** button.
5. Once scanning is completed, '3D View Mode' is turned on.

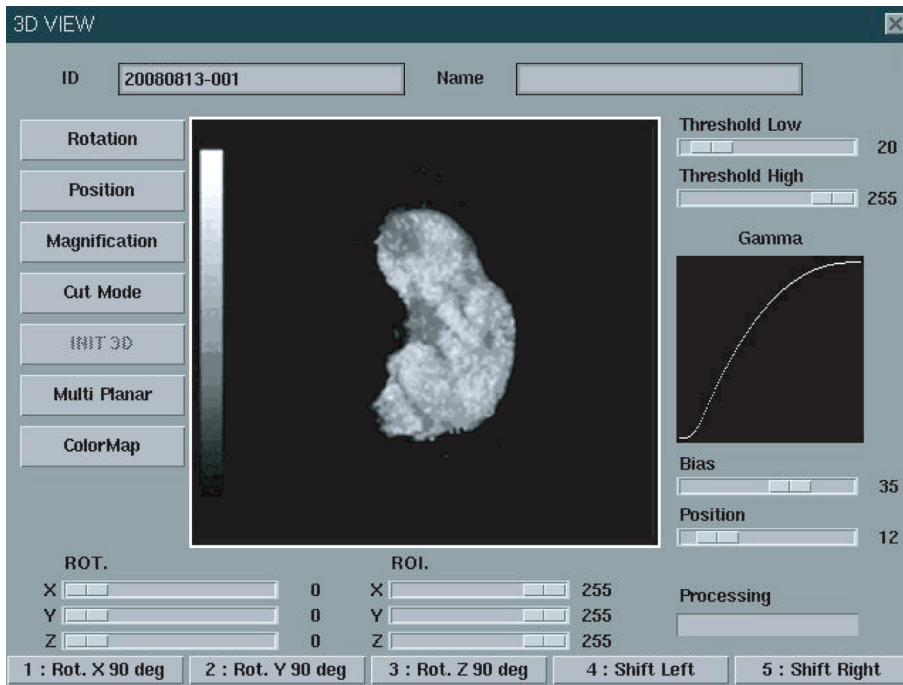


NOTE:

- ▶ To see the 3D scan of a fetus in a frontal view, position the fetal head in the direction of "Direction Mark", putting it in the coronal plane. Then scan the fetus from back to abdomen.
- ▶ The 3D image of the fetal face is more easily found in the coronal plane than in the sagittal plane.

3D View

3D images can be seen through the 3D View application.



[Figure 4.9 3D View]

▣ Viewing a 3D Image

- ▶ Select the menus using the Trackball and the **Set** button.
- ▶ To return to the initial screen of 3D View, press the **Init 3D** button.
- ▶ The Preview function allows the operator to check changes in the values of Rotation, Magnification, and Position in advance. To obtain a clearer image in the Preview screen, press the **Set** button.
- ▶ To close 3D View Mode, press the **X** on the screen. All scanned data and 3D images will be lost if 3D View Mode is closed before saving data. Therefore, ensure that all the necessary images are saved using the **Save** button on the control panel prior to pressing the **X**.

✚ 3D Image Optimization

■ Threshold (Low, High) Adjustment

Adjust the slide bar of the threshold using the Trackball and the **Set** button.

If the slide bar is moved to the left, cyst components – and not bone components – are shown. If the slide bar is moved to the right, bone components – and not cyst components – are shown.

■ Gamma Adjustment

Adjust the 'Bias' and 'Pos' slide bars on the right side of the screen using the Trackball and **Set** button.

- ▶ Pos (Position): Designates the bending start point of the Gamma Curve.
- ▶ Bias: Sets the brightness and contrast by adjusting the curve bend.

The changed values are applied to the Gamma curve and 3D image.

■ Changing ROI Size

Adjust the ROI control slide bar using the trackball and the **Set** button. Changed values can be checked in the Preview screen.

■ Initialization

To return to the initial status in 3D View Mode, press the **Init 3D** button or the Softmenu button **[5] INIT 3D** in Rotation, Position, or Magnification Modes.

■ Rotation

After entering Rotation mode by pressing the **Rotation** button, the 3D image can be rotated using the trackball.

Moving the trackball right or left rotates the 3D image about the X axis, and moving it up or down rotates the image about the Y axis. Moving it while pressing the **Set** button rotates the image about the Z axis.

The rotated 3D image is shown in the Preview screen. After checking the changed values, apply them to the entire screen by pressing the Softmenu button **[4] Apply**.

Pressing the **Exit** applies the changes to the 3D image and exits Rotation mode.

To activate Position, Magnification or ROI Mode functions while rotating the image, press the Softmenu of the corresponding function. To return to the initial image, press the Soft menu button **[5] INIT 3D**.

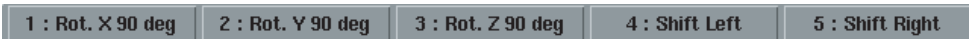


[Figure 4.10 Soft Menu - Rotation Mode]

Tips!

Other ways to rotate the image

1. The ROT slide bar at the bottom of the screen can be adjusted using the trackball and the **Set** button in the 3D View initial screen.
2. Use the Soft Menu in the initial 3D View screen. Use the Softmenu button **[1] ~ [3]** to rotate the 3D image 90° degrees about each axis.



[Figure 4.11 Soft Menu - 3D Mode]

■ Position

The 3D image position can be adjusted with the trackball after entering Position mode. After checking changed values in the Preview screen, apply the changes to the entire screen by pressing the Softmenu button **[4] Apply**.

Pressing the **Exit** applies the changes to the 3D image and exits Position mode.

To activate the Rotation, Magnification or Cut Mode functions while adjusting the image position, press the corresponding *Flexible* Softmenu of each function. To return to the initial image, press the Softmenu button **[5] INIT 3D**.

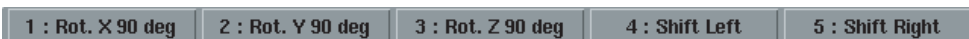


[Figure 4.12 Softmenu - Position Mode]

Tips!

Other ways to move the image

Use the Softmenu in the 3D View initial screen. To move the 3D image right or left, use the Softmenu button **[4] Shift Left** or **[5] Shift Right**.



[Figure 4.13 Softmenu - 3D Mode]

■ Magnification

To magnify or reduce the image size, enter Magnification mode by pressing the **Magnification** button, and move the Trackball right or left. After checking changed values in the Preview screen, apply the changes to the entire screen by pressing the Softmenu button **[4] Apply**.

Pressing the **Exit** button applies the changes to the 3D image and exits the Magnification mode.

To activate the Rotation, Position or Cut Mode function while adjusting the image size, press the corresponding Softmenu of each function. To return to the initial image, press the Softmenu button **[5] INIT 3D**.



[Figure 4.14 Softmenu – Magnification Mode]

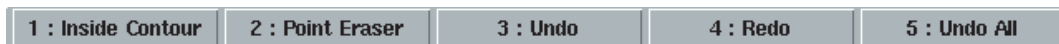
■ Cut Mode

Press the **Cut Mode** button on the left side of the screen to enter Cut mode. Determine the area to cut using the trackball, and press the **Set** button. Then, the “+” cursor appears. After contouring the area to cut, press **Set** button again, and the cutting is finished. To cancel the cutting area, press the **Exit** button.

Press the Softmenu button **[1] Inside Contour** to outline an area to be cut. The Softmenu button **[2] Point Eraser function** is used to cut a portion of the image. The default setting is Inside Contour.

To cancel cutting, press the Sofmenu button **[3] Undo**. To redo the cancelled job, press the Softmenu button **[4] Redo**.

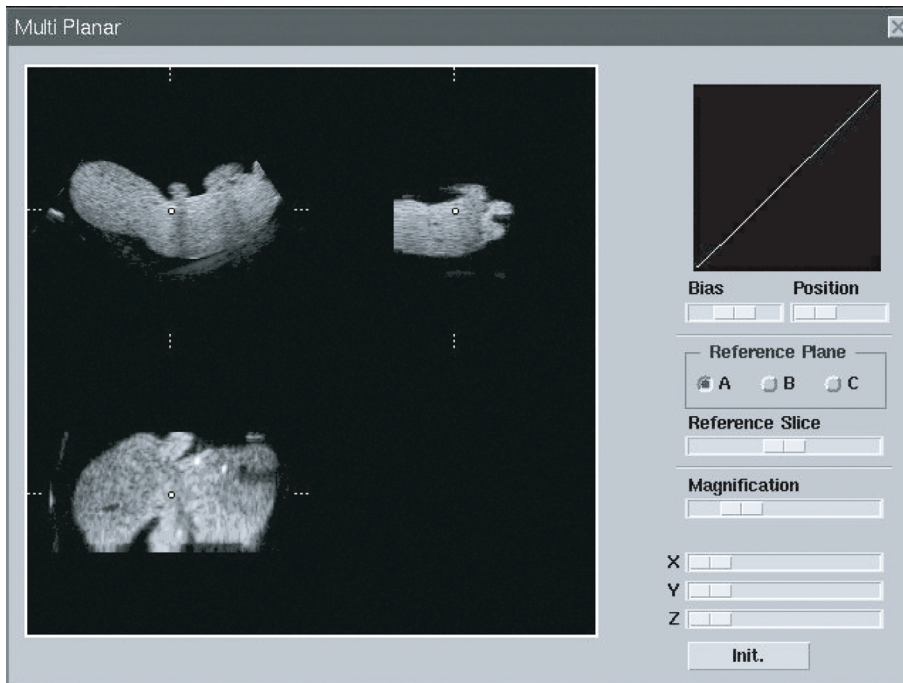
To cancel all cuttings and return to the initial 3D screen, press the Sofmenu button **[5] Undo All**.



[Figure 4.15 Softmenu – Cut Mode]

■ Multi planar

Press **Multi planar**, and *3D multiplanar* screen appears. Shows volume data in cross-section images of Coronal Section, Sagittal Section, and Axial Section.



[Figure 4.16 Multi planar]

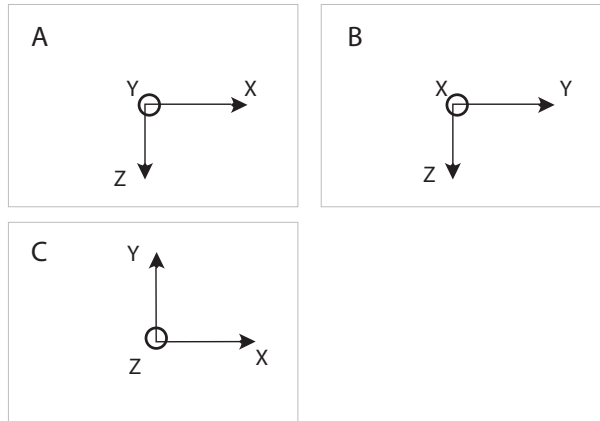
■ Reference Plane

Select the reference plane on the *Multi Planar* window:

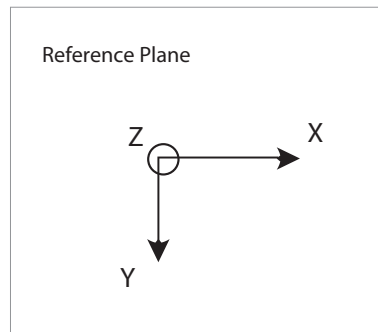
- ▶ A plane: Coronal Section
- ▶ B plane: Sagittal Section
- ▶ C plane: Axial Section

Multi Planar has its standard coordinates system and rotates/moves along that system. However the reference plane rotates/moves along the own coordinates system of reference plane. If you select a reference plane, it rotates/moves along the coordinates system of reference plane. The other planes are rotate/move along its standard coordinates system.

Use X/Y/Z slide on the screen to rotate reference plane.



[Figure 4.17 The standard coordinates systems of Multi-planar]



[Figure 4.18 The coordinates system of the reference plane]

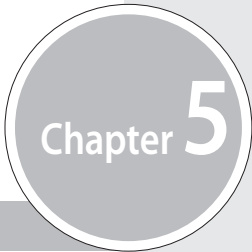
To init all setting, press **Init** on the screen. To finish the 3D Multiplanar and go back to 3D View, press **X**.



NOTE: Refer to '3D Image Optimization' for more information like Gamma Curve setting.

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∴ Measurement Accuracy

Measurement values can vary, depending on the nature of the ultrasound, the body's response to ultrasound, the measurement tools, algorithms, product settings, probe type and user operation.

Before using this product, make sure to read and understand the following information regarding the causes of measurement errors, and measurement optimization.

Causes of Measurement Errors

▣ Image Resolution

The resolution of ultrasound images may be limited by the available space.

- ▶ Errors due to a signal range may be minimized by adjusting focus settings. Optimizing focus settings increases the resolution of the measurement area.
- ▶ In general, lateral resolution is lower than axial resolution. Therefore, measurements should be performed along the axis of the ultrasound beam to obtain accurate values.
- ▶ Gain has a direct impact on resolution. Gain can be adjusted by using the **Gain** button for each mode.
- ▶ In general, increasing the frequency of ultrasound enhances resolution.

▣ Pixel Size

- ▶ An ultrasound images in the product consist of pixels.
- ▶ Since a single pixel represents the basic unit of an image, a measurement error may result in the displacement of approximately ± 1 pixel when compared to the original image size.
- ▶ However, this error becomes significant only when a narrow area in an image is measured.

▣ Ultrasound Velocity

- ▶ The velocity of ultrasound used during measurement is usually 1,540 m/s on average.
- ▶ The velocity of ultrasound may vary depending on the cell type.
- ▶ The possible range of error is between approximately 2-5% depending on the structure of cells (about 2% for typical cells and about 5% for fatty cells).

❏ Doppler Signal Adjustment

- ▶ During velocity measurement, an error may occur depending on the cosine angle between the blood flow and the ultrasound beam.
- ▶ For Doppler velocity measurements, the most accurate results can be ensured when the ultrasound beam is aligned in parallel with the blood flow.
- ▶ If that is not possible, the angle between them should be adjusted by using the Angle option.

❏ Aliasing

- ▶ PW Spectral Doppler Mode uses a signal sampling technique to calculate the frequency (or velocity) spectrum.
- ▶ Adjust the baseline or the velocity scale to minimize aliasing. A lower frequency probe can also be used to reduce aliasing.

❏ Calculation Equation

- ▶ Some of the calculation equations used for clinical purposes originate from hypotheses and approximation.
- ▶ All calculation equations are based on medical reports and articles.

❏ Human Error

- ▶ Human error may occur due to inappropriate use or lack of experience.
- ▶ This can be minimized through compliance with and thorough understanding of the manuals.

Optimization of Measurement Accuracy

2D Mode

- ▶ Resolution is in proportion to the frequency of the probe.
- ▶ Penetration is in inverse proportion to the frequency of the probe.
- ▶ The highest resolution can be obtained at the focus of the probe where the ultrasound beam is narrowest.
- ▶ The most accurate measurements can be obtained at the focus depth. The accuracy decreases as the distance from the focus increases, widening the beam width.
- ▶ Using the zoom function or minimizing the depth display makes distance or area measurements more accurate.

M Mode

- ▶ The accuracy of time measurements can be increased when the sweep velocity and the display format are set to high values.
- ▶ The accuracy of distance measurements can be increased when the display format is set to higher values.

Doppler Mode

- ▶ It is recommended to use lower frequency ultrasound for measurement of faster blood flows.
- ▶ The size of the sample volume is limited by the axial direction of the ultrasound.
- ▶ Using lower frequency ultrasound increases penetration.
- ▶ The accuracy of time measurements can be increased when the sweep velocity is increased.
- ▶ The accuracy of velocity measurements can be increased when the vertical scale is set to smaller values.
- ▶ It is most important to use an optimal Doppler angle to enhance the accuracy of velocity measurements.

❏ Color/Power Doppler Mode

- ▶ A protocol is not specified for images in Color Doppler Mode or Power Doppler Mode. Therefore, the same limitations imposed when measurements are taken in B/W images apply to the accuracy of the measurements taken in these modes.
- ▶ It is not recommended to use images in Color/Power Doppler Mode for measurement of accurate blood flow velocity.
- ▶ The amount of blood flow is calculated based on the average velocity rather than the peak velocity.
- ▶ In all applications, the amount of blood flow is measured in PW Spectral Doppler Mode.

❏ Cursor Position

- ▶ All measurements are affected by input data.
- ▶ To ensure accurate positioning of the cursor:

Adjust the images on the screen so that they are displayed at maximum granularity.

Use the front edge or boundary point of a probe to make the start and end points of a measurement object more distinct.

Make sure that the probe direction is always aligned during measurement.

Measurement Accuracy Table

The following tables show the accuracy of the measurements available using the product. Ensure that the results of measurement accuracy checks are kept within the ranges specified in the table. Except for certain applications or probes, the following accuracy ranges should be maintained for measurement of a straight distance.



NOTE: To ensure accurate measurements, an accuracy check should be performed at least once per year. If the measurement accuracy falls outside the ranges specified in the following table, contact Samsung Medison Customer Service.

2D Mode

Measurements	System Tolerance: (Whichever is greater)	Test Methodology	Accuracy ⁽¹⁾ Based on	Range ⁽²⁾
Axial Distance	< +/- 4% or 2mm	Phantom	Acquisition	.01 – 25 cm
Lateral Distance	< +/- 4% or 2mm	Phantom	Acquisition	.01 – 35 cm
Axial Resolution	< +/- 4% or 3mm	Phantom	Acquisition	.01 – 25 cm
Lateral Resolution	< +/- 4% or 3mm	Phantom	Acquisition	.01 – 35 cm

(1) The accuracy of the measurement differs depending on the user's skill level as well as the table above.

(2) The unit of distance and circumference is cm. It is given in up to two decimal points.

M Mode

Measurements	System Tolerance: (whichever is greater)	Test Methodology	Accuracy ⁽¹⁾ Based on	Range ⁽²⁾
Depth	< +/- 5% or 3 mm	Phantom	Phantom	1 - 25 cm
Time	< +/- 5%.	Signal generator	Phantom	.01 - 11.3 sec

(1) The accuracy of the measurement differs depending on the user's skill level as well as the table above.

(2) The unit of distance and circumference is cm. The unit of velocity is cm/s. It is given in up to two decimal points.

✚ PW Spectral Doppler Mode

Doppler Measurement	System Tolerance (whichever is greater)	Methodology	Range ⁽²⁾
Velocity	< ± 15%	Phantom	0.1 cm/s – 8.8 m/s
Time	< +/- 5%	Signal generator	.01 - 11.3 sec

- (1) The accuracy of the measurement differs depending on the user's skill level as well as the table above.
- (2) The unit of distance and circumference is cm. The unit of velocity is cm/s. It is given in up to two decimal points.

Basic Measurements

Press the **Caliper** button on the control panel.



NOTE: Take basic measurements of distance and area regardless of the application. For information on measurements for each application, please refer to “Measurements by Application” in this chapter.

The available measurement methods vary depending on the current diagnosis mode. Please refer to the following table:

Measurements	Diagnosis Mode	Measurement Methods
Distance	2D, M, PW	2D Distance 2D Line Trace 2D Hip Joint
	M	M Distance
	PW	Doppler Velocity Doppler Velocity (A/B) Doppler Trace
Circumference & Area	2D, M, PW	2D Ellipse 2D Trace
Volume	2D, M, PW	3 Distance 1 Distance Distance + Ellipse

[Table 5.1 Basic Measurement]

Basic Measurement Operations

The following is the information on common button operations for basic measurements:



[Figure 5.1 Basic Measurement – Soft Menu]

Select/Change Measurement Method

Use the **Softmenu** button on the control panel. The Softmenu items displayed vary depending on the diagnosis mode. The selected measurement method is displayed in the user information area.

Delete Measurement Result

Press the **Clear** button on the control panel.

Print Measurement Result

Press the **Print** button on the control panel.

Finish Basic Measurements

Press the **Exit** button on the control panel.



NOTE: To change various settings such as measurement units, press the **Setup** key on the keyboard and select **Measure > General > General**. For more information, please refer to 'Chapter 7. Utilities.'

Distance Measurement

❏ 2D Distance (Line)

This is a basic measurement that is available in all diagnosis modes. You can specify two points in a 2D image and measure the straight distance between them.

You can measure up to 4 distances. When taking more than one measurement, use measurement cursors with different shapes to differentiate them.

1. Press the Softmenu button [**1**] **Distance** to select 2D Distance (Line). "2D Distance (Line)" is displayed on the left side of the screen.
2. Use the trackball and the **Set** button on the control panel to specify both end points of the measurement area.
 - ▶ Place the cursor at a desired position with the trackball, and press the **Set** button.



Repositioning Point

Pressing the **Change** button before pressing the **Set** button to complete positioning resets the position of a point just set.

3. If you specify both end points, the distance between them will be automatically calculated.
4. When the measurement is finished, its result is shown on the screen.

❏ 2D Distance (Trace)

It is a basic measurement that is available in all diagnosis modes. You can specify a point in a 2D image and trace a curve from that point to measure the distance between them.

You can measure up to 4 distances. When taking more than one measurement, use measurement cursors with different shapes to differentiate them.

1. Press the Softmenu button [**1**] **Line Trace** to select 2D Distance (Trace). "2D Distance (Trace)" is displayed on the left side of the screen.
2. Use the trackball and the **Set** button on the control panel to specify the start point of the measurement area.
 - ▶ Place the cursor at a desired position with the trackball, and press the **Set** button.
3. With the trackball, draw a desired curve and press the **Set** button to specify the end point.
4. If you specify both end points, the length of the curve will be automatically calculated.
5. When the measurement is finished, its result is shown on the screen.

2D Hip Joint

This is a basic measurement that is available in all diagnosis modes. You can measure the angle of two straight lines to a straight line in a 2D image. This measurement is commonly used in the obstetrics application.

1. Press the Softmenu button **[4] 2D Hip Joint**. "2D Hip Joint" is displayed on the left side of the screen.
2. Use the trackball and the **Set** button on the control panel to specify the first straight line.
 - ▶ Place the cursor at a desired position with the trackball, and press the **Set** button.
3. Repeat the above process to specify two other straight lines.
4. The angle between them will be calculated automatically.
 - ▶ α : The angle between the first and second straight lines.
 - ▶ β : The angle between the first and third straight lines.
5. When the measurement is finished, its result is shown on the screen. The angles α and β , and the Hip Joint Type are displayed on the screen.

Please refer to the table below for Hip Joint Type information:

Type	α	β
1a	$60 \leq \alpha < 90$	$0 < \beta < 55$
1b	$60 \leq \alpha < 90$	$55 \leq \beta < 90$
2a/b	$50 \leq \alpha < 60$	$0 < \beta < 90$
2c	$43 \leq \alpha < 50$	$77 \leq \beta < 90$
d	$43 \leq \alpha < 50$	$0 < \beta < 77$
3/4	$0 < \alpha < 43$	

[Table 5.2 Hip Joint Type Table]

M Distance

This is a basic measurement that is available in M Mode only. You can specify two points in an M image and measure the distance, elapsed time and velocity between them.

1. Press the Softmenu button **[1] Distance** to select M Distance. "M Distance" is displayed on the left side of the screen.
2. Specify two points and measure the straight distance between them. The method for measuring a line is the same as in "2D Distance (Line)."
3. When the measurement is finished, its result is shown on the screen.

Doppler Velocity

This is a basic measurement that is available in Spectral Doppler Mode only. You can specify two points in a Spectral Doppler image and measure the distance between them, and the velocity at each point to calculate the velocity change, time change and acceleration.



NOTE: In a Spectral Doppler image, the X- and Y-axes represent time and velocity, respectively.

You can measure acceleration for up to two segments and differentiate the points of segments into Point 1 and 2.

1. Press the Softmenu button **[1] Distance** to select Doppler Velocity. "Doppler Velocity" is displayed on the left side of the screen.
2. Specify two points and measure the straight distance between them. The method for measuring a line is the same as in "2D Distance (Line)."
3. When the measurement is finished, its result is shown on the screen.
 - ▶ V1: Velocity at Point 1
 - ▶ V2: Velocity at Point 2
 - ▶ RI: Resistivity Index
 - ▶ V1/V2: The Ratio of Velocity
 - ▶ dV: Change in Velocity
 - ▶ dT: Change in Time
 - ▶ Acc: Acceleration

The equations used for D Velocity measurement are as follows:

$$RI = \frac{V_1 - V_2}{V_1}$$

$$dV = V_2 - V_1$$

$$Acceleration = \frac{(V_2 - V_1)}{(T_2 - T_1)} = \frac{dV}{dT}$$

Doppler Velocity (A/B)

This is a basic measurement that is available in Spectral Doppler Mode only. You can specify two points in a Spectral Doppler image and measure the velocity at each point to calculate the ratio of the velocity between them.

You can calculate up to 4 sets of velocity ratios. The points representing each set are differentiated into Point A and B.

1. Press the Sofmenu button **[1] Distance** to select Doppler Velocity (A/B). "Doppler Velocity (A/B)" is displayed on the left side of the screen.
2. Specify two points to measure velocity for.
 - ▶ Place the cursor at a desired position with the trackball, and press the **Set** button.
3. When the measurement is finished, its result is shown on the screen.
 - ▶ V_A: Velocity at Point A
 - ▶ V_B: Velocity at Point B
 - ▶ RI: Resistivity Index
 - ▶ A/B: The Ratio of Velocity

✚ Doppler Trace

This is a basic measurement that is available in Spectral Doppler Mode only. You can specify a point in a Spectral Doppler image and trace a curve from that point to calculate the velocity, integral value and average velocity of blood flow.

1. Press the Sofmenu button **[1] Distance** to select Doppler Trace. "Doppler Trace" is displayed on the left side of the screen.
2. Trace a curve. The method for measuring a curve is the same as in "2D Distance (Trace)".
3. When the measurement is finished, its result is shown on the screen.
 - ▶ dT: Change in Time
 - ▶ VTI: Velocity Time Integral
 - ▶ Mean V: Mean Velocity
 - ▶ Peak V: Peak Velocity
 - ▶ Mean G: Mean Gradient

The equations used for D Trace measurement are as follows:

$$dT = T_2 - T_1$$

$$VTI = \int v \times dt, \quad (VTI : \text{Velocity Time Integral})$$

$$V_{mean} = \frac{VTI}{\text{Duration of flow}}$$

Circumference and Area Measurement

2D Ellipse

This is a basic measurement that is available in all diagnosis modes. You can measure the circumference and area of a circular (elliptical) object in a 2D image.

You can measure up to 4 distances. When taking more than one measurement, use measurement cursors with different shapes to differentiate them.

1. Press the Softmenu button **[2] Area / Circ** to select 2D Ellipse. "2D Ellipse" is displayed on the left side of the screen.
2. Use the trackball and the **Set** button on the control panel to specify the diameter (axis) of the measurement area.
 - ▶ Place the cursor at a desired position with the trackball, and press the **Set** button.

Tips!

Repositioning Point

Pressing the **Change** button before pressing the **Set** button to complete positioning resets the position of a point just set.

3. Specify the size of the circle (ellipse).
 - ▶ Adjust the size using the trackball, and press the **Set** button.
4. When the measurement is finished, its result is shown on the screen.
 - ▶ Circ.: Circumference of Object
 - ▶ Area: Area of Object
 - ▶ Avg.(C): Average Circumference
 - ▶ Avg.(A): Average Area

The equations used for ellipse measurement are as follows:

$$Circ = 2\pi \cdot \sqrt{\frac{1}{2} \cdot \left\{ \left(\frac{A}{2} \right)^2 + \left(\frac{B}{2} \right)^2 \right\}}, \text{ (A: Long axis, B: Short axis)}$$

$$Area = \pi \times a \times b, \text{ (a, b: Axis)}$$

2D Trace

This is a basic measurement that is available in all diagnosis modes. You can measure the circumference and area of an irregular object in a 2D image.

You can measure up to 4 distances. When taking more than one measurement, use measurement cursors with different shapes to differentiate them.

1. Press the Softmenu button **[2] Area / Circ** to select 2D Trace. "2D Trace" is displayed on the left side of the screen.
2. Use the trackball and the **Set** button on the control panel to specify the start point for tracing over the contour of the measurement area.
 - ▶ Place the cursor at a desired position with the trackball, and press the **Set** button.
3. Trace the curve so that the measurement cursor returns to the start point, and then press the **Set** button.



NOTE: Trace lines must be closed. If you press the **Set** button before tracing is complete, tracing may be done over a straight line between the current point and the start point, resulting in a significant error.

4. When the measurement is finished, its result is shown on the screen.

- ▶ Circ.: Circumference of Object
- ▶ Avg.(C): Average Circumference
- ▶ Area: Area of Object
- ▶ Avg.(A): Average Area

The equations used for Trace measurement are as follows:

$$Circ = \sum \sqrt{\{X(n) - X(n-1)\}^2 + \{Y(n) - Y(n-1)\}^2}, (N = 1, 2 \dots \text{last point})$$

$$Area = \sum \left[\sqrt{X(n-1) \times Y(n) - X(n) \times Y(n-1)} \right], (N = 1, 2 \dots \text{last point})$$

Volume Measurement

3 Distance

This is a basic measurement that is available in all diagnosis modes. You can measure the volume of an object in a 2D image by using 3 straight lines.

1. Press the Softmenu button **[3] Volume** to select 3D Volume: 3 Distance. "3D Volume: 3 Distance" is displayed on the left side of the screen.
2. Specify two points and measure the straight distance between them. The method for measuring a line is the same as in "2D Distance (Line)."
3. Measure the length of the remaining two straight lines as in the above. Measure other two distance using the same method with 2.
4. When the measurement is finished, its result is shown on the screen. The volume of the object along with the length of each straight line are calculated.

The equations used for 3 Distance measurement are as follows:

$$Vol = \frac{4}{3} \pi \cdot \frac{D_1}{2} \cdot \frac{D_2}{2} \cdot \frac{D_3}{2}, (D: \text{distance})$$

1 Distance

This is a basic measurement that is available in all diagnosis modes. You can measure the volume of an object in a 2D image by using only one straight line.

You can measure up to 4 sets of volumes. When measuring more than one set, use measurement cursors with different shapes to differentiate them.

1. Press the Softmenu button **[3] Volume** to select 3D Volume: 1 Distance. "3D Volume: 1 Distance" is displayed on the left side of the screen.
2. Specify two points and measure the straight distance between them. The method for measuring a line is the same as in "2D Distance (Line)."
3. When the measurement is finished, its result is shown on the screen. The volume of the object along with the length of the straight line are calculated.

The equations used for 1 Distance measurement are as follows:

$$Vol = \frac{4}{3} \pi \cdot \left(\frac{D}{2} \right)^3, (D: \text{distance})$$

Distance + Ellipse

This is a basic measurement that is available in all diagnosis modes. You can measure the volume of an object in a 2D image by using one straight line and one circle (ellipse).

You can measure up to 2 sets of volumes. When measuring more than one set, use measurement cursors with different shapes to differentiate them.

1. Press the Softmenu button **[3] Volume** to select 3D Volume: Distance + Ellipse. "3D Volume: Distance + Ellipse" is displayed on the left side of the screen.
2. Specify two points and measure the straight distance between them. The method for measuring a line is the same as in "2D Distance (Line)."
3. Specify the size of the circle (ellipse). The method for measuring a circle (ellipse) is the same as in "2D Ellipse."
4. When the measurement is finished, its result is shown on the screen.
 - ▶ Dia.: Length of Straight Line
 - ▶ B: Length of B-axis in Ellipse
 - ▶ A: Length of A-axis in Ellipse
 - ▶ V: Volume of Circle (Ellipse)

The equations used for Distance + Ellipse measurement are as follows:

$$Vol = \frac{\pi}{6} \times a \times b \times d, (a : \text{Short axis}, b : \text{Long axis}, d : \text{Distance})$$



NOTE: Since Dual Mode simultaneously displays two images on the screen, you don't have to return to the diagnosis mode to measure volume in Dual Mode.

∴ Calculations by Application

Press the **Calc** button on the control panel.

Things to note

▣ Before Taking Measurements

■ Register Patient

Make sure that the currently registered patient information is correct. If the patient is not registered, press the **Patient** button on the control panel.

For the Patient Information menu and entry method, refer to 'Patient Information' in 'Chapter 3. Starting Diagnosis'.

■ Check Probe, Application & Preset

- ▶ Check the probe name and application that are displayed in the title bar. Press the **App.** key on the keyboards to use another probe or application.
- ▶ Check the preset settings in the *Application* screen.

■ Measurement Menu Settings

Set the related menus for convenient measurement. You can specify how an area and volume can be calculated. Please refer to the "Setting Measurements" section in 'Chapter 7. Utilities' for more information on measurement menus and settings.

▣ Measurement Operations

The following gives information on the common button operations for measurements:

■ Select/Change Application

Use the **Calc** button on the control panel. Each time the **Calc** button is pressed, the application toggles in the order. The order in which applications appear can be specified at Calc Sequence in the *Application* screen.

■ Select Measurement Item

Use the **Menu** dial-button on the control panel.

■ Return to Previous Menu

After placing the cursor under Return in the Measurement menu, press the **Menu** dial-button.

■ Print Measurement Result

Press the **Print** button on the control panel.

■ Exit Measurement

Press the **Exit** button on the control panel.

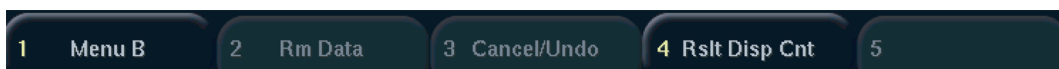
■ End Diagnosis

Press the **End Exam** button on the control panel. The diagnosis for the current patient ends and all measurement results are saved.



NOTE: For information on settings for each application, please refer to 'Chapter 7. Utilities.'

☰ Soft Menu



[Figure 5.2 Calculations by Application – Soft Menu]

■ Menu A / Menu B

When there are a lot of measurement items (menus), they are divided into two menu groups. Select them using the Sofmenu button [1] or the **Change** button on the control panel.

■ Change Method

If the current measurement item can be measured in more than one way, the measurement method is changed. This menu can be selected by pressing the Softmenu button [1] **Chg Method** or the **Change** button on the control panel. Once the measurement is started, the selected measurement method cannot be changed.

In case of measuring distance, choose a measurement method from Line or Trace. When circumference and area are measured, choose a measurement method from Ellipse and Trace.

■ Rm Data

Press the Softmenu button [2] **Rm Data** or the **Clear** button on the control panel. It erases all the measurement data.



NOTE: The measurement results are deleted from the screen but still shown on the report for the corresponding application

■ Cancel / Undo

Press the Softmenu button [3] **Cancel / Undo** to cancel the latest measurement.

■ Rslt Disp Cnt

Press the Softmenu button [4] **Rslt Disp Cnt**. Select number of the measurement result to display. The information related to the item number is displayed in the screen for about a second.

Common Measurement Methods

This section provides information on the common measurement methods used for applications.

✦ Measurements in Spectral Doppler Mode

In general, if you trace a Doppler spectrum, you can obtain results for various measurement items automatically. There are 3 ways to trace a Doppler spectrum.

■ Auto Trace

A spectrum is traced automatically. It is enabled in the Measurement menu in Spectral Doppler Mode.

1. Press **Auto Trace** in the Measurement menu.
2. The system traces a spectrum automatically.
3. When Trace is complete, the measurement results are displayed on the screen.

■ Limited Trace

If you specify a measurement range, a spectrum is traced automatically. It is enabled in the menu in Spectral Doppler Mode.

1. Press **Limited Trace** in the Measurement menu. A bar appears allowing you to specify a measurement area.
2. Specify the measurement range.
 - ▶ Place the bar at a desired position with the trackball, and press the **Set** button.
3. The system traces spectrums within the specified range automatically.
4. When Trace is complete, the measurement results are displayed on the screen.

■ Manual Trace

A spectrum is traced manually. It is enabled in the menu in Spectral Doppler Mode.

1. Press **Manual Trace** in the Measurement menu. A measurement cursor appears over a spectrum.
2. Trace the spectrum. The measuring method is the same as in "D Trace."
3. When Trace is complete, the measurement results are displayed on the screen.

Tips!**Things to consider for Doppler Spectrum Auto Trace**

The state of a Doppler spectrum may affect measurement results. Please see the following:

Causes for Trace Failure

- ▶ If Gain is changed for a Doppler image in the Freeze state, Contour Trace and Peak Trace will not work.
- ▶ If there is little or no noise in an image without a spectrum, Contour Trace will not work.
- ▶ If there is severe noise in an image, Contour Trace will not work.
- ▶ If the Clutter filter is set too high, Auto Trace or Limited Trace may not work.

Causes for Inaccurate Peak Trace

- ▶ If PRF (Pulse Repetition Frequency) is lower than the velocity of the observation area, aliasing may occur. If the original signals are separated from aliasing, Trace can be done but the peak measurement may not be accurate.
- ▶ If the peak of a spectral waveform is not clear or occurs intermittently, Trace can be done but the peak measurement may not be accurate.
- ▶ If the Doppler Gain is set to high or low, it becomes difficult to distinguish spectrums. This may result in measurement error(s).
- ▶ If the Wall Filter is set too high, only part of the spectrum is displayed. In this case, Trace can be done but Peak measurement may not be accurate.
- ▶ If abnormal noise or artifact occurs, Trace can be done but Peak measurement may not be accurate.

Misc.

- ▶ Limited Trace is supported only for two-peak spectrums such as Mitral Valve Inflow and Tricuspid Valve Inflow in the cardiology application.

Volume Flow Measurement

Select Volume Flow in the Measurement menu.

Volume Flow allows you to measure and calculate an area or distance. For information on distance or area measurements, please refer to "Basic Measurements." The TAMV (Time Avg. Mean Velocity) value is automatically measured.

■ Vesl. Area (Vessel Area)

Measure the area of a blood vessel and calculate TAMV and Volume Flow.

$$VolumeFlow(A) = Area \times TAMV \times 60$$

■ **Vesl. Dist. (Vessel Distance)**

Measure the width of a blood vessel and calculate TAMV and Volume Flow.

$$VolumeFlow(D) = \frac{\pi \times d^2}{4} \times TAMV \times 60$$

✚ **Stenosis Measurement**

You can measure the stenosis of each blood vessel system by measuring and calculating an area or distance.

■ **% StA (Stenosis Area)**

Measure the area of the inner and outer walls of a blood vessel.

1. Select the **%StA** menu and the first cursor will appear in 2D Mode.
2. Measure the area of the vessel's outer wall using the Circ / Area measurement method.
3. When the second cursor appears, measure the area of the vessel's inner wall under stenosis.

$$\%Stenosis\ Area. = (Outer\ Area - Inner\ Area) / Outer\ Area \times 100$$

■ **% StD (Stenosis Distance)**

Measure the diameter of a blood vessel.

1. Select the **%StD** menu and the first cursor will appear in 2D Mode.
2. Measure the total diameter of a blood vessel using the Distance measurement method.
3. When the second cursor appears, measure the diameter of the vessel's inner wall under stenosis.

$$\%Stenosis\ Dist. = (Outer\ Distance - Inner\ Distance) / Outer\ Distance \times 100$$

✚ **Heart Rate Measurement**

■ **HR (Heart Rate)**

You can calculate heart rates for a certain period of time.

1. Select **HR** in the Measurement menu. A bar appears allowing you to specify a measurement area.
2. Specify the measurement range.
 - ▶ Place the bar at a desired position with the trackball, and press the **Set** button.
3. The system measures the heart rate within the specified range automatically. The measurement results are displayed on the screen.

OB Calculations

Before Obtaining OB Calculations

Set GA Equation, GA Table and OB Measurement menus. The user can manually write, back up and restore the GA Table. For more information on GA Equation and Table, refer to the Reference Manual.

For more information about other measurement menus and setup, refer to 'Setting Measurements' in 'Chapter 7. Utilities'.



NOTE: For twins, distinguish fetuses by specifying them as Fetus 1 and Fetus 2 in the Measurement menu. Press the **Change** button on the control panel to change a fetus to measure.

Measurement Menu

When the measurements for the selected items are complete, the measurements and gestational age are displayed on the screen.

The measurement method for each item is the same as for basic measurement. Measured items are automatically recorded in a report.



NOTE:

- ▶ For information on basic measurements, please refer to "Basic Measurements" and "Common Measurement Methods" in this chapter.
- ▶ For references on measurement items, please refer to "Reference Manual – Part 1."

OB	OB
Fetal Biometry ▶	Lt. Uterine Artery ▶
Fetal Long Bones ▶	Rt. Uterine Artery ▶
Fetal Cranium ▶	Plac. Artery ▶
Fetal Others ▶	Lt. Fetal Carotids ▶
AFI ▶	Rt. Fetal Carotids ▶
Volume Flow ▶	Fetal Aorta ▶
Umb. Artery ▶	Ductus Venous ▶
MCA ▶	Fetal HR

[Figure 5.3 OB Measurement Menu]

Measurement Menu	Item	Mode	Method	Unit
Fetal Biometry	GS	All	Distance	cm, mm
	CRL	All	Distance	cm, mm
	YS	All	Distance	cm, mm
	BPD	All	Distance	cm, mm
	OFD	All	Distance	cm, mm
	HC	All	Circumference or automatic calculation	cm, mm
	APD	All	Distance	cm, mm
	TAD	All	Distance	cm, mm
	AC	All	Circumference or automatic calculation	cm, mm
	FTA	All	Area or automatic calculation	cm ² , mm ²
	FL	All	Distance	cm, mm
	SL	All	Distance	cm, mm
	TTD	All	Distance	cm, mm
	APTD	All	Distance	cm, mm
Fetal Long Bones	HUM	All	Distance	cm, mm
	ULNA	All	Distance	cm, mm
	TIB	All	Distance	cm, mm
	RAD	All	Distance	cm, mm
	FIB	All	Distance	cm, mm
	CLAV	All	Distance	cm, mm
	Vertebral	All	Distance	cm, mm
Fetal Cranium	CEREB	All	Distance	cm, mm
	OOD	All	Distance	cm, mm
	IOD	All	Distance	cm, mm
	CM	All	Distance	cm, mm
	NF	All	Distance	cm, mm
	NT	All	Distance	cm, mm
	Lat. Vent	All	Distance	cm, mm
Fetal Others	Foot	All	Distance	cm, mm
	Ear	All	Distance	cm, mm
	MP	All	Distance	cm, mm

Measurement Menu	Item	Mode	Method	Unit
AFI	All	All	Distance	cm, mm
	Q1	All	Distance	cm, mm
	Q2	All	Distance	cm, mm
	Q3	All	Distance	cm, mm
	Q4	All	Distance	cm, mm
Volume Flow	Auto Trace	PW	Doppler Spectrum Trace	
	Limited Trace	PW	Doppler Spectrum Trace	
	Manual Trace	PW	Doppler Spectrum Trace	
	PSV	PW	Velocity	cm/s, m/s
	EDV	PW	Velocity	cm/s, m/s
	%StA	All	Calculated after area measurement	%
	%StD	All	Calculated after distance measurement	%
	Vesl. Dist	All	Distance	cm, mm
	Vesl. Area	All	Area	cm ² , mm ²
Umb. Artery	Same as above			
MCA	Same as above			
Rt. / Lt. Uterine Artery	Same as above			
Plac. Artery	Same as above			
Rt. / Lt. Fetal Carotids	Same as above			
Fetal Aorta	Same as above			
Ductus Venous	Same as above			
Fetal HR	Fetal Heart Rate	PW	Heart Rate	bpm

Automatic Calculation

Some items in the measurement menu are automatically calculated based on measurements of other items.

HC

This is automatically calculated using the following formula, provided there are measured BPD and OFD values.

$$HC = \pi \times \sqrt{(BPD^2 + OFD^2)} / 2$$

Exception: when you use Merz reference, $HC = 2.325 * \sqrt{BPD^2 + OFD^2}$

AC

This is automatically calculated using the following formula, provided there are measured APD and TAD values.

$$AC = \pi \times \sqrt{(APD^2 + TAD^2)} / 2$$

Exception: when you use Merz reference, $AC = \pi \times (APD + TAD) / 2$

FTA

This is automatically calculated using the following formula, provided there are measured APD and TAD values.

$$FTA = \pi \times (APD \times TAD) / 4$$

ThC

This is automatically calculated using the following formula, provided there are measured APTD and TTD values.

$$ThC = \pi \times \sqrt{(APTD^2 + TTD^2)} \div 2$$

AFI (Amniotic Fluid Index)

This measures the amniotic fluid index. Measurements are performed by dividing the pregnant woman's abdomen into four parts. The distance between the fetus and the farthest point of each area is measured. To obtain the specific image from each quadrant plane, press the **Freeze** button to switch to the diagnosis mode. After obtaining the image, press the **Freeze** button again to return to the measurement mode.

❏ Calculating Estimated Fetal Weight (EFW)

Estimated fetal weight is calculated automatically when the following items are measured. For information on formulae used for EFW calculation, see 'Estimated Fetal Weight Formula' in the Reference Manual – Part 1.

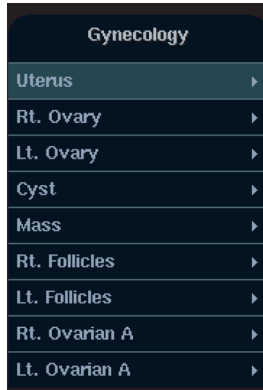
- ▶ BPD and AC
- ▶ BPD and FL, FTA
- ▶ BPD and APTD, TTD, FL
- ▶ BPD and APTD, TTD, SL
- ▶ BPD and TTD
- ▶ AC and FL
- ▶ BPD and AC, FL
- ▶ HC and AC, FL
- ▶ BPD and HC, AC, FL
- ▶ AC



NOTE: For reference, the Osaka University / Tokyo University methods are mainly used in Asia, the Merz method in Europe, and the Shepard / Hadlock methods in the Americas.

GYN Calculations

The measurement method for each item is the same as for basic measurement. Measured items are automatically recorded in a report.



[Figure 5.4 GYN Measurement Menu]



NOTE:

- ▶ For information on basic measurements, please refer to “Basic Measurements” and “Common Measurement Methods” in this chapter.
- ▶ For references on measurement items, please refer to “Reference Manual – Part 2.”

Measurement Menu	Item	Mode	Method	Unit
Uterus	Uterus Length	All	Distance	cm, mm
	Uterus Height	All	Distance	cm, mm
	Uterus Width	All	Distance	cm, mm
	Endo. Thickness	All	Distance	cm, mm
	Cervix Length	All	Distance	cm, mm
	Cervix Height	All	Distance	cm, mm
	Cervix Width	All	Distance	cm, mm
Rt. / Lt. Ovary	Length	All	Distance	cm, mm
	Height	All	Distance	cm, mm
	Width	All	Distance	cm, mm
Cyst	Same as above			

Measurement Menu	Item	Mode	Method	Unit
Mass	Same as above			
Rt. / Lt. Follicle	1 ~ 12	All	Distance	cm, mm
Rt. / Lt. Ovarian A	Auto Trace	PW	Doppler Spectrum Trace	
	Limited Trace	PW	Doppler Spectrum Trace	
	Manual Trace	PW	Doppler Spectrum Trace	
	PSV	PW	Velocity	cm/s, m/s
	EDV	PW	Velocity	cm/s, m/s

Most of the gynecology measurements are distance measurements and volume measurements based on the distance measurement results. If multiple images, such as long axis images and transverse axis images, are needed, press the **Freeze** button to switch to Scan Mode and obtain images from another perspective.

Cardiac Calculations



NOTE:

- ▶ Cardiac measurement is an optional item for SONOACE R3.
- ▶ Since the cardiac blood flow is fast, m/s is used as a velocity unit.

The measurement method for each item is the same as for basic measurement. Measured items are automatically recorded in a report.

Cardiac (A)		Cardiac (B)	
Simpson	▶	AoV Regurg	▶
Vol. A/L	▶	TV Inflow	▶
2D Measure	▶	TV Regurg	▶
LV Mass	▶	PV Systolic	▶
Lt. Ventricle(M)	▶	PV Regurg	▶
Ao/LA(B)	▶	Pulm. Veins	▶
Ao/LA(M)	▶	Hepatic Vein	▶
MV(M)	▶	Tissue Doppler	▶
MV Inflow	▶	Qp:Qs	▶
MV Regurg	▶	Heart Rate	
LVOT Doppler	▶		
AoV Systolic	▶		

[Figure 5.5 Cardiac Measurement Menu]



NOTE:

- ▶ For information on basic measurements, please refer to “Basic Measurements” and “Common Measurement Methods” in this chapter.
- ▶ For references on measurement items, please refer to “Reference Manual – Part 2.”

Measurement Menu	Item	Mode	Method	Unit
Simpson	A4C Diastole	All	Distance	cm, mm
	A4C Systole	All	Distance	cm, mm
	A2C Diastole	All	Distance	cm, mm
	A2C Systole	All	Distance	cm, mm
Vol. A/L	LV Vol. Diastole	All	Volume	ml
	LV Vol. Systole	All	Volume	ml
2D Measure	All	All	Continuous	cm, mm

Measurement Menu	Item	Mode	Method	Unit
2D Measure	IVSd	All	Distance	cm, mm
	IVSs	All	Distance	cm, mm
	LVDd	All	Distance	cm, mm
	LVDs	All	Distance	cm, mm
	LVPWd	All	Distance	cm, mm
	LVPWs	All	Distance	cm, mm
LV Mass	Epi. Area	All	Area	cm ² , mm ²
	Endo. Area	All	Area	cm ² , mm ²
	LV Length	All	Distance	cm, mm
Lt. Ventricle (M)	IVSd	M	Distance	cm, mm
	LVDd	M	Distance	cm, mm
	LVPWd	M	Distance	cm, mm
	IVSs	M	Distance	cm, mm
	LVDs	M	Distance	cm, mm
	LVPWs	M	Distance	cm, mm
	RVDd	M	Distance	cm, mm
	All	M	Continuous	
Ao/LA (B)	Ao-LA	All	Distance	cm, mm
	LVOT Dia	All	Distance	cm, mm
	Ao Root Dia	All	Distance	cm, mm
	LA Dia	All	Distance	cm, mm
Ao/LA (M)	Ao Root Dia	M	Distance	cm, mm
	AoV Cusp Sep.	M	Distance	cm, mm
	LA Dia	M	Distance	cm, mm
	LV PET	M	Time	ms
	LV ET	M	Time	ms
	All	M	Continuous	
MV (M)	All Points	M	Continuous	
	D-E	M	Distance	cm, mm
	E-F Slope	M	Velocity	m/s
	A-C Interval	M	Time	ms
	EPSS	M	Distance	cm, mm

Measurement Menu	Item	Mode	Method	Unit
MV Inflow	Limited Trace	PW	Doppler Spectrum Trace	
	Manual Trace	PW	Doppler Spectrum Trace	
	E-DT-A	PW	Time-Velocity-Time	ms & m/s
	Peak E	PW	Velocity	m/s
	Peak A	PW	Velocity	m/s
	Acc Time	PW	Time	ms
	Dec Time	PW	Time	ms
	PHT	PW	Time	ms
	IVRT	PW	Time	ms
R-R Interval	PW	Time	bpm	
MV Regurg	Auto Trace	PW	Doppler Spectrum Trace	
	Limited Trace	PW	Doppler Spectrum Trace	
	Manual Trace	PW	Doppler Spectrum Trace	
	Peak V	PW	Velocity	m/s
	VTI	PW	Distance	cm, mm
	PISARadius	C	Distance	cm, mm
	PISA-Alias Vel.	C	Velocity	m/s
LVOT Doppler	Auto Trace	PW	Doppler Spectrum Trace	
	Limited Trace	PW	Doppler Spectrum Trace	
	Manual Trace	PW	Doppler Spectrum Trace	
	Peak V	PW	Velocity	m/s
	VTI	PW	Distance	cm, mm
	Dia	All	Distance	cm, mm
AoV Systolic	Auto Trace	PW	Doppler Spectrum Trace	
	Limited Trace	PW	Doppler Spectrum Trace	

Measurement Menu	Item	Mode	Method	Unit
AoV Systolic	Manual Trace	PW	Doppler Spectrum Trace	
	Peak V	PW	Velocity	m/s
	VTI	PW	Distance	cm, mm
	Acc Time	PW	Time	ms
	Ejection Time	PW	Time	ms
	R-R Interval	PW	Time	bpm
AoV Regurg	Auto Trace	PW	Doppler Spectrum Trace	
	Limited Trace	PW	Doppler Spectrum Trace	
	Manual Trace	PW	Doppler Spectrum Trace	
	Peak V	PW	Velocity	m/s
	VTI	PW	Distance	cm, mm
	PHT	PW	Time	ms
	PISARadius	C	Distance	cm, mm
	PISA-Alias Vel.	C	Velocity	m/s
TV Inflow	Limited Trace	PW	Doppler Spectrum Trace	
	Manual Trace	PW	Doppler Spectrum Trace	
	E-DT-A	PW	Time-Velocity-Time	ms & m/s
	Peak E	PW	Velocity	m/s
	Peak A	PW	Velocity	m/s
	Acc Time	PW	Time	ms
	Dec Time	PW	Time	ms
	PHT	PW	Time	ms
R-R Interval	PW	Time	bpm	
TV Regurg	Auto Trace	PW	Doppler Spectrum Trace	
	Limited Trace	PW	Doppler Spectrum Trace	
	Manual Trace	PW	Doppler Spectrum Trace	

Measurement Menu	Item	Mode	Method	Unit
TV Regurg	Peak V	PW	Velocity	m/s
	VTI	PW	Distance	cm, mm
	PISARadius	C	Distance	cm, mm
	PISA-Alias Vel.	C	Velocity	m/s
PV Systolic	Auto Trace	PW	Doppler Spectrum Trace	
	Limited Trace	PW	Doppler Spectrum Trace	
	Manual Trace	PW	Doppler Spectrum Trace	
	Peak V	PW	Velocity	m/s
	Acc Time	PW	Time	ms
	R-R Interval	PW	Time	bpm
PV Regurg	Auto Trace	PW	Doppler Spectrum Trace	
	Limited Trace	PW	Doppler Spectrum Trace	
	Manual Trace	PW	Doppler Spectrum Trace	
	Peak V	PW	Velocity	m/s
	VTI	PW	Distance	cm, mm
	PHT	PW	Time	ms
	PISARadius	C	Distance	cm, mm
	PISA-Alias Vel.	C	Velocity	m/s
Plum. Veins	Dias Vel.	PW	Velocity	m/s
	Sys Vel.	PW	Velocity	m/s
	A. Rev Vel.	PW	Velocity	m/s
	A. Rev Dur.	PW	Time	ms
Hepatic Vein	All	PW	Continuous	
	Dias Vel.	PW	Velocity	m/s
	Sys Vel.	PW	Velocity	m/s
	Rev Vel.	PW	Velocity	m/s
Tissue Doppler	E-DT-A	PW	Time-Velocity-Time	ms & m/s
	Peak E'	PW	Velocity	m/s

Measurement Menu	Item	Mode	Method	Unit
Tissue Doppler	Peak A'	PW	Velocity	m/s
	Peak S	PW	Velocity	m/s
	Acc Time	PW	Time	ms
	Dec Time	PW	Time	ms
	IVCT	PW	Time	ms
	IVRT	PW	Time	ms
Qp:Qs	Sys. VTI	PW	Distance	cm, mm
	Sys. HR	PW	Heart Rate	bpm
	Sys. Dia	All	Distance	cm, mm
	Pulm. VTI	PW	Distance	cm, mm
	Pulm. HR	PW	Heart Rate	bpm
	Pulm. Dia	All	Distance	cm, mm
Heart Rate	Fetal Heart Rate	PW	Heart Rate	bpm

**NOTE:**

- ▶ In Dual 2D Mode, two images can be viewed simultaneously.
- ▶ C Mode is mainly used for measuring reverse cardiac blood flow.
- ▶ As PISA-Radius or PISA-Alias Vel. measurements require Velocity values, you have to select color display for Velocity or Vel + Var in C Mode. For more information, see the 'Color Doppler Mode' section in 'Chapter 4. Diagnosis Mode.'

Vascular Calculations

It is convenient to calculate each measurement value on the Spectral Doppler image.

The measurement method for each item is the same as for basic measurement. Measured items are automatically recorded in a report.



NOTE:

- ▶ For information on basic measurements, please refer to “Basic Measurements” and “Common Measurement Methods” in this chapter.
- ▶ For references on measurement items, please refer to “Reference Manual – Part 2.”

Vascular (A)		Vascular (B)	
Rt. Subclavian	▶	Rt. Mid ICA	▶
Lt. Subclavian	▶	Lt. Mid ICA	▶
Rt. Prox CCA	▶	Rt. Distal ICA	▶
Lt. Prox CCA	▶	Lt. Distal ICA	▶
Rt. Mid CCA	▶	Rt. ECA	▶
Lt. Mid CCA	▶	Lt. ECA	▶
Rt. Distal CCA	▶	Rt. Vertebral	▶
Lt. Distal CCA	▶	Lt. Vertebral	▶
Rt. Bulb	▶	General	▶
Lt. Bulb	▶	Volume Flow	
Rt. Prox ICA	▶	Heart Rate	
Lt. Prox ICA	▶		

[Figure 5.6 Vascular Measurement Menu]

Measurement Menu	Item	Mode	Method	Unit
Rt./ Lt. Subclavian	Auto Trace	PW	Doppler Spectrum Trace	
	Limited Trace	PW	Doppler Spectrum Trace	
	Manual Trace	PW	Doppler Spectrum Trace	
	PSV	PW	Velocity	cm/s, m/s
	EDV	PW	Velocity	cm/s, m/s
	%StA	All	Calculated after area measurement	%
	%StD	All	Calculated after distance measurement	%
	Vesl. Area	All	Area	cm ² , mm ²
	Vesl. Dist	All	Distance	cm, mm
Rt./Lt. Prox CCA	Same as above			
Rt./Lt. Mid CCA	Same as above			
Rt./Lt. Distal CCA	Same as above			
Rt./Lt. Bulb	Same as above			
Rt./Lt. Prox ICA	Same as above			
Rt./Lt. Mid ICA	Same as above			
Rt./Lt. Distal ICA	Same as above			
Rt./Lt. ECA	Same as above			
Rt./Lt. Vertebral	Same as above			
General	Same as above			
Volume Flow	Auto Trace	PW	Doppler Spectrum Trace	
	Vesl. Dist	All	Distance	cm, mm
Heart Rate	Fetal Heart Rate	PW	Heart Rate	bpm

Urology Calculations

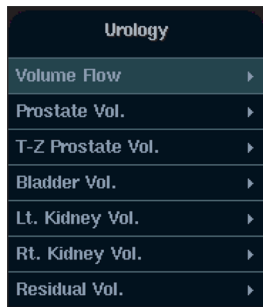
The measurement methods of each menu vary with the Volume Method set at **Setup > Measure > Urology**.

The measurement method for each item is the same as for basic measurement. Measured items are automatically recorded in a report.



NOTE:

- ▶ For information on basic measurements, please refer to “Basic Measurements” and “Common Measurement Methods” in this chapter.
- ▶ For references on measurement items, please refer to “Reference Manual – Part 2.”



[Figure 5.7 Urology Measurement Menu]

3 Distance

Volume is calculated using three distance measurement results.

Measurement Menu	Item	Mode	Method	Unit
Volume Flow	Auto Trace	PW	Doppler Spectrum Trace	cm, mm
	Limited Trace	PW	Doppler Spectrum Trace	cm, mm
	Manual Trace	PW	Doppler Spectrum Trace	cm, mm
	PSV	PW	Velocity	cm/s, m/s
	EDV	PW	Velocity	cm/s, m/s
	%StA	All	Calculated after area measurement	%
	%StD	All	Calculated after distance measurement	%
	Vesl. Dist.	All	Distance	cm, mm
	Vesl. Area	All	Area	cm ² , mm ²

Measurement Menu	Item	Mode	Method	Unit
Prostate Vol.	All	All	Calculated after distance measurement	ml
	1 st Dia.	All	Distance	cm, mm
	2 nd Dia.	All	Distance	cm, mm
	3 rd Dia.	All	Distance	cm, mm
T-Z Prostate Vol.	Same as above			
Bladder Vol.	Same as above			
Rt./Lt. Kidney Vol.	All	All	Calculated after distance measurement	ml
	1 st Dia.	All	Distance	cm, mm
	2 nd Dia.	All	Distance	cm, mm
	3 rd Dia.	All	Distance	cm, mm
	Renal Pelvis	All	Distance	cm, mm
Residual Vol.	Pre All	All	Calculated after distance measurement	ml
	Pre 1 st Dia.	All	Distance	cm, mm
	Pre 2 nd Dia.	All	Distance	cm, mm
	Pre 3 rd Dia.	All	Distance	cm, mm
	Post All	All	Calculated after distance measurement	ml
	Post 1 st Dia.	All	Distance	cm, mm
	Post 2 nd Dia.	All	Distance	cm, mm
	Post 3 rd Dia.	All	Distance	cm, mm

Transitional Zone Prostate Volume, Bladder Volume, Left Renal Volume, and Right Renal Volume measurements are the same as for Prostate Volume.

■ 3 Distance * Factor

Same as '3 Distance'.

■ Ellipsoid

Volume is calculated using the Main diameter and Beside Diameter values.

Measurement Menu	Item	Mode	Method	Unit
Volume Flow	Auto Trace	PW	Doppler Spectrum Trace	cm, mm
	Limited Trace	PW	Doppler Spectrum Trace	cm, mm
	Manual Trace	PW	Doppler Spectrum Trace	cm, mm
	PSV	PW	Velocity	cm/s, m/s
	EDV	PW	Velocity	cm/s, m/s
	%StA	All	Calculated after area measurement	%
	%StD	All	Calculated after distance measurement	%
	Vesl. Dist.	All	Distance	cm, mm
	Vesl. Area	All	Area	cm ² , mm ²
Prostate Vol.	Vol.	All	Calculated after distance measurement	ml
	Main Dia.	All	Distance	cm, mm
	Beside Dia.	All	Distance	cm, mm
T-Z Prostate Vol.	Same as above			
Bladder Vol.	Same as above			
Rt./Lt. Kidney Vol.	All	All	Calculated after distance measurement	ml
	Main Dia.	All	Distance	cm, mm
	Beside Dia.	All	Distance	cm, mm
	Renal Pelvis	All	Distance	cm, mm
Residual Vol.	Pre All	All	Calculated after distance measurement	ml
	Pre Main Dia.	All	Distance	cm, mm
	Pre Beside Dia.	All	Distance	cm, mm
	Post All	All	Calculated after distance measurement	ml
	Post Main Dia.	All	Distance	cm, mm
	Post Beside Dia.	All	Distance	cm, mm

■ Sum of 20 Disks

Measure the prostate circumference and then use the trackball and the **Set** button to measure the prostate axis and calculate the volume.

Measurement Menu	Item	Mode	Method	Unit
Volume Flow	Auto Trace	PW	Doppler Spectrum Trace	cm, mm
	Limited Trace	PW	Doppler Spectrum Trace	cm, mm
	Manual Trace	PW	Doppler Spectrum Trace	cm, mm
	PSV	PW	Velocity	cm/s, m/s
	EDV	PW	Velocity	cm/s, m/s
	%StA	All	Calculated after area measurement	%
	%StD	All	Calculated after distance measurement	%
	Vesl. Dist.	All	Distance	cm, mm
	Vesl. Area	All	Area	cm ² , mm ²
Prostate Vol.	Vol.	All	Dist20	ml
T-Z Prostate Vol	Same as above			
Bladder Vol.	Same as above			
Rt./Lt. Kidney Vol	Same as above			
	Renal Pelvis	All	Distance	cm, mm
Residual Vol.	Pre Vol.	All	Dist20	ml
	Post Vol.	All	Dist20	ml

Fetal Echo Calculations

The measurement method for each item is the same as for basic measurement. In addition, measurement items are similar to those for cardiac calculation.

Measured items are automatically recorded in a report.



[Figure 5.8 Fetal Echo Measurement Menu]



NOTE:

- ▶ For information on basic measurements, please refer to “Basic Measurements” and “Common Measurement Methods” in this chapter.
- ▶ For references on measurement items, please refer to “Reference Manual – Part 2.”

Measurement Menu	Item	Mode	Method	Unit
2D Echo	Asc. Aorta	Distance	Doppler Spectrum Trace	cm, mm
	MPA	Distance	Doppler Spectrum Trace	cm, mm
	Duct. Art	All	Distance	cm, mm
	Rt. / Lt. Atrium	All	Distance	cm, mm
	Rt. Ventricle	All	Distance	cm, mm
	IVS	All	Distance	cm, mm
	LVDd	All	Distance	cm, mm
	LVDs	All	Distance	cm, mm
	LVPW	All	Distance	cm, mm
	Heart Circ.	All	Area	cm, mm

Measurement Menu	Item	Mode	Method	Unit
2D Echo	ThoraCirc.	All	Area	cm, mm
CTAR	All	All	Continuous	cm, mm
	ThAPD	All	Distance	cm, mm
	ThTD	All	Distance	cm, mm
	HAPD	All	Distance	cm, mm
	HTD	All	Distance	cm, mm
Fetal M-mode	All	M	Continuous	cm, mm
	IVSd	M	Distance	cm, mm
	LVDd	M	Distance	cm, mm
	LVPWd	M	Distance	cm, mm
	IVSs	M	Distance	cm, mm
	LVDs	M	Distance	cm, mm
	LVPWs	M	Distance	cm, mm
MPA	RVDd	M	Distance	cm, mm
	Auto Trace	PW	Doppler Spectrum Trace	cm, mm
	Limited Trace	PW	Doppler Spectrum Trace	cm, mm
	Manual Trace	PW	Doppler Spectrum Trace	cm, mm
	PSV	PW	Velocity	cm/s, m/s
	EDV	PW	Velocity	cm/s, m/s
Duct. Art.	Same as above	Same as above		
IVC	Same as above	Same as above		
Duct. Ven	Same as above	Same as above		
Asc. Aorta	Same as above	Same as above		
Desc. Aorta	Same as above	Same as above		
MV Inflow	Peak E	PW	Velocity	cm/s, m/s
	Peak A	PW	Velocity	cm/s, m/s
MV Regurg	Velocity	PW	Velocity	cm/s, m/s
TV Inflow	Peak E	PW	Velocity	cm/s, m/s
	Peak A	PW	Velocity	cm/s, m/s
TV Regurg	Velocity	PW	Velocity	cm/s, m/s
PLI	SF	PW	Velocity	cm/s, m/s
	DF	PW	Velocity	cm/s, m/s
	ARF	PW	Velocity	cm/s, m/s
Heart Rate	Fetal Heart Rate	PW	Heart Rate	bpm

■ **CTAR (Cardio-Thorax Area Ratio)**

This measurement is for comparing the sizes of the fetus’ chest and heart. The comparison is made by obtaining the ThD ap, ThD trans, HrtD ap, and HrtD trans values.

$$CTAR = \frac{HrtD\ ap \times HrtD\ trans}{ThD\ ap \times ThD\ trans} \times 100$$

Report

Check the measurement and calculation results in the report of each application.

- ▶ Press the **Report** button on the keyboard to check the report of the specific application.
- ▶ The applications not yet measured are not shown.
- ▶ The deviated data from the valid range will be displayed with Invalid mark(*).
- ▶ To return to the diagnosis mode, press the **X** on the report screen, or press the **Exit** button on the control panel or the **Report** button.

OB Report							1/1		2010-02-12		15:23:47	
Header							Graph		Edit			
Institution	Institution			Sonographer								
ID	20100208-000			Heart Rate		bpm						
Name	Angie Chung			Birthday		1978-03-16						
LMP	2009-07-10			EDD(LMP)		2010-04-16						
Average US GA	31w2d			EDD(Average US GA)		2010-04-14						
GA(LMP)	31w0d											
EFW Campbell	1685g (59.43oz)			GA(EFW)		30w5d						
Percentile(EFW)	38.79			SD(EFW)		-0.28						
Fetal Biometry												
		1	2	3	Avg.	G.A.	SD					
BPD	Hadlock	8.18			8.18 cm	32w6d ±22d	+1.23					
HC	Hadlock	28.58			28.58 cm	31w3d ±21d	-0.71					
AC	Hadlock	25.92			25.92 cm	30w1d ±21d	-0.82					
FTA	Osaka				53.46 cm ²	30w5d	-0.17					
Calc												
HC/AC		1.10			(0.96 - 1.17)							

[Figure 5.9 Report Screen – Example]


Viewing Report

- ▶ The measurement and calculation items and their values are displayed.
- ▶ When the *report* screen has more than two pages, use the **left / right arrow** button on the *report* screen. To search and check the reports of other applications, use the **Next Package** to move to the specific package.


Editing Report

Press the **Edit** to edit the specific information. After editing, press the **Ok** at the top of the screen to return to the original report screen, and the edited values are shown in the [] bracket in the report.


Comment

Press the **Comment** . Press the **Ok** at the top of the screen after entering some comment to return to the original *report* screen.

Printing out Report

Press the **Print**  in the *report* screen. If there is no connection with a printer, this button will not be displayed.

Exporting Report

- ▶ Press the **Export**  on the screen to save the report as MO Disk or Flash Memory. The *Export Report* window appears on the screen to designate File Name and File Format as shown below.
- ▶ The Export is not activated if the drive is not connected.
- ▶ The file name is automatically given, but the file name can also be inputted manually. The user can choose a file format of Excel, Text, or PDF.

✚ Open Line Transfer

Transfer the report to another computer or printer. Press the **Open Line Transfer** on the *Export Report* window.



NOTE:

- ▶ Connect the USB to RS-232C serial cable to the USB port of the rear panel prior to use this function.
- ▶ If the operating system of the PC connected to this system via the USB to RS-232C Serial Cable is Windows XP™, errors may be caused during report transferring.

Set the computer or printer, connects to this system, like following;

- ▶ 9,600 Baud
- ▶ 8-bit data
- ▶ No parity
- ▶ 1 stop bit

Graph Function

- ▶ This function is used to display the GA values such as BPD, HC, AC and FL, allowing the user to diagnose fetal growth.
- ▶ The function can be used only in the OB report. Press **Graph** on the screen.
- ▶ The graph is created using ID, LMP, and measurement date as standards.
- ▶ To change to the *Report* screen, press *Report* on the screen.
- ▶ To return to the diagnosis mode, press the **X** on the graph screen, or press the **Exit** button on the control panel.



NOTE: Only after the patient name, ID and LMP are entered, the graph and report are automatically saved in the HDD.

▣ Viewing Graph

- ▶ The graph of the recently measured values is drawn according to the gestation period (week) and fetal size (mm).
- ▶ The G.A. values, including the fetal weight, are displayed at the bottom of the screen. Select a specific item on the combo box using the trackball and the **Set** button, and a graph appears.

▣ Viewing History

- ▶ To view the history information, press the **History** on the *OB report* screen. To return to the *graph* screen, press the button again.
- ▶ Select Fetus and Date Display Type to study.

