FUJIFILM
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SONOSITE PX

User Guide

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Caution Federal (United States) law restricts this device to sale by or on the order of a physician.

Patents: US 10,496,137; US 9,895,133; US 9,848,851; US 9,671,491; US 9,151,832; US 8,861,822; US 8,834,372; US 8,568,319; US 8,500,647; US 8,398,408; US 8,066,642; US 7,804,970; US 7,591,786; US D625,015; US D625,014; JP 6462164; JP 6322321; JP 6258367; JP 5972258; EP 2555683; EP 1589878, validated in FR, GB, DE; CN 103237499; CN 101231457; CA 2796067.

Part Number: P21894-02

Publication Date: June 2020

CE 2797

CONTENTS

1. Introduction

2. Intended Use

3. Getting Started

4. Configuring the System

5. Entering Patient Information

6. Scanning

7. Managing Images and Clips

8. Measurements and Calculations

9. Managing Patient Data

10. Measurement References

11. Troubleshooting and Maintenance

12. Cleaning and Disinfecting

13. Safety

14. Acoustic Output

15. IT Network

A. Glossary

B. Index

CHAPTER 1

Introduction

About the Sonosite PX user guide

The *Sonosite PX User Guide* provides information on preparing and using the Sonosite PX ultrasound system and on cleaning and disinfecting the system and transducers. It also provides system specification, and safety and acoustic output information.

Note We highly recommend you read the entire user guide before using the system.

The user guide is intended for a user familiar with ultrasound. It does not provide training in sonography, ultrasound, and clinical practices. Before using the Sonosite PX ultrasound system, you must complete such training.

For information on using accessories and peripherals, refer to the applicable FUJFILM SONOSITE accessory user guide and manufacturer's instructions.

Document conventions

The user guide follows these conventions:

- A **WARNING** describes precautions necessary to prevent injury or loss of life.
- A **Caution** describes precautions necessary to protect the products.
- A **Note** provides supplemental information.
- Numbered and lettered steps must be performed in a specific order.
- Bulleted lists present information in list format but do not imply a sequence.
- Single-step procedures begin with ❖.

Symbols and terms used on the system and transducer are explained in **"Labeling symbols"** on page 13-21 and the **"Glossary"** on page A-1.

Getting help

In addition to the *Sonosite PX User Guide,* the following are available:

- Educational tutorials and system help videos. See **page 3-28**.
- On-board help and user guide: tap an information button  .
- Service manual.
- Fujifilm Sonosite Technical Support

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CHAPTER 2

Intended Use

The intended use is: Medical Diagnostic Ultrasound. The Sonosite PX ultrasound system is intended for diagnostic ultrasound imaging or fluid flow analysis of the human body.

Indications for use

Diagnostic ultrasound

The Sonosite PX ultrasound system is a general purpose ultrasound system intended for use by qualified physicians and healthcare professionals for evaluation by ultrasound imaging or fluid flow analysis of the human body. Specific clinical applications and exam types include:

- Abdominal
- Adult cephalic
- Cardiac adult
- Cardiac pediatric
- Fetal – OB/GYN
- Musculoskeletal (conventional)
- Musculoskeletal (superficial)
- Ophthalmic
- Pediatric
- Peripheral vessel
- Small organ (breast, thyroid, testicles, prostate)
- Transvaginal
- Needle guidance

This device is indicated for Prescription Use Only.

The Sonosite PX Ultrasound System is intended to be used in medical practices, clinical environments, including Healthcare facilities, Hospitals, Clinics and clinical point-of-care for diagnosis of patients.

The system is used with a transducer attached and is powered either by battery or by AC electrical power. The clinician is positioned next to the patient and places the transducer onto the patient's body where needed to obtain the desired ultrasound image.

Clinical applications

The following tables displays the clinical applications and imaging modes for the system and transducers. The predefined exam types available on each transducer are displayed in **Table 3–2** on page 3-24.

Table 2–1: Sonosite PX diagnostic ultrasound indications for use

Intended use:	Diagnostic ultrasound imaging or fluid flow analysis of the human body as follows:						
Clinical application	Mode of operation[a]						
	2D	M	C	PWD	CWD	Combined (spec.)	Other (spec.)
Abdominal	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	c, e, f
Adult cephalic	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	f
Cardiac adult	✓	✓	✓	✓	✓	B+M; B+PWD; B+CWD; B+C; (B+C)+PWD; (B+C)+CWD	c, d, f, g
Cardiac pediatric	✓	✓	✓	✓	✓	B+M; B+PWD; B+CWD; B+C; (B+C)+PWD; (B+C)+CWD	c, d, f, g
Fetal – OB/GYN	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	c, e, f, h
Musculoskeletal (conventional)	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f, h
Musculoskeletal (superficial)	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f, h
Ophthalmic	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	c, e, f
Pediatric	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f, h
Peripheral vessel	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f, h, i
Small organ (breast, thyroid, testicles, prostate)	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f, h
Transvaginal	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	c, e, f, h

a. 2D = B Mode; M = M Mode including simultaneous; PWD = Pulse Wave Doppler; CWD = Continuous Wave Doppler; C = Color Doppler (Velocity Color Doppler or CVD, Color Power Doppler or CPD, Variance or Var)
b. Steep Needle Profiling (SNP) = Needle enhancement in B Mode
c. Tissue Harmonic Imaging (THI)
d. Tissue Doppler Imaging (TDI)

e. Multi-beam imaging (SonoMB) in B Mode
f. Color Doppler includes Power/Velocity
g. Color Doppler includes Velocity/Variance
h. Includes imaging to assist in the placement of needles and catheters in vascular or other anatomical structures
i. B+PWD and (B+C)+PWD includes simultaneous PWD

Table 2-2: C5-1 transducer diagnostic ultrasound indications for use

Intended use:	Diagnostic ultrasound imaging or fluid flow analysis of the human body as follows:						
Clinical application	Mode of operation[a]						
	2D	M	C	PWD	CWD	Combined (spec.)	Other (spec.)
Abdominal	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	c, e, f
Cardiac adult	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	f
Cardiac pediatric	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	f
Fetal - OB/GYN	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	c, e, f
Musculoskeletal (conventional)	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f
Pediatric	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f
Peripheral vessel	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f

a. 2D = B Mode; M = M Mode including simultaneous; PWD = Pulse Wave Doppler; CWD = Continuous Wave Doppler; C = Color Doppler (Velocity Color Doppler or CVD, Color Power Doppler or CPD, Variance or Var)
b. Steep Needle Profiling (SNP) = Needle enhancement in B Mode
c. Tissue Harmonic Imaging (THI)
d. Tissue Doppler Imaging (TDI)
e. Multi-beam imaging (SonoMB) in B Mode
f. Color Doppler includes Power/Velocity
g. Color Doppler includes Velocity/Variance
h. Includes imaging to assist in the placement of needles and catheters in vascular or other anatomical structures

Note The C5.1 transducer is capable of imaging superficial MSK. The frequency is limited to 3.5 MHz.

Table 2-3: IC10-3 transducer diagnostic ultrasound indications for use

Intended use:	Diagnostic ultrasound imaging or fluid flow analysis of the human body as follows:						
Clinical application	Mode of operation[a]						
	2D	M	C	PWD	CWD	Combined (spec.)	Other (spec.)
Fetal - OB/GYN	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	c, e, f, h
Transvaginal	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	c, e, f, h

a. 2D = B Mode; M = M Mode including simultaneous; PWD = Pulse Wave Doppler; CWD = Continuous Wave Doppler; C = Color Doppler (Velocity Color Doppler or CVD, Color Power Doppler or CPD, Variance or Var)
b. Steep Needle Profiling (SNP) = Needle enhancement in B Mode
c. Tissue Harmonic Imaging (THI)
d. Tissue Doppler Imaging (TDI)
e. Multi-beam imaging (SonoMB) in B Mode
f. Color Doppler includes Power/Velocity
g. Color Doppler includes Velocity/Variance
h. Includes imaging to assist in the placement of needles and catheters in vascular or other anatomical structures

Table 2-4: L12-3 transducer diagnostic ultrasound indications for use

Intended use:	Diagnostic ultrasound imaging or fluid flow analysis of the human body as follows:						
Clinical application	Mode of operation[a]						
	2D	M	C	PWD	CWD	Combined (spec.)	Other (spec.)
Cardiac adult	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	f
Cardiac pediatric	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	f
Musculoskeletal (conventional)	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f
Musculoskeletal (superficial)	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f
Ophthalmic	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	e, f
Pediatric	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f
Peripheral vessel	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f, i
Small organ (breast, thyroid, testicles, prostate)	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f

a. 2D = B Mode; M = M Mode including simultaneous; PWD = Pulse Wave Doppler; CWD = Continuous Wave Doppler; C = Color Doppler (Velocity Color Doppler or CVD, Color Power Doppler or CPD, Variance or Var)
b. Steep Needle Profiling (SNP) = Needle enhancement in B Mode
c. Tissue Harmonic Imaging (THI)
d. Tissue Doppler Imaging (TDI)
e. Multi-beam imaging (SonoMB) in B Mode
f. Color Doppler includes Power/Velocity
g. Color Doppler includes Velocity/Variance
h. Includes imaging to assist in the placement of needles and catheters in vascular or other anatomical structures
i. B+PWD and (B+C)+PWD includes simultaneous PWD

Table 2-5: L15-4 transducer diagnostic ultrasound indications for use

Intended use:	Diagnostic ultrasound imaging or fluid flow analysis of the human body as follows:						
Clinical application	Mode of operation[a]						
	2D	M	C	PWD	CWD	Combined (spec.)	Other (spec.)
Musculoskeletal (conventional)	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f
Musculoskeletal (superficial)	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f,
Pediatric	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f
Peripheral vessel	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f, i
Small organ	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f

a. 2D = B Mode; M = M Mode including simultaneous; PWD = Pulse Wave Doppler; CWD = Continuous Wave Doppler; C = Color Doppler (Velocity Color Doppler or CVD, Color Power Doppler or CPD, Variance or Var)
b. Steep Needle Profiling (SNP) = Needle enhancement in B Mode
c. Tissue Harmonic Imaging (THI)
d. Tissue Doppler Imaging (TDI)
e. Multi-beam imaging (SonoMB) in B Mode
f. Color Doppler includes Power/Velocity
g. Color Doppler includes Velocity/Variance
h. Includes imaging to assist in the placement of needles and catheters in vascular or other anatomical structures
i. B+PWD and (B+C)+PWD includes simultaneous PWD

Table 2-6: L19-5 transducer diagnostic ultrasound indications for use

Intended use:	Diagnostic ultrasound imaging or fluid flow analysis of the human body as follows:						
Clinical application	Mode of operation[a]						
	2D	M	C	PWD	CWD	Combined (spec.)	Other (spec.)
Cardiac adult	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	f
Cardiac pediatric	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	f
Musculoskeletal (conventional)	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f, h
Musculoskeletal (superficial)	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f, h
Ophthalmic	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	e, f
Pediatric	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f, h
Peripheral vessel	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f, h, i
Small organ (breast, thyroid, testicles, prostate)	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	b, c, e, f, h

a. 2D = B Mode; M = M Mode including simultaneous; PWD = Pulse Wave Doppler; CWD = Continuous Wave Doppler; C = Color Doppler (Velocity Color Doppler or CVD, Color Power Doppler or CPD, Variance or Var)
b. Steep Needle Profiling (SNP) = Needle enhancement in B Mode
c. Tissue Harmonic Imaging (THI)
d. Tissue Doppler Imaging (TDI)
e. Multi-beam imaging (SonoMB) in B Mode
f. Color Doppler includes Power/Velocity
g. Color Doppler includes Velocity/Variance
h. Includes imaging to assist in the placement of needles and catheters in vascular or other anatomical structures
i. B+PWD and (B+C)+PWD includes simultaneous PWD

Table 2-7: P5-1 transducer diagnostic ultrasound indications for use

Intended use:	Diagnostic ultrasound imaging or fluid flow analysis of the human body as follows:						
Clinical application	Mode of operation[a]						
	2D	M	C	PWD	CWD	Combined (spec.)	Other (spec.)
Abdominal	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	c, e, f
Adult cephalic	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	f
Cardiac adult	✓	✓	✓	✓	✓	B+M; B+PWD; B+CWD; B+C; (B+C)+PWD; (B+C)+CWD	c, d, f, g
Cardiac pediatric	✓	✓	✓	✓	✓	B+M; B+PWD; B+CWD; B+C; (B+C)+PWD; (B+C)+CWD	c, d, f, g
Fetal - OB/GYN	✓	✓	✓	✓	—	B+M; B+PWD; B+C; (B+C)+PWD	c, g

a. 2D = B Mode; M = M Mode including simultaneous; PWD = Pulse Wave Doppler; CWD = Continuous Wave Doppler; C = Color Doppler (Velocity Color Doppler or CVD, Color Power Doppler or CPD, Variance or Var)
b. Steep Needle Profiling (SNP) = Needle enhancement in B Mode
c. Tissue Harmonic Imaging (THI)
d. Tissue Doppler Imaging (TDI)
e. Multi-beam imaging (SonoMB) in B Mode
f. Color Doppler includes Power/Velocity
g. Color Doppler includes Velocity/Variance
h. Includes imaging to assist in the placement of needles and catheters in vascular or other anatomical structures

The system transmits ultrasound energy into the patient's body to obtain ultrasound images as described in the following table.

Table 2-8: Clinical application descriptions

Clinical application	Description	Exam types
Abdominal	You can assess the liver, kidneys, pancreas, spleen, gallbladder, bile ducts, transplanted organs, abdominal vessels, and surrounding anatomical structures for the presence or absence of pathology transabdominally. You can assist with the performance of interventional abdominal procedures and evaluate hemodynamic blood flow in abdominal organs.	Abdomen
Adult cephalic	You can assess the anatomical structures and vascular anatomy of the brain for the presence or absence of pathology. You can use imaging temporally, transoccipitally, or transorbitally.  **WARNING** To avoid injury to the patient, use only the Ophthalmic or Orbital exam type when performing imaging through the eye. The FDA has established lower acoustic energy limits for ophthalmic use. The system will not exceed these limits if the Ophthalmic or Orbital exam type is selected.	Orbital, Transcranial
Cardiac adult	You can assess the cardiac valves, the great vessels, chamber size and volume, cardiac function, hemodynamic assessment, and surrounding anatomical structures for the presence or absence of pathology. You can detect normal lung motion for the presence or absence of pathology.	Cardiac, Focused Cardiac, Lung
Cardiac pediatric	You can assess the cardiac valves, the great vessels, chamber size and volume, cardiac function, hemodynamic assessment, and surrounding anatomical structures for the presence or absence of pathology. You can detect normal lung motion for the presence or absence of pathology.	Cardiac, Focused Cardiac, Lung

Table 2-8: Clinical application descriptions

Clinical application	Description	Exam types
Fetal -OB/GYN	You can assess the fetal anatomy, viability, estimated fetal weight, fetal heart rate, fetal position, gestational age, amniotic fluid, and surrounding anatomical structures for the presence or absence of pathology transabdominally. You can evaluate the blood flow of the fetus, placenta, umbilical cord, and surrounding maternal structures. Color Power Doppler (CPD) and Color Velocity Doppler (CVD) imaging tools are intended to evaluate the blood flow of the fetus, placenta, umbilical cord, and surrounding maternal structures in all cases, including high-risk pregnancies. High-risk pregnancy indications include, but are not limited to, multiple pregnancies, fetal hydrops, placental abnormalities, maternal hypertension, diabetes, and lupus. CPD and Color imaging tools are not intended as a sole means of diagnosis nor as a sole method of high-risk pregnancy screening.  **WARNINGS** ▸ During the first trimester, you should limit the duration of ultrasound imaging based on MI/TI. See **Chapter 14, "Acoustic Output,"** for more information. ▸ CPD or Color images can be used as an adjunctive method, not as a screening tool, for the detection of structural anomalies of the fetal heart and as an adjunctive method, not as a screening tool, for the diagnosis of Intrauterine Growth Retardation (IUGR). ▸ To prevent injury or misdiagnosis, do not use this system for Percutaneous Umbilical Blood Sampling (PUBS) or *in vitro* Fertilization (IVF). The system has not been validated to be proven effective for these two uses.	Early OB, Gynecology, Obstetrics
Musculoskeletal (conventional and superficial)	You can assess musculoskeletal structures, soft tissue structures, and surrounding anatomical structures for the presence or absence of pathology.	MSK, Nerve, Spine, Superficial

Table 2-8: Clinical application descriptions

Clinical application	Description	Exam types
Ophthalmic	You can assess the ocular structures and surrounding anatomical structures for the presence or absence of pathology.  **WARNING** To avoid injury to the patient, use only the Ophthalmic or Orbital exam type when performing imaging through the eye. The FDA has established lower acoustic energy limits for ophthalmic use. The system will not exceed these limits if the Ophthalmic or Orbital exam type is selected.	Ophthalmic, Orbital
Pediatric	You can assess the liver, kidneys, pancreas, spleen, gallbladder, bile ducts, transplanted organs, abdominal vessels and surrounding anatomical structures for the presence or absence of pathology trans abdominally. You can evaluate and perform interventional abdominal procedures and evaluate blood flow in abdominal organs.	Abdomen, Arterial, MSK, Superficial, Venous
Peripheral vessel	You can assess the carotid arteries, deep veins and arteries in the arms and legs, superficial vessels in the arms and legs, great vessels in the abdomen, and various small vessels feeding organs for the presence or absence of pathology.	Arterial, Carotid, Venous
Small organs (breast, thyroid, testicles, prostate)	You can assess the breast, prostate, thyroid, testicles, lymph nodes, hernias, soft tissue structures, and surrounding anatomical structures for the presence or absence of pathology. You can demonstrate blood flow in superficial anatomical structures.	Breast, Superficial

Table 2-8: Clinical application descriptions

Clinical application	Description	Exam types
Transvaginal	You can assess the uterus, ovaries, adnexa, and surrounding anatomical structures for the presence or absence of pathology transvaginally. You can assess blood flow in pelvic organs transvaginally. During early OB, you can assess the fetal anatomy, viability, fetal heart rate, fetal position, gestational age, amniotic fluid, and surrounding anatomical structures for the presence or absence of pathology transvaginally. You can evaluate the blood flow of the fetus, placenta, umbilical cord, and surrounding maternal structures. Color Power Doppler (CPD) and Color Velocity Doppler (CVD) imaging tools are intended to evaluate the blood flow of the fetus, placenta, umbilical cord, and surrounding maternal structures in all cases, including high-risk pregnancies. High-risk pregnancy indications include, but are not limited to, multiple pregnancies, fetal hydrops, placental abnormalities, maternal hypertension, diabetes, and lupus. CPD and Color imaging tools are not intended as a sole means of diagnosis nor as a sole method of high-risk pregnancy screening.  **WARNINGS** ▸ During the first trimester, you should limit the duration of ultrasound imaging based on MI/TI. See **Chapter 14, "Acoustic Output,"** for more information. ▸ CPD or Color images can be used as an adjunctive method, not as a screening tool, for the detection of structural anomalies of the fetal heart and as an adjunctive method, not as a screening tool, for the diagnosis of Intrauterine Growth Retardation (IUGR). ▸ To prevent injury or misdiagnosis, do not use this system for Percutaneous Umbilical Blood Sampling (PUBS) or *in vitro* Fertilization (IVF). The system has not been validated to be proven effective for these two uses.	Gynecology, Early OB, Obstetrics

Biometric measurements

You can perform the following clinical measurements on the Sonosite PX ultrasound system. For details, see **Chapter 8, "Measurements and Calculations,"** and **Chapter 10, "Measurement References."**

Calculations include:

- Volume
- Volume flow
- Cardiac
- Obstetrics
- Ratios
- Percent reduction

Measurements and their references include:

- Cardiac measurements
- Obstetrical measurements
- General measurements (such as distance, area, angle, velocity, slope, and VTI)

Measurement and analysis performance encompasses the accuracy of the caliper measurements as well as the accuracy of algorithms used to further analyze the measurements. The accuracy values require that the operator can place the caliper marker over one pixel. The values do not include acoustical anomalies of the body. Other limitations and assumptions for measurement performance are given in **Chapter 10, "Measurement References."**

Accuracy of each clinical measurement possible and the range over which this accuracy can be expected to be maintained are also found in **Chapter 10, "Measurement References."**

Contraindications

The Sonosite PX ultrasound system has no known contraindications.

CHAPTER 3

Getting Started

WARNING Do not use the system if it exhibits erratic or inconsistent behavior. Such behavior could indicate a hardware failure. Contact Fujifilm Sonosite Technical Support (see **"Getting help"** on page 1-2).

About the system

The Sonosite PX system is a portable device that acquires and displays high-resolution, real-time ultrasound images. Features available depend on your system configuration, transducer, and exam type.

Basic operating steps

A license key is required to activate the software. See **"Software licensing"** on page 11-3.

1. Connect a transducer (see **page 3-20**).
2. Turn on the system (see **page 3-7**).
3. Select the transducer and exam type, or use the default selections (see **page 3-23**).
4. (Optional) Enter patient information (see **page 5-2**).
5. Scan (see **page 6-1**).

Hardware features

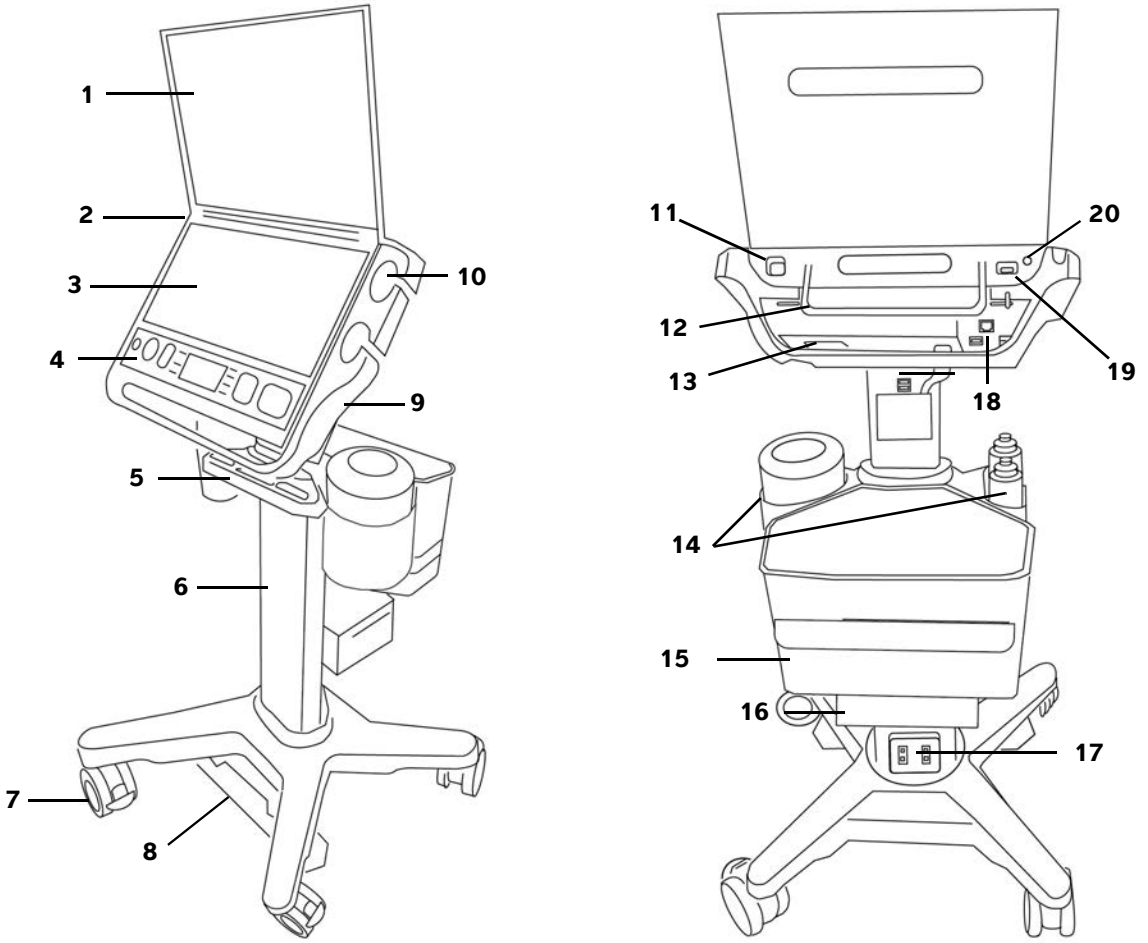


Figure 3–1 Sonosite PX system on the stand

Front view		Back view	
1	Clinical monitor	11	System USB ports
2	DC connector for the portable power supply (used off the stand)	12	System handle
3	Touch panel	13	System TTC connector
4	Physical controls	14	Wipes and gel holders
5	Cable management system	15	Storage container and drawer

Front view		Back view	
6	Stand	16	Printer
7	Locking wheels (4)	17	Plugs for the stand AC power cord and the printer power cord
8	Height adjustment pedal	18	Ports on the stand (USB, HDMI, Ethernet)
9	Stand platform with built-in triple transducer connector (TTC)	19	ECG port (future use)
10	Transducer holders	20	Power on/off button

Accessories and peripherals

WARNING Use only accessories and peripherals recommended by Fujifilm Sonosite, including the power supply. Connection of accessories and peripherals not recommended by Fujifilm Sonosite could result in electrical shock and system malfunction. Contact Fujifilm Sonosite or your local representative for a list of accessories and peripherals available from or recommended by Fujifilm Sonosite.

The Sonosite PX ultrasound system is designed to support a variety of accessories and peripherals. For a complete list, see **"Compatible accessories and peripherals"** on page 13-15.

Preparing the system

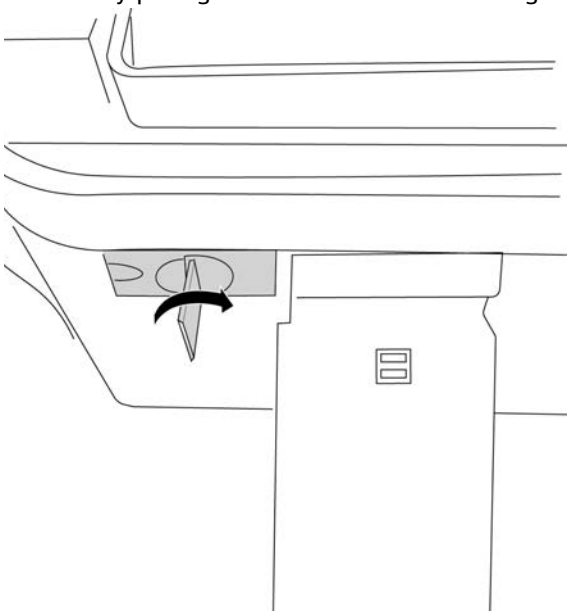
You can use the system on or off the stand.

WARNING Do not lean on the ultrasound system's handle while the system is on the stand. The system could tilt suddenly, causing you to lose your balance.

Docking the system to the stand

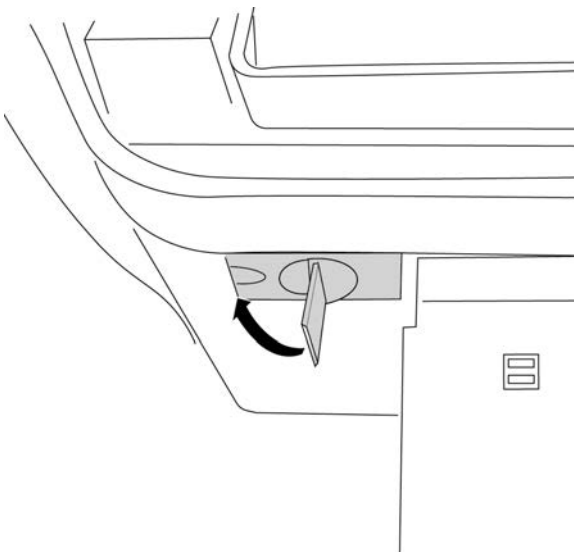
To dock the system to the stand

1 Make sure that the connector located on the bottom of the built-in Triple Transducer Connect (TTC) is loose by pulling the latch down then rotating it.



2 Dock the system to the platform, and secure it by rotating the system handle down until it clicks.

3 Tighten the connection between the system and the TTC by pushing the connector back into place, rotating the latch in the opposite direction, then pressing it up.



Securing the system to the stand

The stand platform has two security latches located on the back left and the back right. By default, the right latch is spring-loaded in a closed position, while the left latch is held open by an adjacent screw. You can change how the system is secured to the stand.

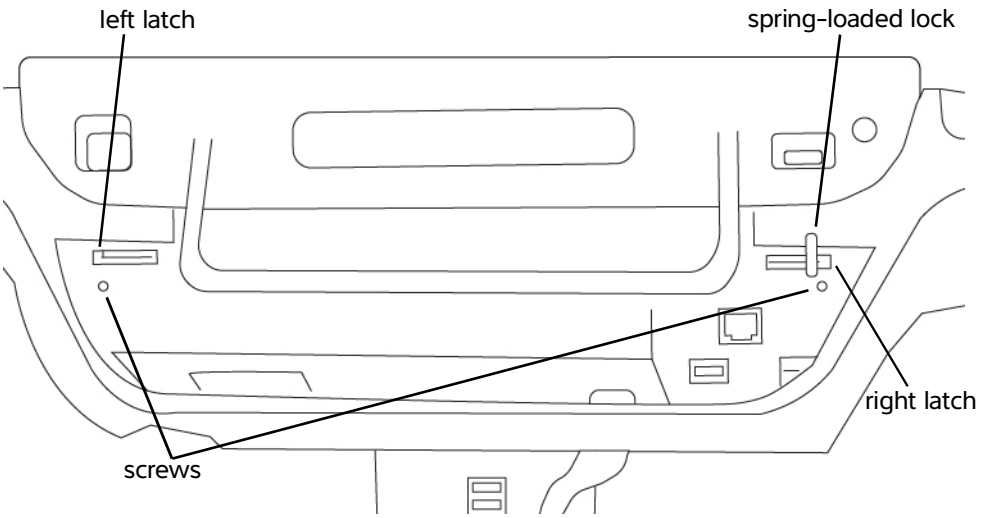


Figure 3-2 Security latches and adjacent screws

To lock or unlock the system on the stand

❖ Do one of the following:

- To partially secure the system to the stand, leave the security latches in the default configuration.
- To securely lock the system to the stand, loosen the screw holding the left latch open. Allow the latch to close, then tighten the screw. You can also tighten the screw next to the right latch.
- To more easily remove the system from the stand, hold the spring-loaded latch open while tightening the adjacent screw. The latch will remain in the open position.

Undocking the system from the stand

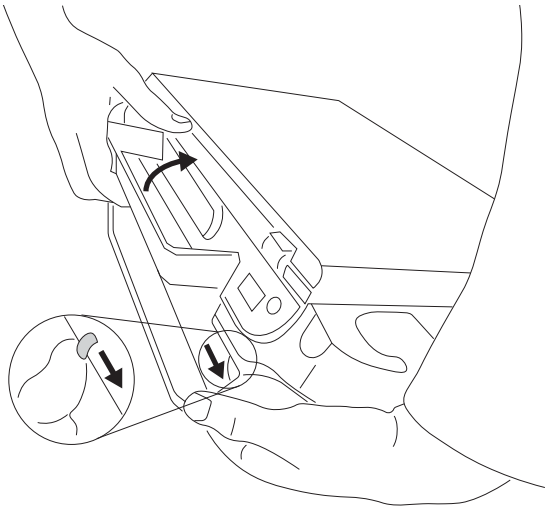
To undock the system from the stand

Caution Disconnect any devices attached to the ultrasound system such as USB devices, transducers (see **"To remove a transducer"** on page 3-23), or cables, before removing it from the stand. Failure to disconnect attached devices may result in damage to the system or accessories.

1 Loosen the connection between the system and the built-in Triple Transducer Connect (TTC) by pulling the latch down then rotating it.

2 Depending on how the system is secured (see the previous section), do one of the following:

- If the system is partially secured, hold the spring-loaded latch open and simultaneously pull up on the system handle.



- If the system is locked to the stand, loosen the screw or screws locking one or both latches, hold the left safety latch open, and re-tighten the screw. Remove the system by holding the spring-loaded latch open and simultaneously pulling up on the system handle.
- If the system is not locked to the stand, pull up on the system handle.

Adjusting the height and angle

WARNING Lock the wheels whenever the system is unattended or stationary.

To lock a wheel

❖ Press down the lever on the wheel.

To unlock the wheel, press up on the bottom of the lever.

To adjust the platform angle

❖ Grasping the platform on both sides, tilt it up or down.

Note To avoid the monitor from hitting you while you are adjusting the platform, close the system's lid.

To raise or lower the platform

❖ While pressing down the height-adjustment pedal located at the bottom of the stand, grasp both sides of the platform and push down or pull up to the desired height.

Turning the system on or off

WARNINGS

- Verify that the hospital AC mains supply voltage corresponds to the power supply voltage range.
- Plug the system only into a grounded hospital-grade AC mains outlet.
- Use only power cords provided by Fujifilm Sonosite with the system.

Cautions

- Do not use the system if an error message appears on the monitor. Note the error code and turn off the system. Call Fujifilm Sonosite or your local representative.
- When using AC power, position the system to allow easy access to unplug it from the AC mains outlet.

The system can be powered by the internal batteries or by AC power.

To turn on the system

1 If you are operating the system using AC power, do one of the following (refer to **Figure 3-1** on page 3-2):

- If you are using the system on the stand, connect one end of the stand AC power cord to the stand.
- If you are using the system off the stand, connect the portable power supply to the DC connector located on the system.

2 Connect the AC power cord coming from the stand or the portable power supply to a hospital-grade AC mains outlet.

3 Press the power button .

Notes

- If the system does not maintain expected battery charge, or if the battery icon on the monitor does not display the battery charge status, disconnect and reconnect the system to AC power.
- Connect the system to AC power to maintain battery charge, especially if the system will not be used for several days.

To turn off the system

Note If the system appears unresponsive, wait several minutes before restarting it. Restarting the system while it is performing data-intensive background activities, such as transferring patient files, can result in loss of patient data. To power down an unresponsive system, press and hold the power button until the system shuts down. This procedure may take 5 seconds or longer.

❖ Press the power button.

Note Turning off the system logs you out and ends the active study.

The system will power down when your data is safe. Any in-progress transfers will complete when power is restored.

Putting the system into sleep mode

To conserve battery power, the system enters sleep mode after a period of inactivity. To specify the period of inactivity before the system goes into sleep mode, see **page 4-26**.

To put the system immediately into sleep mode

❖ Tap the system menu ☰, and then tap **Sleep**.

Installing or replacing the batteries

WARNINGS

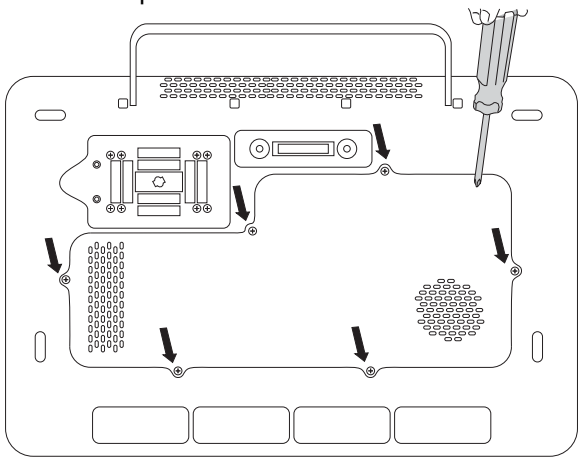
- To avoid injury to the operator and to prevent damage to the ultrasound system, inspect the batteries for leaks prior to installing.
- To avoid data loss and to conduct a safe system shutdown, do not operate the system without batteries installed. See **"Battery safety"** on page 13-8.

To install the batteries

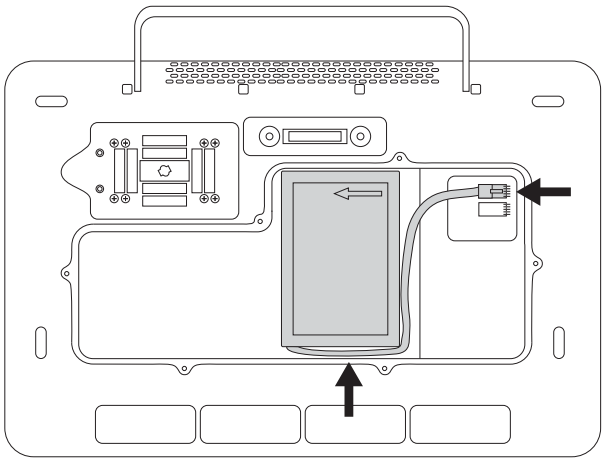
1 Disconnect the power supply from the ultrasound system.

2 If necessary, remove the system from the stand (see **page 3-5**), and turn it upside down.

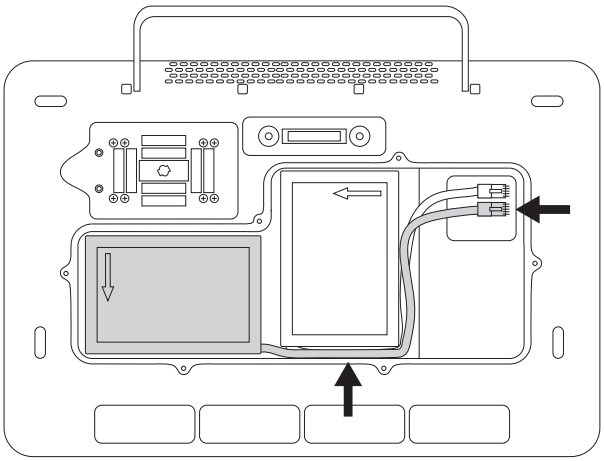
3 Use a Phillips screwdriver to remove the screws and then the cover to the battery compartment.



4 Place the first battery in the battery compartment as shown, then plug its cable into the connector. Make sure the cable is placed fully within the compartment.



5 Place the second battery in the battery compartment as shown, then plug its cable into the connector. Make sure the cable is placed fully within the compartment.



6 Replace the cover and then use the screwdriver to reinstall the screws.

Power and battery indicators

Caution

- Connect the system to AC power when the battery charge is low.
- Periodically check to make sure that the battery charges fully. If the battery fails to charge fully, contact Fujifilm Sonosite Technical Support (see **"Getting help"** on page 1-2).
- Use only Fujifilm Sonosite batteries with the system.

Icons in the system status area on the clinical monitor (see **page 3-14**) and lights on the system and stand show the power and battery status:

Table 3-1: Power and battery indicators

Indicator	Status
	The system is unplugged, and the batteries are discharging. The length of the blue bar indicates the approximate level of battery charge, and the time remaining until the battery dies is displayed below the icon. When the battery charge is low, the color of the bar changes to yellow. At a charge of approximately 5% or lower, the color changes to orange and the system beeps and displays a warning message. If Beep alert is on (see **"Audio settings"** on page 4-13), the system beeps when the battery charge is below 15%.

Table 3-1: Power and battery indicators

Indicator	Status
	The system is on AC power, and the batteries are charging. The approximate level of battery charge is displayed below the icon.
	The system is on AC power only.
Power button on the back of the system	Yellow indicates that the system is booting, green indicates that the system is on, and blinking green indicates that the system is asleep.
Light on the touch panel	The light turns on when the system is asleep, indicating that the system can be activated with a touch. A solid light means that the system is connected to AC power. A blinking light means that the system is on battery power. The faster the light blinks, the higher the battery charge.
Light on the lid	Light is off when the lid is open or the system is off. When the lid is closed, the solid light means that the system is connected to AC power. A blinking light means that the system is on battery power. The faster the light blinks, the higher the battery charge.
Light next to the system power connector	Visible when off the stand. The light is on when the system is receiving power from the portable power supply.
Light on the stand base	The light is on when the stand is receiving power.
Light next to the stand/system connector	The light is on when the system is receiving power through the stand.

Inserting and removing USB devices

You can use the USB ports on the system and stand for connecting devices such as a USB storage device. Use USB storage devices to export patient data and logs. An administrative user can also import and export user accounts and setup configurations.

WARNING Use only accessories and peripherals recommended by Fujifilm Sonosite, including the printer. Connection of accessories and peripherals not recommended by Fujifilm Sonosite could result in electrical shock and system malfunction.

Cautions

- To avoid losing data from or damaging the USB storage device, do not remove the USB storage device or turn off the ultrasound system while exporting. In addition, do not bump or apply pressure to the USB storage device while it is connected to the system. The connector could break.
- If the USB icon does not appear in the system status area on the monitor, the USB storage device may be defective. Replace the USB storage device.
- Do not remove the system's internal storage device. Data on the device is encrypted for HIPAA compliance and will be lost if the device is removed. The internal storage device should be removed for service purposes only.

Note To protect patient confidentiality, remove all identifying information from patient images, files, or records before sending electronically.

To connect a USB storage device for importing or exporting

❖ Insert the USB storage device into a USB port (see **"Hardware features"** on page 3-2).

The USB storage device is ready when the USB icon appears on-screen.

To view information about the device, see **"USB settings"** on page 4-29.

To disconnect a USB storage device

Disconnecting the USB storage device while the system is exporting to it may cause the exported files to be corrupted or incomplete.

1 If exporting, wait at least five seconds after the USB animation icon stops.

2 Remove the USB storage device from the port.

General interaction

Once a new Sonosite PX has been configured (see **"Configuring the system for the first time"** on page 4-2), a startup screen displays when you turn the system on.

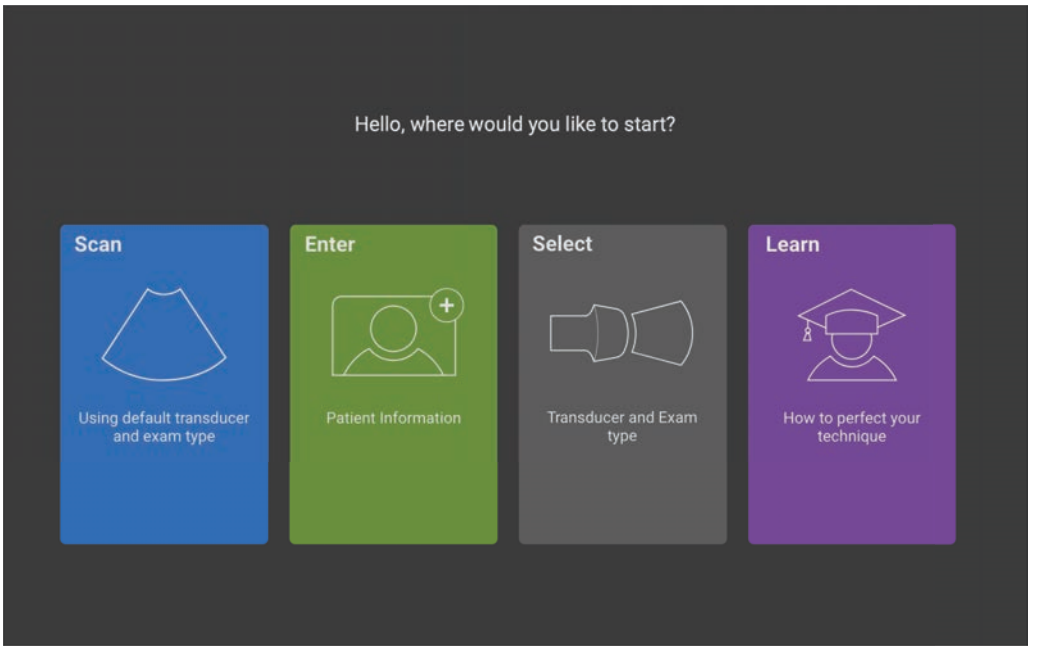


Figure 3-3 Sonosite PX startup screen

The system has four main modules that are accessible from the startup screen:

- **Scan** – This module is where you perform patient exams.
- **Enter** – This module lets you access the patient information form, where you can enter patient information, search for a patient, view the scheduled list of patients, and select a study.
- **Select** – This module is where you select the combination of transducer and exam type to use for your scan.
- **Learn** – This module contains scan-along educational tutorials for ultrasound, as well as system help videos.

You can choose some of these modules as your startup screen (see **page 4-27**).

Clinical monitor

WARNINGS

- Fujifilm Sonosite does not recommend using a monitor other than the clinical monitor provided by Fujifilm Sonosite. Only the images presented on the clinical monitor are validated for the intended use of the device.
- Do not use a monitor connected through the digital video out port for medical diagnosis.

The clinical monitor displays the ultrasound image as well as details about the exam and system status. The clinical monitor is not a touchscreen.

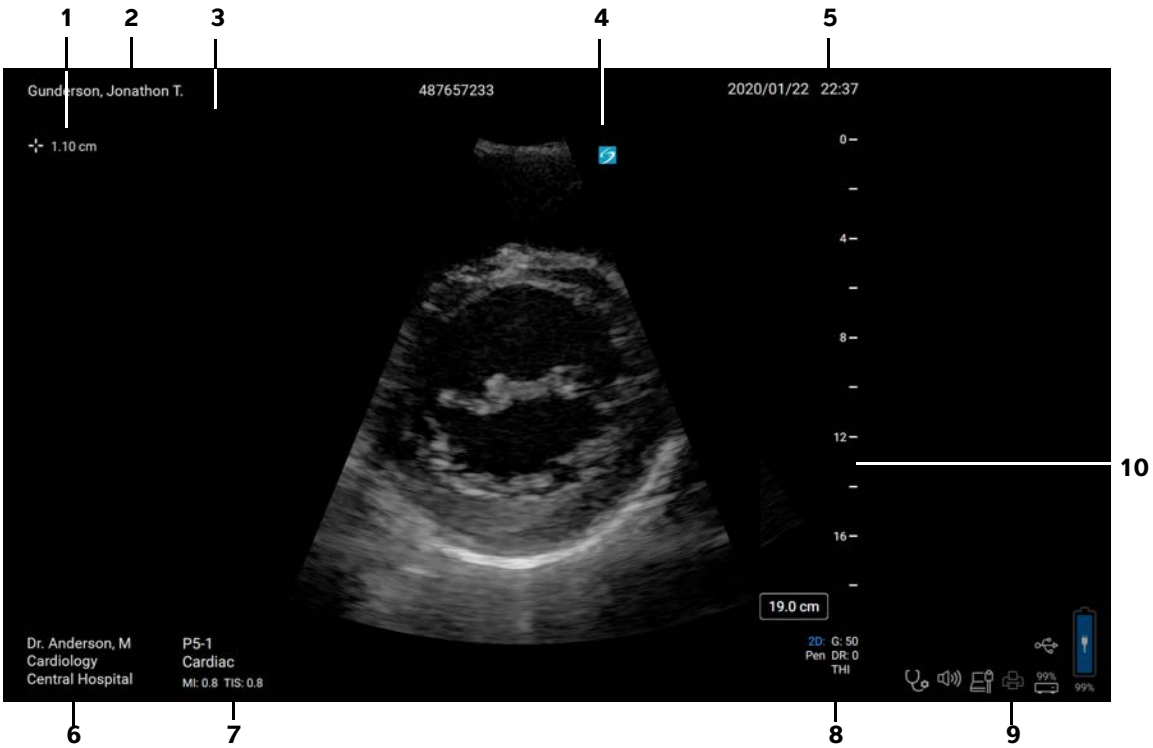


Figure 3–4 Clinical monitor layout

1	Measurement and calculation area	6	Clinician, Department, and Hospital
2	Patient header	7	Selected transducer, exam type, and MI and TI values
3	Orientation marker	8	Imaging mode or modes, selected controls
4	Ultrasound image	9	System status area
5	Date and time	10	Depth scale

Digital video output

WARNINGS

- To avoid possible electrical shock or electromagnetic interference, verify proper operation and compliance with relevant safety standards for all equipment before clinical use. Connecting additional equipment to the ultrasound system constitutes configuring a medical system. Fujifilm Sonosite recommends verifying that the system, all combinations of equipment, and accessories connected to the ultrasound system comply with relevant installation requirements and safety standards.
- For safety, Fujifilm Sonosite recommends isolating auxiliary video connections with external devices; for example, optical or wireless interface adapters. Check the electrical safety of your system with a trained biomedical engineer prior to use.

Resolution

Digital video output resolution is 1920 x 1080 at 60 Hz.

Physical controls

The physical controls come in two versions: international and English. The English version replaces a few of the icons shown in the following figure with phrases.

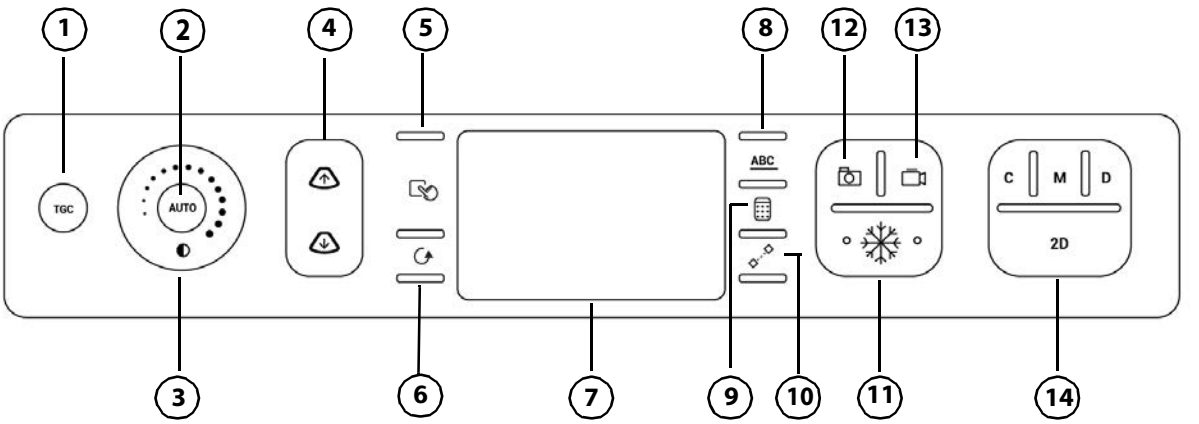


Figure 3–5 International controls

1	**TGC**	Press the button to display the on-screen time gain compensation (TGC) controls (live imaging only).
2	**AUTO**	Press the button to automatically adjust the gain profile (live imaging only).
3	**GAIN or** 	Drag your finger counterclockwise or clockwise around the wheel to decrease or increase the overall gain. When the image is frozen, the wheel scrolls through the cine loop instead.
4	**DEPTH** 	Press the buttons to decrease or increase the imaging depth (live imaging only).
5	**SELECT or** 	Press the button to cycle through touchpad controls that will affect on-screen behavior, switch between calipers, or to advance to the next step when performing a multi-step measurement.
6	**UPDATE or** 	Press the button to complete an action, to begin and end scrolling in Doppler and M Mode, or to switch the focus between images.
7	**Touchpad**	Use the touchpad to select, adjust, and move items on the clinical monitor.
8	**ABC**	Press the button to display or hide labeling options on the touch panel.
9	**CALCS or** 	Press the button to display or hide analysis packages on the touch panel.
10	**CALIPER or** 	Press the button to display a caliper on the clinical monitor and measurement controls on the touch panel.
11		Press the button to freeze and unfreeze the image.
12		Press the button to save an image to internal storage, and save measurements and calculations to the report.
13		Press the button during live imaging to save a clip to internal storage. To adjust the clip settings, see **page 7-1**.

14	**Imaging modes**	
	C	Press the button to turn color imaging on and off.
	M	Press the button to turn M Mode on. Press again to begin M Mode scrolling. Press a third time to turn M Mode off.
	D	Press the button to turn Doppler on. Press again to begin Doppler scrolling. Press a third time to turn Doppler off.
	2D	Press the button to return to 2D imaging.

Touchpad

Use the touchpad as a selection device. When the touchpad is active, drag your finger on the surface to move the item on the screen.

You can use the touchpad to do the following:

- Move labels, pictograms, and transducer marker
- Move calipers
- Position the M-line and the D-line
- Position and size region of interest (ROI) boxes and image sectors
- Move the zoom box
- Move the baseline
- Pan a frozen zoomed 2D image

Scroll through the cine frames on a frozen image

Touch panel

The touch panel display varies depending on how you are using the system (see **Figure 3-6** on page 3-18). Use the touch panel to adjust settings; select the exam type, transducer, and imaging mode; enter patient information; perform measurements; and more. As you use the touch panel, the results appear on the clinical monitor.

You interact with the touch panel the same as with many other touchscreen devices.

- **Swipe**: Move your finger quickly across the panel. Faster than dragging.
- **Drag**: Move one or two fingers across the panel, usually to move an object from one location to another.

- **Tap**: Quickly touch the panel once; for example, to activate a control.
- **Scrolling**: When the scroll bar appears, you can use it to scroll through content. Both horizontal and vertical scrolling is available.

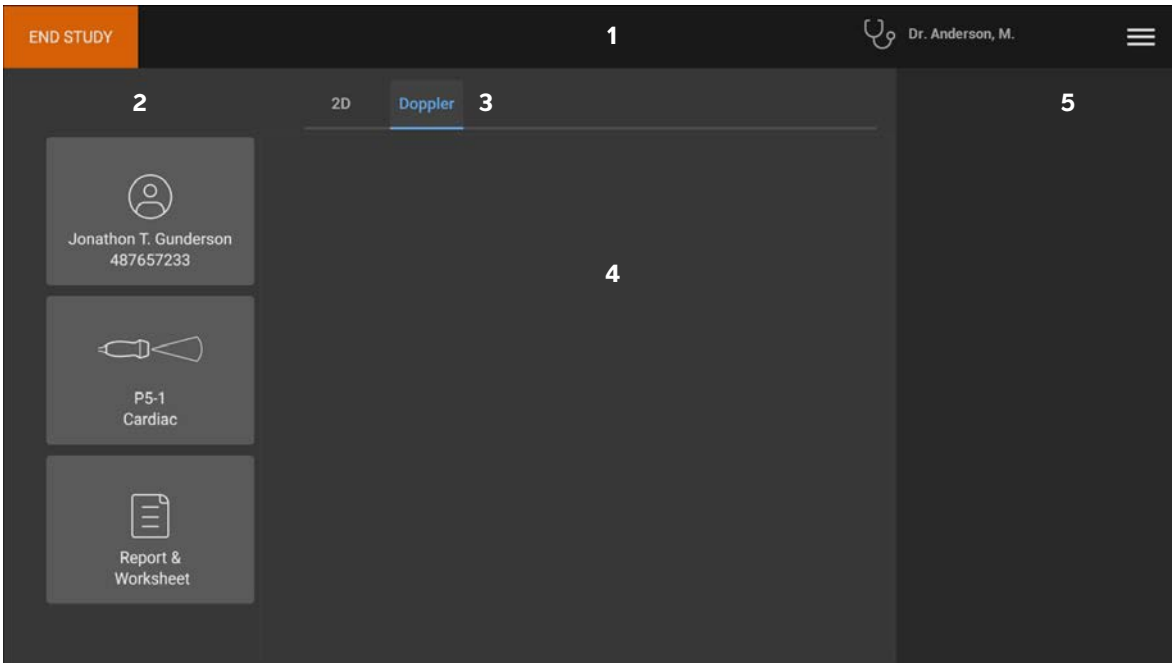


Figure 3–6 Touch panel layout

1 Header with end study button, clinician login, and system menu

2 Left panel buttons

3 Tabs that vary depending on use

4 Variable content including imaging controls, labels, measurements and calculations

5 Variable display including right panel buttons, images and clips, measurement and calculation results

On-screen keyboard

You can enter text into text boxes (for example, on the patient form) using the on-screen keyboard.

To enter text using the on-screen keyboard

1 Tap a text box or press the **ABC** button.

The on-screen keyboard appears.

2 Tap keys as needed:

- Tap the shift key  to change an alphabet key to an uppercase character.
- Tap the caps lock key  to change all the keys to uppercase characters.
- When filling in a form, tap **previous** to jump to the previous text box.
- When filling in a form, tap **next** or the tab key  to advance to the next text box.
- Tap **123*#** to display keys for numbers, symbols, and special characters.
- Tap **abc** to return to the alphabet keys.
- When filling in a form, hold down an alphabet key to reveal accented characters.
- Tap  to delete a character on the left side of pointer.
- Tap  to close the keyboard. In certain contexts, the return key  also closes the keyboard.

Preparing transducers

WARNINGS

- Some gels and sterilants can cause an allergic reaction on some individuals.
- Some transducer sheaths contain natural rubber latex and talc, which can cause allergic reactions in some individuals. Fujifilm Sonosite recommends that you identify your latex and talc-sensitive patients and be prepared to treat allergic reactions promptly.

Cautions

- To avoid damage to the transducer, use only gels recommended by Fujifilm Sonosite. Using other gels can damage the transducer and void the warranty. If you have questions about gel compatibility, contact Fujifilm Sonosite or your local representative.
- Clean transducers after each use. See **Chapter 12, "Cleaning and Disinfecting."**

Connecting transducers

This section provides instructions to connect a transducer, with or without the built-in Triple Transducer Connect (TTC), as well as instructions to remove a transducer.

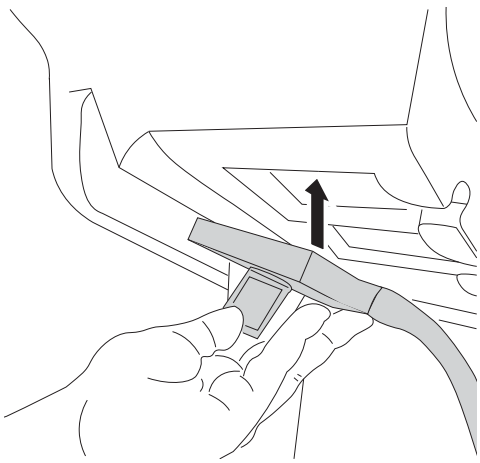
To connect a transducer to the stand TTC

The Sonosite PX stand includes a three-transducer module (TTC) that lets you simultaneously connect up to three transducers to the ultrasound system.

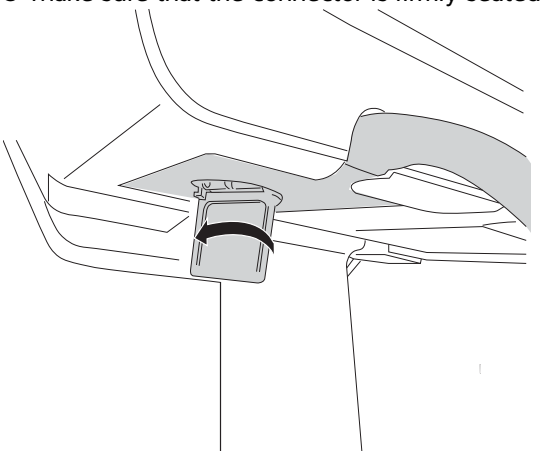
WARNING While disconnecting or connecting a transducer, do not lean on the ultrasound system's handle. The system could tilt suddenly, causing you to lose your balance.

1 Pull the transducer latch handle up, and rotate it clockwise.

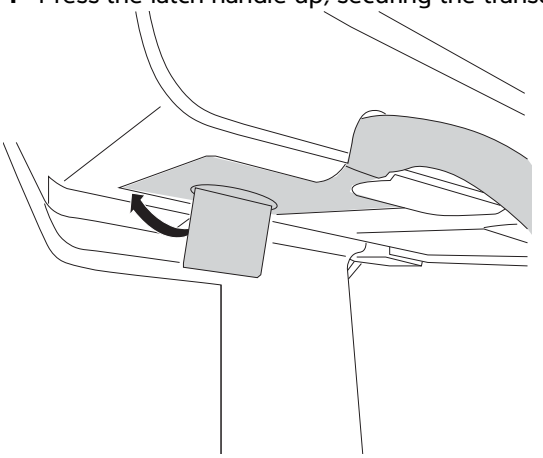
2 Insert the transducer connector into one of the three TTC connector ports on the bottom of the platform.



3 Make sure that the connector is firmly seated, and then turn the latch handle counterclockwise.



4 Press the latch handle up, securing the transducer connector to the TTC.



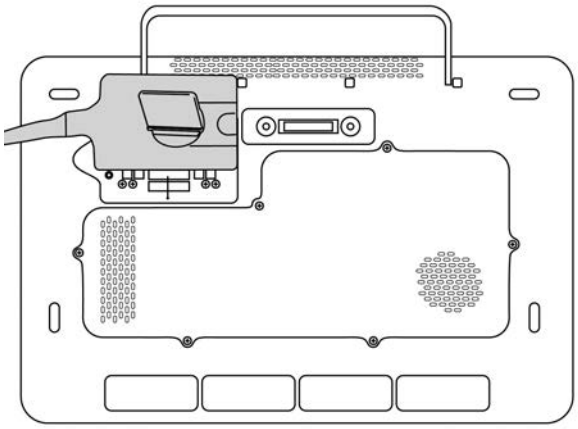
To connect a transducer directly to the system

You can connect one transducer directly to the system after removing it from the stand. See **"To undock the system from the stand"** on page 3-5.

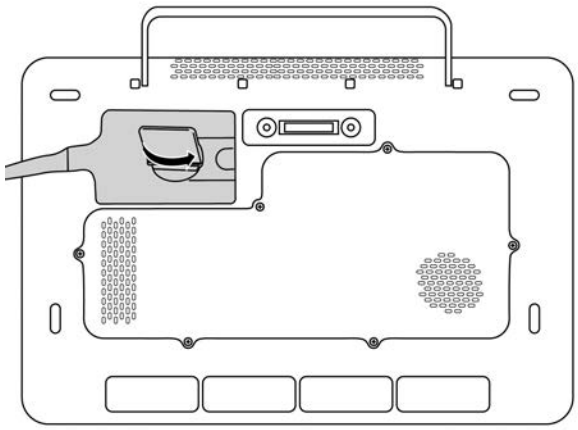
1 Turn the system upside down.

2 Pull the transducer latch up, and rotate it clockwise. Align the transducer connector with the connector on the bottom of the system.

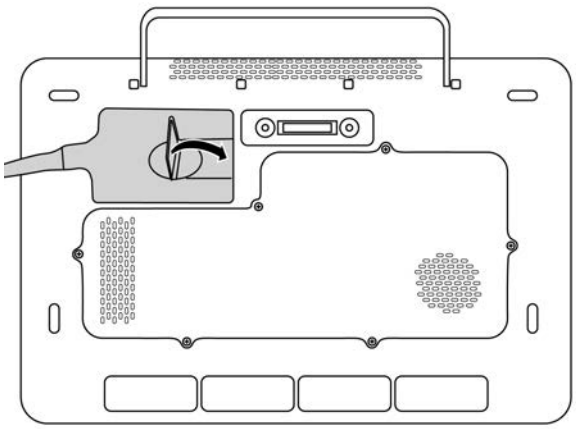
3 Insert the transducer connector into the system connector.



4 Turn the latch counterclockwise.



5 Press the latch down, securing the transducer connector to the system.



To remove a transducer

Caution To avoid equipment damage that could lead to image quality degradation, do not disconnect a transducer while it is in use. Either freeze the image or switch to another transducer before disconnecting.

1 Pull the transducer latch up, and rotate it until loose.

2 Pull the transducer connector away from the system or the built-in TTC.

Selecting a transducer and exam type

WARNING To prevent misdiagnosis or harm to the patient, use the correct transducer for the application. The diagnostic capability differs for each transducer, exam type, and imaging mode. Transducers are developed to specific criteria depending on their physical application. These criteria include biocompatibility requirements. Understand the system's capabilities prior to use.

Before scanning, select a transducer and exam type. Exam types are predefined groups of scanning settings optimized for a clinical use.

To select a transducer and exam type

1 Do one of the following:

- On the startup screen, tap **Select Transducer and Exam type**.
- In the touch panel, tap the current transducer and exam button.
- In the patient form (see **"Patient form fields"** on page 5-2), tap the current transducer and exam button.

Cards for the available transducers appear.

2 On the card for the appropriate transducer, do one of the following:

- Double-tap the exam type.
- Tap the exam type, and then tap **Scan**, or tap **Cancel** to cancel.

  Scrolling the list of exam types displays any hidden items.

Table 3-2: Imaging modes and exam types on transducers

Transducer	Exam type	Imaging mode			
		2D M Mode	Color[a]	PW Doppler[b]	CW Doppler
C5-1[c]	Abdomen	✓	CVD, CPD	✓	—
	Early OB	✓	CVD, CPD	✓	—
	Gynecology	✓	CVD, CPD	✓	—
	Lung	✓	CVD, CPD	✓	—
	Musculoskeletal (MSK)	✓	CVD, CPD	✓	—
	Nerve	✓	CVD, CPD	✓	—
	Obstetrics	✓	CVD, CPD	✓	—
	Spine	✓	CVD, CPD	✓	—
IC10-3[c]	Early OB	✓	CVD, CPD	✓	—
	Gynecology	✓	CVD, CPD	✓	—
	Obstetrics	✓	CVD, CPD	✓	—

Table 3-2: Imaging modes and exam types on transducers

Transducer	Exam type	Imaging mode			
		2D M Mode	Color[a]	PW Doppler[b]	CW Doppler
L12-3[c]	Arterial[d]	✓	CVD, CPD	✓	—
	Breast	✓	CVD, CPD	✓	—
	Carotid	✓	CVD, CPD	✓	—
	Lung	✓	CVD, CPD	✓	—
	Musculoskeletal (MSK)	✓	CVD, CPD	✓	—
	Ophthalmic	✓	CVD, CPD	✓	—
	Nerve	✓	CVD, CPD	✓	—
	Superficial	✓	CVD, CPD	✓	—
	Venous[d]	✓	CVD, CPD	✓	—
L15-4[c]	Arterial[d]	✓	CVD, CPD	✓	—
	Breast	✓	CVD, CPD	✓	—
	Carotid	✓	CVD, CPD	✓	—
	Musculoskeletal (MSK)	✓	CVD, CPD	✓	—
	Nerve	✓	CVD, CPD	✓	—
	Superficial	✓	CVD, CPD	✓	—
	Venous[d]	✓	CVD, CPD	✓	—

Table 3-2: Imaging modes and exam types on transducers

Transducer	Exam type	Imaging mode			
		2D M Mode	Color[a]	PW Doppler[b]	CW Doppler
L19-5[c]	Arterial[d]	✓	CVD, CPD	✓	—
	Lung	✓	CVD, CPD	✓	—
	Musculoskeletal (MSK)	✓	CVD, CPD	✓	—
	Nerve	✓	CVD, CPD	✓	—
	Ophthalmic	✓	CVD, CPD	✓	
	Superficial	✓	CVD, CPD	✓	—
	Venous[d]	✓	CVD, CPD	✓	—
P5-1	Abdomen	✓	CVD, CPD	✓	—
	Cardiac	✓	CVD, Var	✓	✓
	Focused Cardiac	✓	CVD, Var	✓	✓
	Lung	✓	CVD, CPD	✓	—
	Obstetrics	✓	CVD, CPD	✓	—
	Orbital	✓	CVD, CPD	✓	—
	Transcranial	✓	CVD, CPD	✓	—

a. Color Doppler Variance (Var) is available in the cardiac exam only. Color Power Doppler (CPD) is available in all exams except the cardiac exam type. CVD = Color Velocity Doppler
b. For the cardiac exam types, PW TDI is also available
c. Needle guide-capable. For more information, refer to *Using CIVCO Products with FujifilmSonositeSystems.*
d. Available with simultaneous Doppler imaging (see **page 6-14**).

Gel

Use acoustic coupling gel on the transducer during exams. Although most gels provide suitable acoustic coupling, some gels are incompatible with some transducer materials. Fujifilm Sonosite recommends Aquasonic gel and provides a sample with the system.

For general use, apply a liberal amount of gel between the transducer and the body. For interventional use, apply a transducer sheath.

Sheaths

WARNING Use market-cleared, sterile transducer sheaths and sterile coupling gel for transrectal, transvaginal, or guided-needle procedures. Do not apply the transducer sheath and coupling gel until you are ready to perform the procedure. After use, remove and discard the single-use sheath, and clean and disinfect the transducer using a Fujifilm Sonosite-approved disinfectant. See the cleaners and disinfection document available at **www.sonosite.com** for a complete list of the most current cleaners and disinfectants.

To apply a transducer sheath

1. Place gel inside the sheath. Make sure that the gel is at the end of the sheath.
2. Insert the transducer into the sheath.
3. Pull the sheath over the transducer and cable until the sheath is fully extended.
4. Secure the sheath using the bands supplied with the sheath.
5. Check for and eliminate air bubbles between the face of the transducer and the sheath.

   Air bubbles between the face of the transducer and the sheath may affect the ultrasound image.
6. Inspect the sheath to ensure that there are no holes or tears.

Transporting the system

If you need to transport the system, make sure to observe the following:

- Close the lid and lower the stand.
- To wheel the system, push forward on the handle located on the back of the stand.

Educational tutorials and system help videos

The Sonosite scan-along educational tutorials are animated 3D videos that describe scanning techniques, terminology, and more. Scanning is active while a video plays, so you can practice scanning techniques in conjunction with the visual guides.

To play a tutorial

1 Display the tutorials by doing one of the following:

- Tap **Learn** on the startup screen.
- Tap **Learn** on the touch panel.
- Tap **Learn** from the system menu ☰ in the upper right corner of the touch panel.

2 At the top of the page, tap a category (for example, **Basics**).

The current selection is highlighted.

3 Swipe left or right on the touch panel to show additional cards.

4 Tap a video selection from one of the cards.

The video player starts. Tap the play button to play your selection.

5 Do any of the following:

- Select a language from the **Video Language** menu.
- Pause or restart the video using the controls at the bottom of the player.
- Tap the volume control to mute the audio. Tap again to unmute.
- Drag the volume slider to adjust the volume.
- Tap another video in the list to play it.
- Tap **Back** to return to the Learn screen.
- Tap **Scan Along** to play the video while scanning.

  The video appears on the scan screen. You can play, pause, expand, or close the video.

CHAPTER 4

Configuring the System

System Settings is where you customize the system and set preferences.

Notes

- Not all system settings are available if you log in to the system as a guest (see **"Logging in as a user"** on page 4-12).
- Reset functions are provided on some system settings pages.

To navigate system settings

1 On the touch panel, tap the system menu ☰.

2 Tap **System Settings**.

3 Tap a setting from the list to display the settings page.

4 Do any of the following while in a settings page:

- If a system settings has multiple pages, tap the **Back** button to return to the previous page.
- Tap another system setting from the list to display its settings page (any changes you have made are saved).
- Tap **Done** to save your changes and exit system settings.
- Tap **Cancel** to cancel any changes.

To return to factory defaults

Caution Restoring the system to the default settings will delete all settings and patient data. Back up your data prior to performing this action.

1 To manually reset the system, simultaneously press the **AUTO,** , and **2D** buttons.

2 Make sure the system is connected to AC power, and tap **Yes** to continue.

Resetting the system takes approximately thirty-five minutes.

Note If your system does not have enough power, you will need to restart the process.

3 When the reset is complete, tap **OK** to restart the system.

Using the system as an administrator

Users with administration rights have the ability to manage users, configure certain settings and security features on the system, and import custom settings. An administrative user can also use the configuration wizard to configure the system.

Available security settings help you to meet the applicable security requirements listed in the HIPAA standard. Users are ultimately responsible for ensuring the security and protection of all electronic protected health information collected, stored, reviewed, and transmitted on the system.

Caution Healthcare providers who maintain or transmit health information are required by the Health Insurance Portability and Accountability Act (HIPAA) of 1996 and the European Union Data Protection Directive (95/46/EC) to implement appropriate procedures: to ensure the integrity and confidentiality of information and to protect against any reasonably anticipated threats or hazards to the security or integrity of the information or unauthorized uses or disclosures of the information

Configuring the system for the first time

A new Sonosite PX system automatically launches a configuration wizard when it is first turned on. The first page of the wizard prompts you to create your administrator account. During system setup, some of the settings (such as date and time) may have been set at the factory. You can always enter other values, depending on the guidelines set by your organization.

1 Turn the machine on by pressing the power button (refer to **Figure 3-1** on page 3-2).

The configuration wizard starts automatically.

2 On the first page, enter the administrative login information you would like to use.

Note To ensure security, choose a password that contains uppercase characters (A-Z), lowercase characters (a-z), and numbers (0-9). Passwords are case-sensitive.

3 On the next page, confirm the date and time settings, modifying them as appropriate.

4 Select whether or not you want to import custom settings from another Sonosite PX system.

If you import custom settings, the wizard skips the rest of the setup process.

5 On the next page, enter your institution and departmental information.

6 Specify the period of inactivity before the system goes into sleep mode or turns off.

7 Finally, select one of the following modes:

Note You can only switch modes by running the wizard again (administrators only), which resets the system and deletes all data.

- **Secure mode:** Secure mode requires users to log into the system, although a guest account that does not require a login is still available. Secure mode helps ensure data protection and enables you to connect to a directory server.
- **Non-secure mode:** Non-secure mode allows any user to access all system functions without requiring a login.

Caution Fujfilm Sonosite strongly recommends configuring the system in secure mode. Operating in non-secure mode increases the risk of being out of compliance with HIPAA regulations.

The system restarts to enable the new settings.

Accessing Administrative settings

To log into and out of the system and change your password, see **"Logging in as a user"** on page 4-12. If you have forgotten your administrator password, see **page 4-1** to reset the system or contact Fujfilm Sonosite (see **"Getting help"** on page 1-2).

Caution Restoring the system to the default settings will delete all settings and patient data. Back up your data prior to performing this action.

To display Administration settings

1 Tap ☰, and then tap **System Settings**.

2 To display the main Administration settings page, tap **Administration** in the list on the left.

3 Type your administrative login information, and tap **Login**.

Managing users on the system

Only administrators can manage user accounts, including importing user accounts from another system, creating or editing a user account, or deleting user accounts from the system.

To manage users by synchronizing with a directory server and using server-based user accounts, see **"Configuring a connection to a directory server"** on page 4-5.

Required fields are indicated by an asterisk (*).

To add a new user on the system

1. Using your administrative login information, log into the administrative settings page.
2. Tap **User Management**.
3. On the user management page, tap **Add User**. Fill in the user information fields.
4. If you want to require that the user change their password, select **Require password change on next login**, and then enter a temporary password for the new user to gain initial access.

Notes

- To ensure security, choose a password that contains uppercase characters (A-Z), lowercase characters (a-z), special characters, and numbers (0-9).
- Passwords are case-sensitive.
- The default minimum time required between changing passwords (24 minutes) could cause a conflict with requiring a user to change their password on next login. See **page 4-6** to change the default minimum time.

5. If you want the user account to expire on a given date (such as accounts for students, interns, or other temporary personnel), select **Enable account expiration**, and then enter the number of days (such as 90) until the account will expire into the **Set account expiration in days** field.
6. When you have finished configuring the new user account, tap **Save to Database**.

To edit a user

1. Using your administrative login information, log into the administrative settings page.
2. Tap **User Management**.
3. Tap the user account in the list, then tap **Edit User**.
4. Make the desired changes to the user information fields.

Note Although you can change the first or last name of a user, you cannot modify the user account name once it has been created.

5 When you have finished modifying the user account, tap **Save to Database**.

To change a user password

1 Using your administrative login information, log into the administrative settings page.

2 Tap **User Management**.

3 Tap the user account in the list, then tap **Edit User**.

4 Select **Reset password.**

5 Type the new password in the **Password** text box and in the **Confirm** text box.

Note The password typed in both fields must match.

To enable a disabled user account

1 Using your administrative login information, log into the administrative settings page.

2 Tap **User Management**.

3 Tap the user account in the list, then tap **Edit User**.

4 Set the user **Status** to **Active**.

To delete a user

1 On the user management page, tap the user account in the list.

2 Tap **Delete User**.

3 Tap **Yes**.

Configuring a connection to a directory server

In order to use server-based user accounts, you should configure the system in secure mode (see **"Configuring the system for the first time"** on page 4-2).

To configure the connection to a directory server

1 Using your administrative login information, log into the administrative settings page.

2 Tap **LDAP/AD**.

3 Select **Use LDAP/AD authentication**.

Note Enabling a connection to a corporate directory server disables local account creation. You can continue to use pre-existing local user accounts, but you cannot add new local accounts while this setting is enabled.

4 In the **Remote server** field, type the IP address of the remote server.

5 In the **Port** field, type the port number of the directory.

6 (Optional) If you want to encrypt the communication between the ultrasound system and the directory server, tap the checkbox next to **Secured**.

7 In the **Search root** field, type the path to the root directory.

8 In the **User DN** field, type the user domain name.

9 In the **Manager name** field, type the username of an account that has LDAP access.

10 In the **Manager password** field, type the password for the account that has LDAP access.

11 When you've finished configuring your connection, tap **Test Connection**.

Note If the connection fails, make sure that you have entered the correct information and that there are no issues with the network or server.

12 Tap **Save**.

Managing password requirements

Administrators can define the complexity of user account passwords, including the types of required characters, length of the password, and lock-out policies after multiple unsuccessful login attempts. Password requirements defined on the system only apply to local user accounts.

To establish user account password requirements

1 Using your administrative login information, log into the administrative settings page.

2 Tap **Password Rules**.

3 Under **Password complexity**, select the desired combination of parameters for password complexity.

4 Use **Minimum length** and **Maximum length** to control how short or long passwords should be.

5 If you want to change the minimum default password duration value of 24 minutes, enter a value into the **Min duration for the password to be active (mins)** field.

6 If you want to limit reuse of passwords, enter the number of times a person can re-use a previous password into the **Enforce password history count** field.

7 If you want passwords to be changed periodically, enter the number of days until password expiration into the **Password expires in (days)** field.

To establish lock-out thresholds for multiple unsuccessful login attempts

1 Using your administrative login information, log into the administrative settings page.

2 Tap **Password Rules**.

3 Enter the number of unsuccessful attempts a person can enter before the system prevents them from attempting to log in again into the **Account lockout threshold (unsuccessful attempts)** field.

4 Enter the length of time (in minutes) that a user will be prevented from attempting to log in after they've been locked out into the **Account lockout duration (mins)** field.

Protecting patient information

Note To protect patient confidentiality, remove all identifying information from patient images, files, or records before sending electronically.

You can configure the system to require a user name and password at startup (see **page 4–2**). If you require user login, set up local user accounts on the system or connect to a directory server to access accounts.

To help protect sensitive patient information, you can choose not to display the patient name and ID number on the monitor and to remove it from exported images and video clips.

To hide patient information on the monitor

1 Using your administrative login information, log into the administrative settings page.

2 Tap **Admin Settings**.

3 Ensure that the **Hide patient information on clinical monitor** checkbox is selected.

To hide patient information in exported data

1 Using your administrative login information, log into the administrative settings page.

2 Tap **Admin Settings**.

3 Ensure that the **Hide patient information on export** checkbox is selected.

To remove all patient data from the system

If you have forgotten your login information, see **page 9–7**.

Caution Back up patient data prior to performing this action.

1 Using your administrative login information, log into the administrative settings page.

2 Tap **Admin Settings**.

3 Tap **Delete All Patient Data**.

4 Make sure the system is connected to AC power, and tap **Yes** to continue.

Deleting patient data takes approximately thirty-five minutes.

Note If your system does not have enough power, you will need to restart the process.

5 When the wipe is complete, tap **OK** to restart the system.

Controlling data import and export

Administrators can access settings to control whether users can export data to or use a USB storage device, or access networks

To disable exporting data to a USB storage device

1 Using your administrative login information, log into the administrative settings page.

2 Tap **Admin Settings**.

3 Deselect the **Enable export to USB** checkbox.

To restrict access to USB storage devices and networks

1 Using your administrative login information, log into the administrative settings page.

2 Tap **Admin Settings**.

3 Under **Enabled I/O devices**, select which type of device you want to restrict:

- If you want to restrict wireless network access, deselect the **Wi-fi** checkbox.
- If you want to restrict Ethernet network access, deselect the **Ethernet** checkbox.
- If you want to prevent any USB devices from connecting to the system, deselect the **USB devices** checkbox.

Creating a sign-in notification

Administrators can create a notification or other message that users will see when they log in to the system. The message can be configured to display only the first time a new user logs in, or it can be configured to appear every time a user signs in.

To create a sign-in notification

1 Using your administrative login information, log into the administrative settings page.

2 Tap **Admin Settings**.

3 Select the **Enable system use notification** checkbox, and then type in the text for your notification.

Note The text is limited to a maximum of 200 words.

4 Select the appropriate option to display the notification each time a user logs in, or only the first time a new user logs in.

Reviewing and resetting system settings

The Administration settings enables administrators to review their system settings and compare them against the default factory settings. You can also reset the system to the default settings, but this will erase all settings and data.

To review system settings

1 Using your administrative login information, log into the administrative settings page.

2 Tap **Admin Settings**.

3 Tap **Compare Security Controls**.

4 The system generates a report to compare current settings to the factory defaults.

5 When completed, the system will give you the option to save the report to a USB drive.

To reset the system

If you have forgotten your login information, see **page 4-1**.

Caution Restoring the system to the default settings will delete all settings and data. Back up your data prior to performing this action.

1 Log into the administrative settings page, tap **Admin Settings** and tap **Factory Reset**.

2 Make sure that the system is connected to AC power, then tap **Yes** to continue.

Resetting the system takes approximately thirty-five minutes.

3 When the reset is complete, tap **OK** to restart the system.

Configuring internal storage settings

The administrator can set up how the system manages internal storage by managing Auto Delete settings and internal storage alerts.

Note Your Auto Delete settings must be compatible with your DICOM settings (see **page 4-14**). If you have set up a storage commit server, make sure that the system is auto-deleting storage committed studies only. If only an archive server is set up, you can allow the system to delete archived studies. Otherwise, you may select the all studies option.

To configure Auto Delete settings

1 Using your administrative login information, log into the administrative settings page.

2 Tap **Auto Delete**.

The Auto Delete Settings page appears**.**

3 Under **Auto Delete**, select one of these choices:

- **On**
- **Off (manual)**

This is the default option.

4 Select the type of study to delete:

- **Storage Committed studies only**
- **Archived studies only**
- **All studies**

5 Select the age of the studies to delete:

- **24 hours old**
- **3 days old**
- **7 days old**
- **28 days old**

6 Tap **Save** and confirm your selection.

Auto Delete will occur daily at midnight or at first boot up.

To receive storage alerts

❖ On the Connectivity settings page, select **Internal storage capacity alert**.

The system displays a message if internal storage is near capacity when a user ends a study.

Caution If the save available icon 

does not appear in the system status area, internal storage may be defective. Contact Fujfilm Sonosite Technical Support (see **"Getting help"** on page 1-2).

Configuring remote worksheets access

The ultrasound system supports custom and default worksheets available from the ultrasound workflow application Sonosite Synchronicity Workflow Manager. As an administrator, you can configure the system to access the remote worksheets server. Refer to **page 4-14** to set up your DICOM connections and to the *Sonosite Synchronicity Workflow Manager Administrative User Guide* to set up the remote worksheets server.

Note Downloading remote worksheets from the server replaces the local versions of the worksheets on the system.

To use a custom worksheet, see **page 9-8**.

To configure access to the remote worksheets server

1 Set up a local DICOM location on your ultrasound system (see **page 4-20**), and set **Transfer images** to **End of exam.**

Note For the remote worksheet feature to work with static IP configurations, the network needs to be configured with a DNS address.

2 On your system, set up the server as a DICOM archiver (see **page 4-19**) and select the **Include private tags** checkbox.

3 Set the server as a secure HTTPS address. You cannot use an unsecured address.

a Log into the administrative settings page.

b Tap **Remote Worksheets**.

The Remote Worksheets page appears.

c Enter the address (URL) of the remote server.

d Tap **Verify** to verify the address, or **Clear** to clear the field.

To import remote worksheets

1 Using your administrative login information, log into the administrative settings page.

2 Tap **Remote Worksheets**.

The Remote Worksheets page appears**.**

3 Tap **Synchronize** to download the remote worksheets.

Notes

- Successfully synchronizing remote worksheets will completely replace the current set of remote worksheets.
- Tap **Verify** to test the server connection and settings.

4 Tap **OK** once the update is complete.

Logging in as a user

If user login is required, the user login page appears when you turn on the system. If your administrator has set up a server-based login, use your server user name and password to log in. You can also use your server-based login if the ultrasound system is not connected to the server, provided you have already logged in at least once prior to taking the system offline. The system stores locally cached user information.

To log in as a user

1 On the login page, type your login name and password.

If another user is logged in, tap  at the top of the page to sign out then sign back in.

2 Tap **OK**.

To log in as guest

Guests can scan, save images and clips, view worksheets, and manage patient data for the current study. Guests can also access system information, on-board help, and Learn videos. Guests cannot access other patient information or some system settings.

1 Turn on the system.

2 In the login page, tap **Guest**.

To log out as a user

❖ Do one of the following:

- Tap  at the top of the page, and tap **Sign out** from the menu.
- Turn off or restart the system.

To change your password

Notes

- You can only change your password on the system if your system is using local user accounts. Server-based passwords need to be changed on the server.
- The system notifies you if your password does not meet the password requirements.
- You may need to wait to change your password. The default minimum duration between password changes is 24 minutes.

1 Turn on the system.

2 On the change password page, type your old and new passwords, confirm the new password, and then tap **OK**.

Audio settings

On the Audio settings page, you can specify sound settings and adjust the volume for beeps and clicks.

To display the Audio settings page

1 Tap the system menu ☰, and then tap **System Settings**.

2 Tap **Audio** in the list on the left.

To specify sound settings

❖ On the Audio settings page, do either or both of the following:

- Select **Button clicks** for keys to click when tapped.
- Select **Beep alert** for the system to play sounds.

To adjust the volume for beeps and clicks

❖ On the Audio settings page, drag the **Beeps and clicks volume** slider. To mute the volume for Beeps and Clicks, tap the volume control to mute the audio. Tap again to unmute.

Connectivity and DICOM settings

On the Connectivity settings page, you can specify the system location and manage wireless certificates. Users with administrative rights can also configure network and DICOM connections, and import and export connectivity settings from the DICOM configuration page.

To view information about network status on your system, see **page 4–25**.

To display the Connectivity settings page

1 Tap the system menu ☰, and then tap **System Settings**.

2 Tap **Connectivity** in the list on the left.

To specify the system location

The location you specify in Connectivity settings represents the active location of the system.

❖ On the **Connectivity** settings page, select a location from the **Location** list.

About DICOM

The ultrasound system conforms to the Digital Imaging and Communications in Medicine (DICOM) standard as specified in the *Sonosite PX DICOM Conformance Statement*, available at **www.sonosite.com**. The conformance statement provides information about the purpose, characteristics, configuration, and specifications of the network connections supported by the system. Using data in the DICOM standard, the ultrasound system can do the following by connecting over a local area network (LAN/WLAN):

- Transfer patient data to an archiver (see **"Archiving studies"** on page 9-3), such as a Picture Archive and Communication Systems (PACS) archiver.
- Confirm successful archiving with a storage commitment server.
- Import scheduled procedures and patient data from a worklist server (see **"Using the worklist"** on page 5-4.)
- Send a report about a performed procedure using an MPPS (modality performed procedure step) server.
- Export data as DICOMDIR files to a USB storage device (see **"Exporting studies"** on page 9-5).

The system can transfer to one or more devices and connect to different networks, depending on how you configure it. The DICOM log collects network errors and events, typically to support diagnostics (see **"Logs"** on page 4-30).

Configuring the system for DICOM transfer

To configure the system for DICOM transfer, do the following tasks (typically completed by a network administrator or PACS administrator):

1 Back up default DICOM configuration settings to a USB device kept in a secure location. You can revert to the default settings if necessary (see **"Importing and exporting connectivity settings"** on page 4-22).

2 Connect to the network (see **page 4-15**).

3 Complete the DICOM configuration pages for locations and devices (see **page 4-16**).

4 Associate devices with locations (see page 4-20).

To display the DICOM settings page

1 Tap the system menu, and then tap **System Settings**.

2 Tap **Connectivity** in the list on the left.

3 On the Connectivity settings page, tap **DICOM Setup**.

Connecting to the network

You can connect to the network by Ethernet or wirelessly.

To connect to the network by Ethernet

Connect the ultrasound system to a standard Ethernet 10/100/1000 network. Devices connected to the system's Ethernet port must comply with the IEC 60601-1 or IEC 60950 standards.

1 Connect the Ethernet cable to the Ethernet port on the back of the stand (see **Figure 3-1** on page 3-2).

2 On the Connectivity settings page, tap **DICOM Setup**.

3 Tap **Config**, then select **Location**.

4 On the DICOM Location page, tap **New** to configure a new connection.

5 See "**Location**" on page 4-16 to configure and save a location with the correct network settings, making sure to select **LAN** from the **Network** type.

If the system is physically connected to a network, the Ethernet connected icon appears in the system status area on the monitor.

To connect to the network wirelessly

Wireless connectivity is a licensed feature.

1 On the Connectivity settings page, tap **DICOM Setup**.

2 Tap **Config**, then select **Location**.

3 On the DICOM **Location** page, tap **New** to configure a new connection.

4 See "**Location**" on page 4-16 to configure and save a location with the correct network settings, making sure to select a wireless frequency from the **Network** type.

The wireless icon indicates the status of the wireless connection (the number of white bars indicates the strength of the connection).

DICOM configuration pages

The DICOM configuration pages are as follows:

- **Location** Configuration for network settings, including settings for a wireless network connection. Also specifies which devices you want to associate with that network. For example, configure a location called "Office," and then associate an archiver with it. You can configure up to seven locations (see **"Associating devices with locations"** on page 4-20).
- **Archive** Configuration for PACS archivers, devices for storing patient studies (images and clips). Only one archiver per location can receive in-progress image transfers. You can associate up to four archivers per location.
- **Storage Commit** Configuration for storage commitment servers, devices that take responsibility for and provide receipt of content sent by the ultrasound system.
- **Worklist** Configuration for worklist servers, devices that contain scheduled patient procedure data. You can import the data into the patient form (see **"Using the worklist"** on page 5-4).
- **MPPS** Configuration for MPPS servers, devices that coordinate detailed information about the study performed. You can associate one MPPS server per location.

To configure a new location or device

Note Changing the configuration requires a system restart.

1 On the DICOM settings page, tap **Config**.

2 From the **DICOM** list, select a configuration page.

3 Tap **New**.

4 Complete the configuration setup fields, and tap **Save.**

To delete a location or device

1 On the proper configuration page, select the name from the list of locations or devices.

2 Tap **Delete**.

3 Tap **Yes** to confirm the deletion.

Location

- **Alias** Name that identifies the network location of the ultrasound system.
- **AE title** DICOM Application Entity title.
- **Port** Device listening port number for incoming Verify requests and Storage Commit responses. TCP port 104 is typically assigned for DICOM.

- **IPv4** or **IPv6** Select one to enable an internet protocol and fill out the following fields:
  - **DHCP** or **Automatically obtain an IPv6 address** Automatically obtains information for the rest of the fields.
  - **IP address** Unique identifier of the ultrasound system location. Cannot be between 127.0.0.0 and 127.0.0.8.
  - **Subnet mask** Identifies a network subdivision. The default value is 255.255.0.0.
  - **Default gateway** IP address where network connects to another network. Cannot be between 127.0.0.0 and 127.0.0.8.
  - **DNS address** Domain Name Server address.
- **Transfer images** Specify when to transfer images: during or at end of study.
- **JPEG compression** Select High, Medium, or Low. A high compression has a smaller file size but less detail. For best image quality, select Low. See **"Limitations of JPEG format"** on page 4-29.
- **Network** Choose a network from the list.
- **FIPS** Select if configuring a FIPS (Federal Information Processing Standards) wireless connection.

Note Selecting FIPS restricts the available security policy choice on the wireless page to WPA2, the encryption to AES, and the authentication type to EAP-TLS. FIPS cannot be enabled if any of the wireless profiles associated with a location are not configured appropriately.

- **Wireless Profile** Select if configuring a wireless location.

The following fields are available for wireless network connections:

- **Profile name** Name of the profile set for this location. For each wireless location, you can have up to 10 profiles.
- **Network name (SSID)** Network Name Service Set Identifier for the network.
- **Security policy** Security type that authenticates the network:
  - **Open** No security.
  - **WEP** The following fields appear:
    - **Encryption** Encryption key type (64 bit or 128 bit)
    - **Key index** WEP key index 1-4. Network location where a specific key is stored.
    - **Key** WEP key value used to encrypt data.
  - **RADIUS** Remote Access Dial-Up User Service -802.1x Key Exchange. The following fields appear:
    - **Authentication type** Select one of the following:
      - **EAP-TLS** Extensible Authentication Protocol-Transport Layer Security. The following fields appear:

- **User name** Name of designated user.
- **Client certificate** Select from the list of client certificates installed on the system.
- **Private key** One of a pair of keys (public and private) that is provided only to the requestor and never shared.
- **Private key password** A unique combination of letters and symbols that allows user access.
- **Certification authority** Validates the authentication server or certificate authority. The list is populated by wireless certificates that you have imported (see **page 4–22**). Select the desired certificate from the list.

- **EAP-PEAPv0**
  - **User name** Name of designated user.
  - **Password** A unique combination of letters and symbols that allows user access.
  - **Certification authority** Validates the authentication server or certificate authority. The list is populated by wireless certificates that you have imported (see **page 4–22**). Select the desired certificate from the list.
- **WPA** or **WPA2** Wi-Fi Protected Access. The following fields appear:
  - **Authentication** If you select **Personal**, the **Passphrase** field appears; enter the WPA shared key entry used in configuring the network.
  - **Encryption** Encryption protocol for the network.
  - **Authentication type** Select one of the following:
- **EAP-TLS** Extensible Authentication Protocol-Transport Layer Security. The following fields appear:
  - **User name** Name of designated user.
  - **Client certificate** Select from the list of client certificates installed on the system.
  - **Private key** One of a pair of keys (public and private) that is provided only to the requestor and never shared.
  - **Private key password** A unique combination of letters and symbols that allows user access.
  - **Certification authority** Validates the authentication server or certificate authority. The list is populated by wireless certificates that you have imported (see **page 4–22**). Select the desired certificate from the list.
- **EAP-PEAPv0** Extensible Authentication Protocol-Protected Extensible Authentication Protocol. The following fields appear:
  - **User name** Name of designated user
  - **Password** A unique combination of letters and symbols that allows user access.

- **Certification authority** Validates the authentication server or certificate authority. The list is populated by wireless certificates that you have imported (see **page 4-22**). Select the desired certificate from the list.

Archiver

- **Alias** Unique name for the archiver.
- **AE title** Archiver DICOM Application Entity Title.
- **Images** Defines how images are sent to the archiver: RGB (uncompressed), Mono (uncompressed), or JPEG.

  IP address The Internet Protocol address for the archiver.
- **Port** Device port number. TCP port 104 is typically assigned for DICOM.
- **Ping** Tap to determine whether the IP address is accessible. The system displays **OK** or **Failed**.
- **Include video clips** If the check box is selected, video clips are transferred.
- **Include Basic Text SR** Select this check box to send the Basic Text Structured Report to the archiver.
- **Include Comprehensive SR** Select this check box to send the Comprehensive Structured Report to the archiver.
- **Include private tags** If the archiver is a Sonosite software product (for example, Sonosite Synchronicity Workflow Manager), select this checkbox to integrate successfully with the product.

Note Because the tags may be incompatible with some earlier archivers, keep this checkbox unselected unless you use Sonosite software products. For more information, see the conformance statement for your ultrasound system.

Storage Commit

Required fields are marked with asterisks.

- **Alias** Unique name that identifies the network location of the storage commit server.
- **AE title** DICOM Application Entity Title.
- **IP address** The Internet Protocol address for the storage commit server.
- **Port** Device port number. TCP port 104 is typically assigned for DICOM.
- **Ping** Tap to determine whether the IP address is accessible. The system displays OK or Failed.

Worklist

- **Alias** Unique name for the worklist server.
- **AE title** Application Entity title.

- **Date range** Restricts the query to patient procedures that are scheduled for: Today; Yesterday, Today, Tomorrow; All.
- **This device only** Restricts the query to patient procedures that are scheduled for the system based on its AE title.
- **Modality** US (Ultrasound) is the default modality type.
- **IP address** The Internet Protocol address for the worklist server.
- **Port** Device port number. TCP port 104 is typically assigned for DICOM.

Automatic query Turns automatic query on/off.

- **Occurs every** In an automatic query, length of time between automatic updates.
- **Start time** In an automatic query, start time for the automatic update (displayed in 24 hour time).
- **Ping** Tap to determine whether the IP address is accessible. The system displays OK or Failed.

MPPS

- **Alias** Unique name that identifies the network location of the MPPS system.
- **AE title** DICOM Application Entity Title.
- **IP address** The Internet Protocol address for the MPPS server.
- **Port** Device port number. TCP port 104 is typically assigned for DICOM.
- **Ping** Tap to determine whether the IP address is accessible. The system displays OK or Failed.

Associating devices with locations

For each location, select which devices you want to receive the data that you transfer, which archivers you want to designate as an MPPS or storage commitment server, and which worklist server you want to receive data from. Once these selections are complete, select the location you want to use.

Note Changing the configuration requires a system restart.

To associate devices with a location

The devices must be configured before you can associate them. See **"To configure a new location or device"** on page 4-16.

1 On the DICOM settings page, select the location of the system from the **Location** list.

2 In the list of devices, check the box next to one or more archivers or worklist servers.

You can select a maximum of four archivers and one worklist server for each location. Only one archiver can be selected to receive in-progress transfers. Selected devices have an adjacent checkmark.

3 If you want to use the MPPS service, associate the MPPS server with the archiver:

a Check the box of the MPPS server that you want. (MPPS servers appear near the end of the list.)

b Check the box of the archiver.

c Check the box in the archiver's MPPS column.

4 If you want to use the storage commitment service, associate the storage commitment server with the archiver:

a Check the box for the storage commitment server that you want. (Storage commitment servers appear at the end of the list.)

b Check the box for the archiver.

c Check the box in the archiver's SC column.

5 Complete any additional configuration tasks, and then tap **Done**.

To disassociate devices with a location

1 On the DICOM settings page, select the location from the **Location** list.

2 Do any of the following:

- To disassociateor worklist server, select its check box.
- To disassociate an MPPS server from an archiver, select the check box for the MPPS server.
- To disassociate a storage commitment server from an archiver, select the check box for the storage commitment server.
- To disassociate an archiver from all servers, deselect and then reselect its check box.

To verify the connection status of devices

❖ On the DICOM settings page, tap **Verify** to confirm that the associated devices are connected. (If **Verify** is unavailable, check cable and wireless connections. Restart the system if you changed configuration. If the problem continues, see your system administrator.)

The connection status of the devices appears in the **Status** column:

- **Failed** DICOM cannot communicate with the device.
- **Success** DICOM can communicate with the device.
- **Unknown** Configuration may have changed since the connections were last verified.
- **Busy** The DICOM manager may be working on another task such as study data being transferred to an archiver. Wait for the transfer to complete and then tap **Verify** again.

Importing and exporting connectivity settings

If you are logged in as an administrator, you can import and export all location and connectivity settings from and to another Sonosite PX system. These settings include DICOM configuration data for locations, wireless settings, archivers, storage commit servers, worklist servers, and MPPS servers.

To connect a USB storage device, see **page 3-12**.

The system does not import IP addresses or AE titles when you import configuration data from another system.

Caution To avoid losing data from or damaging the USB storage device, do not remove the USB storage device or turn off the ultrasound system while exporting. In addition, do not bump or apply pressure to the USB storage device while it is connected to the system. The connector could break.

To import or export connectivity settings

1. Connect the USB storage device that contains the settings.
2. On the Connectivity settings page, tap **DICOM Setup.**
3. Tap **Config**.
4. Tap **Import** or **Export** at the bottom of the page.
5. Select the USB storage device, and then tap **Import** or **Export**.

   The system restarts. If you have imported data, all configurations on the system are replaced with imported data. If you have exported data, all configurations on the USB storage device are replaced with exported data. Five seconds after the exporting completes, you can safely remove the USB storage device and use it to import the data onto another Sonosite PX system.

Certificates

To import or delete certificates

If your security scheme requires it, you can import certificates, including wireless certificates. The system supports the following file types: CER, PFX, and PVK.

Caution To avoid losing data from or damaging the USB storage device, do not remove the USB storage device or turn off the ultrasound system while exporting. In addition, do not bump or apply pressure to the USB storage device while it is connected to the system. The connector could break.

1 On the Connectivity settings page, tap **Certificates**.

   A list of certificates on the system appears.

2 Do one of the following:

   - Import certificates: Connect the USB device that contains the certificates (see **"To connect a USB storage device for importing or exporting"** on page 3-12). Verify that the certificates on the system, plus those on the USB storage device, do not exceed 20. Delete certificates if necessary, then tap **Import**.

     Note Certificates on the USB storage device replace certificates on the system.

   - Delete certificates: select the certificates to delete, and then tap **Delete**.

Customization settings

On the Customization settings page, you can specify settings for obstetric and abdominal measurements and calculations.

To display the Customization settings page

1 Tap the system menu ☰, and then tap **System Settings**.

2 Tap **Customization** in the list on the left.

Obstetrics calculations settings

See **"Obstetrical references"** on page 10-17.

To select authors for obstetrical calculations

1 On the Customization settings page, select the desired authors from the drop-down lists.

2 To reset to the factory default, tap **Cancel**.

Table 4–1: OB calculation authors

Calculation result	Gestational OB measurements	Available authors
Gestational Age (GA)	GS	Nyberg, Hansmann
	CRL	ASUM, Hadlock, Intergrowth21
	BPD	ASUM, Hadlock
	HC	ASUM, Hadlock
	AC	ASUM, Hadlock
	FL	ASUM, Hadlock
	OFD	Hansmann, ASUM
Estimated Fetal Weight (EFW)[a]	HC, AC, FL	Hadlock 1
	BPD, AC, FL	Hadlock 2
	AC, FL	Hadlock 3
EFW %	EFW, GA	Hadlock

a. The Estimated Fetal Weight (EFW) calculation uses an equation that consists of one or more fetal biometry measurements. Individual selections for Hadlock's EFW equations 1, 2, and 3 are not determined by the user. The selected equation is determined by the measurements that have been saved to the patient report with priority given to the order listed above.

Abdominal calculations settings

To specify the bladder volume calculation

❖ On the Customization settings page, select the desired coefficient from the drop-down list under **Bladder**.

The system will use the chosen coefficient to calculate bladder volume.

Date and Time settings

WARNING To obtain accurate obstetrics calculations, an accurate date and time are critical. Verify that the date and time are accurate before each use of the system.

To display the date and time settings page

1 Tap the system menu ☰, and then tap **System Settings**.

2 Tap **Date and Time** in the list on the left.

To set the date and time

❖ On the Date and Time settings page, do the following:

- Under **Date**, choose the desired date format, and then type the current year, month, and day.
- Under **Time**, type the current time in hours and minutes.
- To obtain the system time from a time server, select **Use time on time server** and enter the **Server address**.

Note If you select **Use time on time server**, you cannot edit the **Date** and **Time**. If you want to edit the **Date** and **Time**, deselect **Use time on time server** first.

- To specify that the system automatically adjusts for daylight savings time changes, select **Daylight savings time**. This option is available only if you select **Use time on time server**.
- Select your time zone from the **Time zone** list. This option is available only if you select **Use time on time server**.

Display Information settings

On the Display Information settings page, you can specify which details appear on the monitor during imaging.

To display the Display Information settings page

1 Tap the system menu ☰, and then tap **System Settings**

2 Tap **Display Information** in the list on the left.

To specify details that appear on the monitor

❖ On the Display Information settings page, select settings in the following sections:

- **Patient header** Information that appears in the patient header, including the **Patient name**, **Patient ID**, **Department ID**, **Date and Time**, **User**, and **Institution**.
- **Mode data** Imaging information for 2D, Doppler, Color, or M Mode.

Network Status settings

The Network Status settings page displays the following information:

General information

- Location
- IP connectivity and addresses (both IPv4 and IPv6)
- Subnet mask
- Default gateway
- DNS address
- Ethernet MAC address

Wireless only information

- Wireless network SSID
- Connected BSSID
- Wireless MAC address
- Wireless signal strength
- Wireless connected status
- FIPS status

To display the Network Status settings page

1 Tap the system menu ☰, and then tap **System Settings**.

2 Tap **Network Status** in the list on the left.

Power and Battery settings

On the Power and Battery settings page, you can specify the period of inactivity before the system goes into sleep mode or turns off.

To display the power and battery settings page

1 Tap the system menu ☰, and then tap **System Settings**.

2 Tap **Power and Battery** in the list on the left.

To specify power settings

❖ On the Power and Battery settings page, select from the following lists:

- **Sleep delay** Select **Off**, or **5** or **10** minutes to specify the period of inactivity before the system goes into sleep mode.

The system will automatically turn off if it is in sleep mode and the battery charge level drops below 14%.

Note The system will not sleep if you are in Procedure mode (see "2D imaging controls" on page 6-2).

- **Power delay** Select **Off**, or **15** or **30** minutes to specify the period of inactivity before the system automatically turns off.

General settings

The General settings page has settings for general presets and the ability to import and export system settings.

To display the General settings page

1 Tap the system menu ☰, and then tap **System Settings**.

2 Tap **General** in the list on the left.

To adjust brightness

You can adjust the brightness of the monitor or the touch panel to compensate for the level of light in the room in which the system is located.

❖ Do any of the following on the General settings page:

- Drag the **Monitor brightness** slider right or left.
- Drag the **Touch panel brightness** slider right or left.
- Drag the **Physical control brightness** slider right or left.

To select patient ID settings

❖ Under **Patient ID**, do any of the following:

- **Auto save patient form** When this option is on, the system saves the patient form as an image in the patient's study.
- **Generate patient ID** When this option is on, the system automatically generates a unique patient ID upon starting a study from the patient form, unless a patient ID is entered manually or from the worklist. This option can be used to accommodate certain workflows.

To choose a startup mode

You can choose what mode the system will be in when you start it, end a study, or log in.

❖ On the General settings page, select an option in the **Startup** section:

- **Start select screen** Displays the startup screen, which offers you the option of scanning, entering patient information, selecting a transducer and exam type, or viewing visual guides.
- **Scanning** Displays the 2D imaging screen.
- **Transducer/exam select** Displays the options for selecting transducers and exam types.
- **Patient info** Displays the patient form.

Importing and exporting

Users with administrator rights can import or export all system settings, except connectivity settings, from the General settings page.

To import or export

When you import from the General settings page, all system preferences on the system are replaced with the imported preferences. When you export from the General settings page, all system preferences on the USB storage device are replaced with the exported preferences.

1 Connect a USB storage device (see **page 3-12**).

2 On the General settings page, do either of the following:

- To import labels, exam types, user accounts, and system settings, tap **Import**, and then tap **Yes**.

  Select the desired USB storage device, and then tap **Import**.

  All labels, exam types, user accounts, and system settings are replaced with those from the USB storage device.

- To export labels, exam types, user accounts, and system settings, tap **Export**, and then tap **Yes**.

  Select the desired USB storage device, and then tap **Export**.

3 A copy of all labels, exam types, user accounts, and system settings saves to the USB storage device. Passwords for user accounts are encrypted.

System information settings

The System Information settings page displays system hardware and software versions, patents, and license information. See also **"Software licensing"** on page 11-3.

To display the System Information settings page

1 Tap the system menu ☰, and then tap **System Settings**.

2 Tap **System Information** in the list on the left.

USB settings

On the USB settings page, you can view information about connected USB devices, specify file formats and options for exporting data to a USB storage device, and enable automatic export of ended studies.

Note You can only export data to a USB storage device if your administrator has enabled this setting.

To display the USB settings page

1 Tap the system menu ☰, and then tap **System Settings**.

2 Tap **USB** in the list on the left.

To specify export options

1 On the USB settings page, select an **Export type**:

- **DICOM export** creates DICOMDIR files readable by a DICOM reader. Video clips export in MJPEG format.
- **Multimedia export** organizes files in a standard folder structure. Video clips export as mp4 files.

2 Select an **Image format** for your export type. For JPEG formats, also select a JPEG compression. A high compression has a smaller file size but less detail (see **"Limitations of JPEG format"** on page 4-29).

For optimal DICOM image quality, select RGB image format and low compression.

3 (Multimedia export only) Select a sort order from the **Sort by** list.

4 (**DICOM export** only) Select any of the following:

- **Include Basic Text SR** to export the Basic Text Structured Report.
- **Include Comprehensive SR** to export the Comprehensive Structured Report.

5 Tap **Done**.

Limitations of JPEG format

When transferring or exporting images in JPEG format, the system uses *lossy compression*. Lossy compression may create images that have less absolute detail than BMP format and do not render identically to the original images. In some circumstances, lossy-compressed images may be inappropriate for clinical use.

JPEG settings:

Setting	Quality Level
Low	100%; The difference between the compressed and uncompressed image is near 0.
Medium	90%; Generally loss only to high frequency content (some degradation occurs at the edges of structures in the image).
High	75%; General loss of detail

Note The ratio of the image size without compression to the image size with compression is dependent on the content of the image

For more information on using lossy-compressed images, consult the industry literature.

Logs

Logs collect information that may be useful when troubleshooting the system. You can send the information to Fujfilm Sonosite Technical Support (see "Getting help" on page 1-2).

On the Logs settings page, you can view the following logs:

- **User** Collects information about user logins and user creation, as well as information about when the log was exported or cleared.
- **DICOM** Collects network errors and events, typically to support diagnostics (see "About DICOM" on page 4-14).
- **Assert** Collects processor exceptions and software-generated assertions to support diagnostics.
- **System** Collects errors and events to support diagnostics.
- **Diagnostics** Records the results of the diagnostic check of transducer imaging elements that the system performs automatically when a transducer is initially activated. This report log identifies any transducer element that might be experiencing poor performance. **Figure 4-1** displays an example of a diagnostic report.

Transducer performance test detected suspicious elements (element numbers go from 0 to 127): 6, 7, 8, 11, 13, 15.
Suspicious elements per image region: left 6, center 0, right 0.
Configuration: System SN: 000PHX. Software BOM: 1.0.00012. TTC SN: 123456. Transducer: L19-5 with SN 123456 in bay 2. Please see the user guide's Troubleshooting and Maintenance section for more information about addressing image quality issues.

Figure 4–1 Transducer diagnostic report

- **ePHI** Collects information about creating, deleting, modifying, accessing, viewing, storing, and exporting patient data.

You can export the logs as .csv files to a USB storage device and read them on a PC using a spreadsheet program.

Log contents are saved as entries are generated. The logs have limited space and overwrite existing content when full. Only an administrator can clear logs.

To display the Logs settings page

1 Tap the system menu ☰, and then tap **System Settings**.

2 Tap **Logs** in the list on the left.

To export a log

Caution To avoid losing data from or damaging the USB storage device, do not remove the USB storage device or turn off the ultrasound system while exporting. In addition, do not bump or apply pressure to the USB storage device while it is connected to the system. The connector could break.

1 Connect a USB device (see **page 3–12**).

2 On the Logs settings page, tap the log under **Log type**.

3 Tap **Export**.

A list of USB storage devices appears.

4 Select the appropriate USB storage device, and tap **Export**.

5 Tap **Yes** to confirm the export.

Five seconds after the exporting completes, you can safely remove the USB storage device.

To clear a log

1 On the Logs settings page, tap the log under **Log type**.

2 Tap **Clear** and confirm your selection.

CHAPTER 5

Entering Patient Information

Sonosite PX offers tools for entering, searching, and managing patient information, which will become part of the patient exam record or *study*. You can search the worklist server or system for specific studies, update patient information, create new studies, and save studies. For more information on managing patient data and studies, see **CHAPTER 9**.

You can start scanning without entering any patient information. As soon as you begin collecting images and data, the data is saved to a new study and the **END STUDY** button appears. Before archiving any images, you should enter a patient name (see **"Creating a new patient"** on page 5-2).

Note If you want to save images and other data to a new study, you need to end the previous study.

Ending the previous study

1. Make sure that you have saved images and other information that you want to keep (see **"Saving an image or a clip"** on page 7-1).
2. In the top navigation bar of the touch panel, tap **END STUDY**.

   The End Study dialog box appears.
3. Do one of the following:

   - To start a new study tap **Yes**.

     The startup screen appears.
   - To return to the current study, tap **Cancel**.

Note Turning off the system will also end the study.

Creating a new patient

The patient form lets you enter identification, exam, and clinical details for the patient study.

After you begin a new patient form, all images, video clips, and other information you save during the study are linked to that patient.

To create a new patient information form

1 To start a new patient information form, do one of the following:

- Tap **Enter** on the startup screen.
- Tap **+ New Patient** on the touch panel.

2 Tap a text box to edit it using the on-screen keyboard.

3 Tap  to close the keyboard, or tap **Scan** to scan.

Patient form fields

The patient form fields available depend on exam type. In some fields, you can enter symbols and special characters (see "To enter text using the on-screen keyboard" on page 3-19).

- **Patient**
  - MRN (medical record number)

Note The **Generate patient ID** option enables the system to auto-generate a unique patient ID to accommodate certain workflows. For more information, see "General settings" on page 4-27.

  - Patient name fields
  - Accession number
  - Date of birth
- **Provider**
  - Performing
  - Referring
  - Institution

    Tap the ⌄ to expand the menu.
    - Type the institution's name.
    - Department ID

- **Change Transducer/Exam**

  Displays the current transducer and exam type. Tap the button to navigate to the transducer and exam select screen (see **"Selecting a transducer and exam type"** on page 3-23).

- **More Exam Info** (tap to expand the menu)
  - Gender
  - Height

    The patient height in inches and centimeters.
  - Weight

    The patient weight in pounds and kilos.

    BMI (body mass index)

    Automatically calculated after you enter height and weight.
  - BSA (body surface area)

    Automatically calculated after you enter height and weight.
  - HR (heart rate)

    Enter the beats per minute. Saving the heart rate using a measurement overwrites this entry.
  - BP (blood pressure)
  - Indications
- **Obstetrics** (tap to expand the menu)
  - Last Menstrual Period

    In an obstetrical exam, select **LMP** or **EDD** and then enter either the date of the last menstrual period or the established due date. In a gynecology exam, enter the date of the last menstrual period. The LMP date must precede the current system date.
  - Gestational Age (weeks and days)
  - Gravida

    Enter the total number of pregnancies.
  - NT Credential

    A combination of letters and numbers representing a Nuchal Translucency (NT) credential ID number. For example, P12345.
  - Para

    Enter the total number of births.
  - Multiples

    Select the number of multiples (up to four) to display multiple sets of measurements on the calculations menu.

- Aborta

  Enter the total number of abortions.

- **Procedure Codes** (tap to expand the menu)

  Available only if the DICOM worklist feature is configured. For further details, see the following section **"Using the worklist"**.

Using the worklist

You can import patient information from the Hospital Information System or Radiology Information System with the DICOM worklist feature. For more information on DICOM, see **page 4-14.**

The worklist automatically updates if set up for an automatic worklist query. You can also manually update the worklist, and you can manually search the worklist server for a matching patient procedure.

To set up the worklist

1 Configure the system for DICOM transfer (see **page 4-14**).

2 Configure the worklist server (see **page 4-19**).

3 Select the parameters used for automatic worklist queries (see **page 4-19**).

The following table displays the parameters that apply to searches and updates:

Table 5-2: Query parameters

Parameters	Manual patient search	Manual worklist update	Automatic query update
Patient data	✓	—	—
Date range	✓	✓	✓
Modality	✓	✓	✓
This device only	✓	✓	✓
Automatic query on/off	—	—	✓
Occurs every	—	—	✓
Start time	—	—	✓

4 Connect the worklist server to the system (see **page 4-20**).

To access the worklist

❖ Tap **Worklist** on the main touch panel screen, or at the bottom of the patient form.

The current list of scheduled patients appears.

To sort the worklist

By default, the list is sorted by date and time, with the most recent patient listed first. You can re-sort the list.

❖ Tap the column heading that you want to sort by. Tap it again to sort in reverse order.

To manually search the worklist

1 On a new patient form, do any of the following:

- Fill in any of the following fields for the query: MRN, patient name, date of birth, and accession number.

  The search is on the characters you enter. For example, *Smith* returns *Smith, Smithson, Smithy*.

- Under **Procedure Codes**, specify any of the following from **Additional worklist query parameters**:
  - **Modality** Select a procedure type from the list. US (Ultrasound) is the default.
  - **Requested procedure ID** Type a procedure ID.
- Tap **Cancel** to cancel the search and clear the search fields.

2 Tap **Search**.

The worklist appears with the search results, number of results, and time of the last update.

To manually update the worklist

❖ Tap the refresh icon  .

To select a patient

❖ In the list, tap a row.

The selected row is highlighted.

To clear the worklist

❖ Tap the **Clear** button.

Search results are removed.

To enter patient information from the worklist

1 In the worklist, select the patient procedure you want.

Note You can select more than one procedure if the patient information matches.

2 Do one of the following:

- Tap **Select** to import patient information into the patient form.

  Patient information from the worklist is uneditable.

- To return to the patient form without selecting a procedure, tap **Cancel**.

Selecting a procedure

Once you have imported patient information from the worklist, you can select a scheduled procedure for the patient.

To select a scheduled procedure

1 On the patient form, tap the ⌄ to expand the menu under **Procedure Codes**

2 Under **Scheduled procedure**, select a procedure from the **Name** list.

Only procedures imported from the worklist are visible.

3 Select a protocol from the drop-down list.

The definition of the selected procedure appears in the **Meaning** field.

To change the procedure

You can select a procedure different from the scheduled procedure.

1 On the patient form, tap the ⌄ to expand the menu under **Procedure Codes**.

2 Under **Performed procedure**, select the desired procedure from the **Code** list.

The definition of the procedure appears in the **Meaning** field. If desired, you can edit the field.

To modify the list of codes available

1 On the patient form, tap the ⌄ to expand the menu under **Procedure**.

2 Under **Performed procedure**, tap **Edit** to navigate to the **Performed Procedure Codes**.

3 To add a new code (required fields are marked with an asterisk):

a Tap **Add Code**.

b Fill in the **Code**, **Code scheme**, and **Code meaning** fields.

c Tap **Save**.

4 To delete a code or codes, tap a row in the list and then tap **Delete**.

Saving patient information

Patient information is automatically saved and included in the study when entered in the patient form. You can also save an image of the patient form, which is stored with the other study images.

To save an image of the patient information form

❖ Tap **Save as Image** at the bottom of the patient form.

Editing patient information

To edit patient information during scanning

1 While scanning, tap **Patient** in the touch panel.

2 Tap a text box to edit it using the on-screen keyboard.

3 Tap **Cancel** to cancel your changes, and return to the scan.

4 Tap **Scan**.

A pop-up message appears warning you that patient data has changed.

5 Do one of the following:

- Tap **Cancel** to cancel any edits and return to the scan.
- Tap **Modify** to change patient data without ending the study.
- Tap **New** to start a new study using the edited information.

To access and edit patient information

1 You can access patient information in two ways:

- Tap **Patient** in the touch panel to open the patient form.
- Tap **Patient List**, open a study from the list, and access the patient form (see **page 9-3**).

2 Tap a text box to edit the patient form using the on-screen keyboard.

Note You can edit patient information if the study has not been archived or exportedand if the information is not from a worklist.

Reviewing patient information

You can review patient information when you review worksheets, calculations, and the report. See **"Managing reports and worksheets"** on page 9-7.

To review patient information

1. On the touch panel, tap **Report & Worksheet**.

   The workspace displays with the default Worksheet tab open.

2. To open patient information, tap the **Patient** tab.

   A read-only version of the patient form opens.

3. Review the patient information.

CHAPTER 6

Scanning

This chapter describes scanning with the Sonosite PX ultrasound system.

Understanding imaging modes

Sonosite PX allows you to scan in several imaging modes. The modes that are available to you depend on the transducer and the exam type you have chosen.

The active imaging mode (or modes) is always highlighted in blue.

- **2D** is the system's default imaging mode. The system displays echoes in two-dimensional view by assigning a brightness level based on the echo signal amplitude.
- **M Mode** (motion mode) is a time motion display of the ultrasound wave along a chosen ultrasound line. It provides a trace of the 2D image displayed over time. A single beam of ultrasound is transmitted, and reflected signals are displayed as dots of varying intensities, creating lines across the screen.
- **Doppler** imaging is a display of a spectrum of flow velocities over time. The amplitude of the signal is indicated as a shade of gray. You can use Doppler imaging to display blood flow and tissue movement.
- **Color** is a form of pulse wave (PW) Doppler in which the energy of the returning echoes is displayed as an assigned color. You can use color imaging to show the presence, velocity, and direction of blood flow toward and away from the transducer.

Imaging controls

During scanning, a set of commonly used controls based on your imaging mode, chosen transducer, and exam type are located in the center of your touch panel. Control availability depends on whether the image is live or frozen.

To access a control in the more controls section

1 When you are in an imaging mode, tap **+ More Controls** at the bottom of the touch panel.

The control area expands, and you can scroll down to use additional imaging controls.

2 To close the **+ More Controls** area, tap **– Less Controls**.

Scanning in 2D

To scan in 2D

1 Press the **2D** button.

A blue highlight appears when 2D is active.

2 Adjust controls as needed.

3 To freeze the image, press  .

2D imaging controls

Table 6-1: Controls available in 2D

Control	Use	Available in	
		Live	Frozen
Auto Gain Adjust	❖ Tap the up or down arrows on the control to set the target brightness level the system uses when you press the **AUTO** button. For more information on adjusting the gain, see **page 6-15**.	✓	—
Centerline	❖ Tap the button on the control to turn the centerline graphic on or off. You can use the graphic to align the image with the transducer. See **"Using the centerline"** on page 6-18.	✓	—
Video Clip Settings	❖ Tap the button on the control to display the video clip settings. See **"To set clip controls"** on page 7-1.	✓	—
Dual	**1** Tap the control to begin Dual imaging. **2** Tap the right or left buttons to scan the right or left images. See **"Scanning in dual mode"** on page 6-13.	✓	✓

Table 6-1: Controls available in 2D

Control	Use	Available in	
		Live	Frozen
Dynamic Range	❖ Tap the up or down arrows to control the contrast of the gray scale used in the image. A lower setting increases the image contrast, making echoes appear brighter against a darker background.	✓	✓
Reset Gain	❖ Tap the button on the control to return the gain to default values. For more information on adjusting the gain, see **page 6-15**.	✓	—
LVO	❖ Tap the button on the control to lower the mechanical index (MI) of the system. **THI** is also turned on. Sonosite PX is not validated or cannot support the use of contrast imaging.	✓	—
Needle Guide	**1** If using an IC10-3 or L19-5 transducer with an attached needle bracket, tap the control to turn the needle guide on. **2** For transverse-angle brackets, use the touchpad to move the needle depth indicator. See **"Needle guide control"** on page 6-23.	✓	—
Needle Profiling	❖ Tap the left or right button on the control to choose the needle entry side. See **"Needle profiling"** on page 6-20.	✓	—
Optimize	❖ Tap one of the available options (the system automatically gives you a selection based on the exam type and transducer): ▸ **Res** provides the best possible resolution. Use this setting when the ultrasound signal does not need to penetrate very deeply, such as for shallow structures. ▸ **Gen** balances resolution and penetration. ▸ **Pen** provides the best possible penetration. Use this setting when the ultrasound signal needs to penetrate deeply. The image is optimized by applying a specific group of settings such as focal zones, aperture size, frequency (center and bandwidth), line density, and waveform.	✓	—

Table 6-1: Controls available in 2D

Control	Use	Available in	
		Live	Frozen
Orientation	**1** Tap a button on the control to orient the image to the upper right, upper left, lower left, or the lower right. **2** Make sure that the location of the dot on the icon matches up with the indicator located on the side of the transducer.	✓	—
Power	❖ Tap the arrows on the control to adjust the transmit power levels to the desired range while maintaining adequate image quality. MI (mechanical index) and TI (thermal index) are updated accordingly.	✓	—
Procedure Mode	❖ Turn on or off by tapping the button on the control. When **Procedure Mode** is on, sleep mode and automatic power-off are disabled, and the system is prevented from interrupting a procedure.	✓	—
Sector	**1** Turn on or off by tapping the button on the control. **2** Press **SELECT/** to switch between using the touchpad for adjusting the sector width or for steering the sector right or left.	✓	—
SonoMB	❖ Turn on or off by tapping the button on the control. Multibeam imaging enhances the 2D image by viewing a target from multiple angles and then merging or averaging the data (not available with phased array transducers).	✓	—
Thermal Index	❖ Tap the button on the control to select a thermal index (TI) setting: ▸ **TIS** (soft tissue): choose this setting for soft tissues. ▸ **TIB** (bone): choose this setting when the ultrasound beam passes through soft tissue and a focal region is in the immediate vicinity of bone. ▸ **TIC** (cranial bone): choose this setting when the ultrasound beam passes through bone near the beam entrance into the body.	✓	—

Table 6-1: Controls available in 2D

Control	Use	Available in	
		Live	Frozen
THI	❖ Tap the button on the control to turn Tissue Harmonic Imaging (THI) on or off. THI allows the system to transmit at one frequency and receive at a different frequency to reduce noise and improve resolution. Dynamic range is reduced. Available with certain exam types and transducers.	✓	—
Zoom	▸ During live imaging, tap the magnifying glass (for further details, see **"Zooming in on an image"** on page 6-17). ▸ When the image is frozen, tap the up or down arrows to increase or decrease the zoom.	✓	✓

Scanning in M Mode

To scan in M Mode

1 Press the **M** button.

The control is highlighted, and the M-line appears on the 2D image.

2 Drag your finger on the touchpad to move the M-line to the desired position in the 2D image.

3 Adjust the depth as needed (see **page 6-15**).

4 To display both the live M-line image and M Mode trace, do one of the following:

- Press **UPDATE/** ↻ .
- Press **M** again.

5 To switch the focus from the trace to the M-line (2D image), press **UPDATE/** ↻ .

Note The **UPDATE/** ↻ button can only be used when the M Mode trace is in focus.

6 Adjust the images and controls (see **page 6-6**) with each image selected.

You can also tap **2D** or **M Mode** near the top of the touch panel to change the focus between the 2D and M Mode images and controls.

7 To exit M Mode, press **2D** or **M**.

M Mode controls

In addition to most of the 2D controls (see **page 6-2**), M Mode imaging uses the following controls.

Table 6-2: Controls available in M Mode

Control	Use	Available in	
		Live	Frozen
Display Format	❖ Tap the button on the control to display the settings, then tap the format of your choice: ▸ 1/3 2D, 2/3 Sweep ▸ 1/2 2D, 1/2 Sweep ▸ 2/3 2D, 1/3 Sweep ▸ Side by Side For example, **1/3 2D, 2/3 Sweep** divides the screen so that the top 1/3 shows the 2D image with the M- or D-line, while the bottom 2/3 displays the M Mode or Doppler trace. You can adjust the images independently of each other.	✓	✓
Sweep Speed	❖ Tap **Slow**, **Med**, or **Fast** to select the speed of the M Mode trace. Sweep speed affects the number of heart cycles displayed. Use a slower speed for slower heart rates, and a faster speed for faster heart rates.	✓	—

Scanning in Doppler

Doppler modes

Your ultrasound system has several types of Doppler imaging available:

- Pulsed Wave (PW); the transducer emits ultrasound pulses to a specific depth, limiting the velocities that can be measured, but allowing you to accurately determine the location of blood flow.
- Continuous Wave (CW); the transducer continuously emits and receives ultrasound waves along the beam, enabling the measurement of high velocity blood flow independent of a specific depth location.
- Pulsed Wave Tissue Doppler Imaging (TDI); the pulsed wave signal measures velocity of myocardial tissue movement rather than blood flow.

CW and TDI are available only in the cardiac exam type.

To scan in Doppler

1 Press the **D** button.

The control is highlighted, and the D-line appears on the 2D image.

2 In the cardiac exam type only, select one of the following modes:

- **PW** – Pulsed wave Doppler
- **CW** – Continuous wave Doppler
- **TDI** – Tissue Doppler Imaging

3 Adjust the D-line and the gate (sample volume):

- To position the D-line, drag your finger left or right on the touchpad.
- To adjust the D-line tilt, tap a setting on the **Steering** control (linear transducers only).

  If this control is hidden, tap **+ More Controls** to access it.
- For CW Doppler, adjust the focus by moving the diamond on the D-line up or down.
- To position the gate, move your finger up or down on the touchpad.
- To adjust the gate size, tap the arrows on the **Gate** control.

  If this control is hidden, tap **+ More Controls** to access it.
- To adjust the angle of the gate: use the **Angle Correct** control.

  If this control is hidden, tap **+ More Controls** to access it.

4 To begin Doppler scrolling, do one of the following:

- Press **UPDATE/**  .
- Press **D** again

5 To switch the selection from the scrolling image to the D-line (2D image), press **UPDATE/**  .

6 With each image selected, adjust the images and controls (see **page 6–2** for 2D controls).

You can also tap **2D** or **Doppler** near the top of the touch panel to change the focus between the 2D and Doppler images and controls.

7 To exit Doppler, press **2D** or **D**.

Doppler imaging controls

In Doppler imaging, you can adjust controls in D-line and in scrolling Doppler.

Table 6-3: Controls available in Doppler

Control	Use	Available in	
		Live	Frozen
Angle Correct	❖ Tap a preset button, or use the slider to rotate to any angle from -60° to 60°. Changing the angle can optimize for the blood flow within the vessel. This will correct spectral Doppler velocities for the direction of the blood flow.	✓	✓
Auto Trace	**1** Tap the button to access the auto trace settings. **2** Choose which part of the Doppler waveform to trace (peak or mean) and where to display the trace relative to the baseline. The settings chosen apply to the automatic trace you can use to make Doppler measurements. See **page 8-12**.	✓	✓
Display Format	❖ Tap the button on the control to display the settings, then tap the format of your choice: ▸ 1/3 2D, 2/3 Sweep ▸ 1/2 2D, 1/2 Sweep ▸ 2/3 2D, 1/3 Sweep ▸ Side by Side ▸ Full 2D, Full Sweep For example, **1/3 2D, 2/3 Sweep** divides the screen so that the top 1/3 shows the 2D image with the M- or D-line, while the bottom 2/3 displays the M Mode or Doppler trace.	✓	✓
Doppler Baseline	❖ Tap the up or down arrows to move the baseline. Repositioning the Doppler baseline can optimize for the aliasing velocity.	✓	✓
Doppler Mode	❖ Tap **PW**, **CW**, or **TDI** (CW and TDI are available only in the cardiac exam type) See **"Scanning in Doppler"** on page 6-6 for an explanation of Doppler modes.	✓	—

Table 6-3: Controls available in Doppler

Control	Use	Available in	
		Live	Frozen
Doppler Scale	❖ Tap the up or down arrows to change the maximum velocity displayed on the Doppler scale. Changing the scale can help optimize the display for faster or slower blood flow.	✓	—
Gate	❖ Tap the up or down arrows to increase or decrease the gate size, modifying the amount of information included in the Doppler sample.	✓	—
Invert	❖ Turn on or off by tapping the button on the control. Invert switches the direction of the Doppler spectral display.	✓	✓
Power	❖ Tap the arrows on the control to adjust the transmit power levels to the desired range while maintaining adequate image quality. MI (mechanical index) and TI (thermal index) are updated accordingly.	✓	—
Procedure Mode	❖ Turn on or off by tapping the button on the control. When **Procedure Mode** is on, sleep mode and automatic power-off are disabled, and the system is prevented from interrupting a procedure.	✓	✓
Simultaneous	Turn on or off by tapping the button on the control. See **"Scanning in simultaneous mode"** on page 6-14.	✓	—
Steering	❖ Tap a setting to optimize the Doppler angle for the direction of the blood flow (linear transducers only).	✓	—
Sweep Speed	❖ Tap **Slow**, **Med**, or **Fast** to set the speed of the Doppler trace. Sweep speed affects the number of heart cycles displayed. Use a slower speed for slower heart rates, and a faster speed for faster heart rates.	✓	—

Table 6–3: Controls available in Doppler

Control	Use	Available in	
		Live	Frozen
Thermal Index	❖ Tap the button on the control to select a thermal index (TI) setting: ▸ **TIS** (soft tissue): choose this setting for soft tissues. ▸ **TIB** (bone): choose this setting when the ultrasound beam passes through soft tissue and a focal region is in the immediate vicinity of bone. ▸ **TIC** (cranial bone): choose this setting when the ultrasound beam passes through bone near the beam entrance into the body.	✓	—
Volume	❖ Tap the up or down arrows to increase or decrease the Doppler speaker volume.	✓	—
Wall Filter	❖ Tap to select the strength of the filter: **Low**, **Med**, or **High**. Wall Filter removes low level echoes on each side of the baseline. A higher filter correlates to a higher cutoff velocity.	✓	—

Scanning in Color

The color display is usually superimposed on the 2D image, allowing you to simultaneously visualize anatomy and flow dynamics.

Color types

Your ultrasound system has several types of color imaging available:

- Color or Color Velocity Doppler (CVD) imaging provides velocity information.
- Color Power Doppler (CPD) imaging provides amplitude strength of the Doppler signal but does not provide velocity information. You can use it to detect the presence of blood flow in very low flow states.
- Variance (Var) displays a color map that highlights areas of blood flow with rapidly changing velocities by indicating high variance in green. High variance can suggest turbulent flow. Variance is available in cardiac exams only.

To scan in Color

1 Press the **C** button.

The control is highlighted, and the color box appears.

2 To change the type of color imaging the system uses, use the **Color Type** control located on the touch panel.

3 Position the color box by dragging your finger on the touchpad.Tap the touchpad to switch from controlling the position of the box to controlling the size of the box.

4 Size the color box by dragging your finger on the touchpad.

5 To steer the color box (linear transducers only), tap **Steering**, and select an angle.

6 Adjust controls as needed.

7 To exit color mode, press **C** or **2D**.

Color imaging controls

Table 6-4: Controls available in Color

Control	Use	Available in	
		Live	Frozen
Centerline	❖ Tap the button on the control to turn the centerline graphic on or off. You can use the graphic to align the image with the transducer. See **"Using the centerline"** on page 6-18.	✓	—
Color Baseline	❖ Tap the up or down arrows to move the baseline. Repositioning the color baseline can optimize for the aliasing velocity.	✓	✓
Color Compare	Color Compare displays two versions of the image. One version displays 2D and color, and the other version displays 2D only. **1** Tap the buttons to choose between left and right displays or top and bottom displays. **2** Use the imaging controls to jointly optimize both versions of the image or clip and view the cine loop.	✓	—
Show/Hide Color	❖ Tap the button on the control to show or hide color, allowing you to view the 2D image with or without the color graphics.	✓	✓

Table 6-4: Controls available in Color

Control	Use	Available in	
		Live	Frozen
Color Flow	❖ On the **Color Flow** control, tap one of the following: ▸ **High** optimizes for high blood flow areas, minimizing flash artifacts. ▸ **Med** optimizes for medium blood flow area such as an artery. ▸ **Low** optimizes for low flow areas such as breast, venous, or musculoskeletal. For a more precise setting, adjust the **Color Scale** control.	✓	—
Color Type	❖ Tap one of two choices: **Color** and **CPD**; **Color** and **Var**. The choice depends on transducer and exam type. See **"Scanning in Color"** on page 6-10 for an explanation of color types.	✓	—
Dual	**1** Tap the control to display side by side color or 2D images. **2** Tap the right or left buttons to activate one of the images. See **"Scanning in dual mode"** on page 6-13.	✓	✓
Invert	❖ Turn on or off by tapping the button on the control. Switches the displayed direction of the blood flow and reduces the need to reposition the transducer.	✓	✓
Color Scale	❖ Tap the up or down arrows to adjust the color scale.	✓	—
Power	❖ Tap the arrows on the control to adjust the transmit power levels to the desired range while maintaining adequate image quality. MI (mechanical index) and TI (thermal index) are updated accordingly.	✓	—
Procedure Mode	❖ Turn on or off by tapping the button on the control. When **Procedure Mode** is on, sleep mode and automatic power-off are disabled, and the system is prevented from interrupting a procedure.	✓	✓
Steering	❖ Tap a setting to optimize the display of color for the direction of the blood flow (linear transducers only).	✓	—

Table 6-4: Controls available in Color

Control	Use	Available in	
		Live	Frozen
Thermal Index	❖ Tap the button on the control to select a thermal index (TI) setting: ▸ **TIS** (soft tissue): Choose this setting for soft tissues. ▸ **TIB** (bone): Choose this setting when the ultrasound beam passes through soft tissue and a focal region is in the immediate vicinity of bone. ▸ **TIC** (cranial bone) Choose this setting when the ultrasound beam passes through bone near the beam entrance into the body.	✓	—
Wall Filter	❖ Tap to select the strength of the filter: **Low**, **Med**, or **High**. Wall Filter removes low level echoes on each side of the baseline. A higher filter correlates to a higher cutoff velocity.	✓	—
Zoom	▸ During live imaging, tap the magnifying glass (for further details, see **"Zooming in on an image"** on page 6-17). ▸ When the image is frozen, tap the up or down arrows to increase or decrease the zoom.	✓	✓

Scanning in dual mode

Dual displays two separate 2D or color images side by side. The system supports independent image information for each dual side (for example, depth and orientation markers), and you can view frames in the cine buffer for each image independently. You can also switch between the two images to adjust some controls including depth, mode, and gain.

You can use dual imaging to display the same structure in two different planes. Dual imaging can also be used to display two adjacent areas of the body.

To scan in dual mode

1 Tap **Dual** to start dual imaging with the left-hand image active.

If this control is hidden, tap **+ More Controls** to access it.

2 Scan to obtain your first image, and adjust controls as needed.

3 On **Dual**, tap **R** to activate the right-hand image.

4 Scan to obtain your second image, and adjust controls as needed.

5 To view independent cine buffers for side by side images in Dual, see **"To view frames in the cine buffer"** on page 6-18.

6 On **Dual**, tap the highlighted button to turn Dual off.

Scanning in simultaneous mode

Simultaneous imaging assesses body structures simultaneously in two modes (2D and PW Doppler), or three modes (2D, color Doppler, and PW Doppler). See **Table 3-2** for compatible exam types and transducers.

WARNING The PW Doppler sensitivity and waveform appearance in simultaneous imaging may be inferior to that in non-simultaneous Doppler imaging modes. You can turn off simultaneous imaging to confirm Doppler waveform characteristics.

To perform a scan using simultaneous Doppler

1 Press **D** to begin Doppler imaging.

2 Position and adjust the D-line and gate using the touchpad or the **Angle Correct**, **Steering**, and **Gate Size** controls.

3 Press **ENTER** or **D** again to display the scrolling image.

Note Pressing **UPDATE/**  toggles the display of 2D, Color, and Doppler controls and calculations.

4 Tap the button on the control to turn on **Simultaneous**.

If this control is hidden, tap **+ More Controls** to access it.

5 Scan the image in 2D and PW Doppler, or 2D, Color Doppler, and PW Doppler.

6 Tap **+ More Controls** to access and adjust specific controls for each of the three modes.

Note Full display is unavailable in simultaneous Doppler mode.

7 To view independent cine buffers for side by side images in simultaneous Doppler, see **"To view frames in the cine buffer"** on page 6-18.

Adjusting the image

Adjusting the depth

Depth refers to the depth of display. You can adjust the depth in all imaging modes except Doppler sweep. The vertical depth scale on the touch panel lists all available depth levels for the current transducer. Depth controls are unavailable when the image is frozen.

To adjust the depth

As you adjust the depth, the depth value appears in a rectangle in the lower right corner of the image area or upper right corner if the image orientation is upside down.

Note The depth value in the lower right corner of the monitor is always the total acquired depth of the unzoomed image. When you zoom, this value stays the same.

❖ Press the following buttons:

- The upper depth control to decrease the displayed depth and view structures closer to the skin line.
- The lower depth control to increase the displayed depth and view deeper structures.

Adjusting the gain

Gain refers to amplifying the intensity of the returning sound waves on the display. In 2D mode, increasing the gain brightens the image. Decreasing the gain darkens the image. When you are in Color mode, the gain controls adjust the intensity of the signals within the color box.

You can adjust the gain by:

- Pressing the **AUTO** button
- Adjusting the **TGC** sliders
- Using the **GAIN/** wheel

Gain controls are unavailable when the image is frozen.

To adjust gain automatically

❖ Press the **AUTO** button.

The system automatically balances the gain each time you press this control. Automatic gain adjustment does not occur continuously. If needed, press the button again when adjustments are made to the image or the location of the transducer.

You can use the **Auto Gain Adjust** control to adjust the target brightness level the system uses when you press the **AUTO** button. This customization can be saved, along with other optimizations, to a custom exam type.

To adjust gain by using the TGC sliders

1 Press the **TGC** button on the physical control panel to display the time gain compensation controls on the touch panel.

2 Do one or more of the following:

- Drag the near gain slider left or right to decrease or increase the near gain, which adjusts the gain at shallow depths.
- Drag the middle gain slider up or down, left or right to adjust the gain at the middle depths of the image.
- Drag the far gain slider left or right to decrease or increase the far gain, which adjusts the gain at deeper depths.
- Drag the bottom gain slider left or right to affect the overall gain.

To adjust gain by using the gain wheel

❖ Drag your finger counterclockwise or clockwise around the **GAIN/** wheel to decrease or increase the overall gain.

Note When the image is frozen, the **GAIN/** wheel controls the cine buffer (see **"To view frames in the cine buffer"** on page 6-18).

To reset the gain to the default setting

❖ Do one of the following:

- Tap the button on the **Reset Gain** control.
- If you are using the TGC sliders, double tap on the gain centerline.

Zooming in on an image

You can freeze or unfreeze the image or change the imaging mode while zooming, but you cannot use the on-screen time gain compensation (TGC) controls. When you freeze an image, the zoom control changes appearances.

When you zoom in on an image, the magnifying glass icon appears on the image.

To zoom in on an image during scanning

1 On the **Zoom** control, tap the magnifying glass icon.

A zoom box appears.

If this control is hidden, tap **+ More Controls** to access it.

2 Position the zoom box by dragging your finger on the touchpad.

3 Press **SELECT/** to switch from controlling the position of the box to controlling the size of the box.

4 Size the zoom box by dragging your finger on the touchpad.

5 Tap the **Zoom** control again to zoom in on the selected area.

6 To exit zoom, do one of the following:

- Tap **UnZoom**.
- Tap **2D**.

To zoom in on a frozen image

1 Freeze the image .

2 Tap the up or down arrows on the **Zoom** control to increase or decrease the magnification of the current image.

If this control is hidden, tap **+ More Controls** to access it.

3 (Optional) Pan the image by dragging your finger left, right, up, or down on the touchpad.

Viewing frames

While imaging, the system always retains a certain number of frames in the cine buffer. You can move forward and backward in the cine buffer.

The system clears the cine buffer when you unfreeze the image or press **2D**.

You can view frames in the cine buffer during Dual and Simultaneous imaging. See **page 6-13** and **page 6-14**.

To view frames in the cine buffer

1 Freeze the image .

On a frozen image, the cine icon and bar appear on the left side of the monitor.

2 Do any of the following:

- Tap right or left on the touchpad to move forward or backward frame by frame.
- Drag your finger right or left on the touchpad to move forward or backward in the cine buffer continuously.
- Drag your finger counterclockwise or clockwise around the **GAIN/** wheel, to move backward or forward in the cine buffer respectively.
- A single tap on the right part of the **GAIN/** wheel will advance the buffer by one frame. A single tap on the left part of the wheel will reverse the buffer by one frame.

  The current frame number appears on the touch panel. The frame number changes as you move forward or backward.

Using the centerline

The centerline graphic aligns with the center mark of the transducer and serves as a reference mark for the center of the displayed image during live 2D imaging. The centerline graphic is currently available for the following transducers and exam types.

Table 6-5: Exam types compatible with the centerline

Transducer	Exam type								
	Abdomen	Arterial	Breast	Carotid	MSK	Nerve	Superficial	Spine	Venous
C5-1	✓	—	—	—	✓	✓	—	✓	—
L12-3	—	✓	✓	✓	✓	✓	✓	—	✓
L15-4	—	✓	✓	✓	✓	✓	✓	—	✓
L19-5	—	✓	—	—	✓	✓	✓	—	✓

WARNING When using the centerline feature as a reference during a freehand needle procedure, the centerline represents only the center of the ultrasound image and is not an accurate predictor of the path the needle will take.

To turn the centerline graphic on or off

❖ Tap the button on the **Centerline** control.

Centerline is not available when using the **Needle Guide** control.

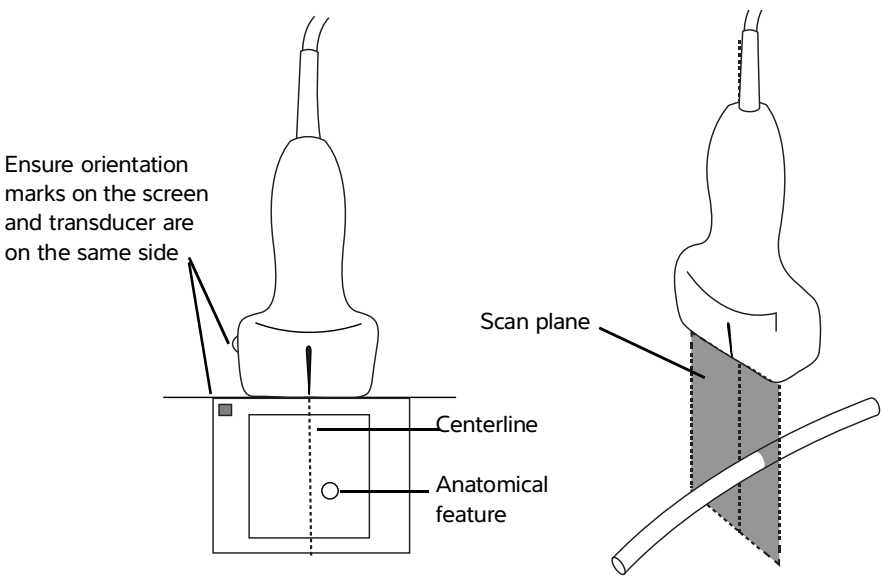


Figure 6-1 Relationship of the centerline graphic to the transducer and the ultrasound image.

Small tilts or rotations of the transducer can affect the relationship between any external reference points and the anatomy that appears on the ultrasound image.

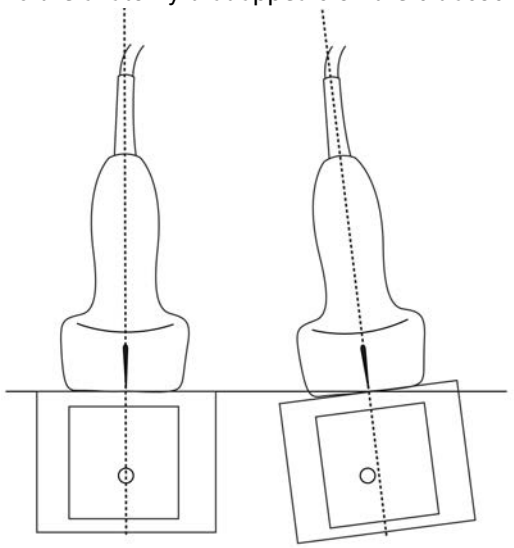


Figure 6–2 Relationship of the ultrasound image to the transducer angle or tilt.

Visualizing needles

Needle profiling

WARNINGS

- To avoid incorrect needle placement when Needle Profiling is on:
  - Using movement and fluid injection, verify the needle-tip location and trajectory. Needle profiling enhances linear structures within a selected angle range on the ultrasound plane. Linear structures outside the selected angle range or the ultrasound plane—such as a bent needle—may be less apparent.
  - Note that linear structures are enhanced only in an outlined portion of the image. The area outside the outline remains unchanged.
  - Note that the beam divergence of a curved array transducer may prevent a segment of the needle shaft from showing in the image. The needle tip may not appear in all imaging conditions.
- Too much gain or motion (respiratory or heart) can cause an increase in image artifacts when Needle Profiling is enabled.

Sonosite PX features the enhanced Auto Steep Needle Profiling technology as a licensed option. This techbology can facilitate needle guidance during catheter placement and nerve-block procedures, and enhances linear structures within an outlined area on the screen. Auto Steep Needle Profiling technology simultaneously visualizes the needle shaft at shallow, medium, and steep angles. Linear structures are best enhanced when perpendicular to the angle guide.

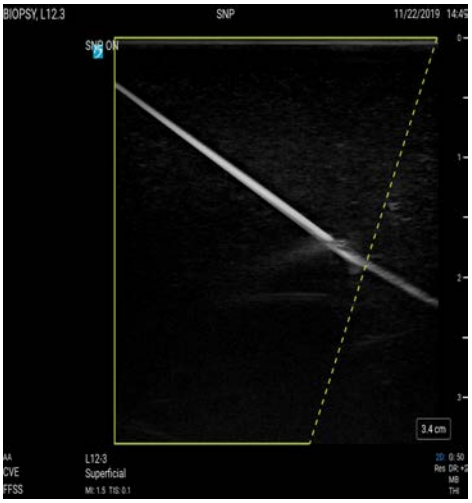


Figure 6–3 Image with Needle Profiling on. The area within the green trapezoidal outline is the enhancement area.

For curved array transducers, Auto Steep Needle Profiling technology can help identify the direction of the needle, although only segments of the needle shaft may show in the image. Use movement and fluid injection to help verify the needle tip location.

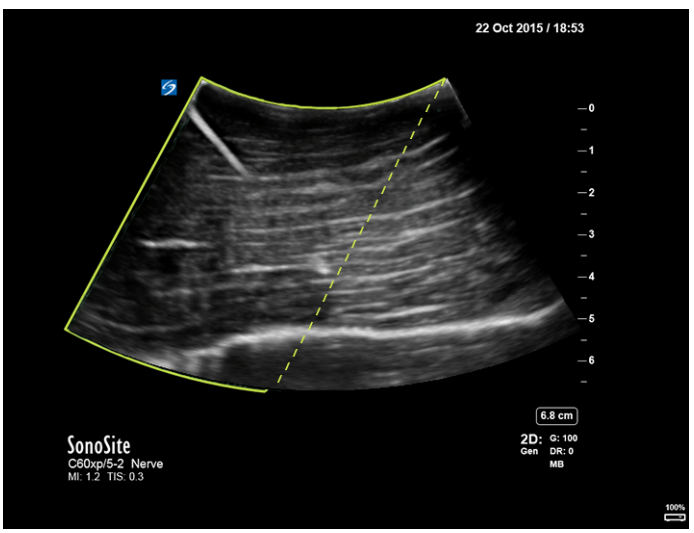


Figure 6–4 Needle Profiling with a curved array

Needle Profiling is available with 2D full-screen imaging only in the following exam types.

Table 6-6: Exam types compatible with needle profiling

Transducer	Exam type							
	Arterial	Breast	Carotid	MSK	Nerve	Superficial	Spine	Venous
C5-1	—	—	—	✓	✓	—	✓	—
L12-3	✓	✓	✓	✓	✓	✓	—	✓
L15-4	✓	✓	✓	✓	✓	✓	—	✓
L19-5	✓	—	—	✓	✓	✓	—	✓

To use needle profiling

1 In 2D imaging, tap **Needle Profiling**.

If this control is hidden, tapping **+ More Controls** displays it.

2 To ensure that the target is within the outlined area, tap one of the icons on the **Needle Profiling** control to change the enhancement area from one side of the image to another.

3 Insert the needle toward the angle guide.

4 (Optional) To help identify artifacts or other structures, tap **Needle Profiling** to turn it off.

Tap again to turn it back on.

Needle size and angle

Use a 17-gauge to 25-gauge needle (recommended). Enhancement results can depend on the type and brand of needle used. For more information, consult the medical literature on needle visibility in ultrasound-guided procedures.

You can angle the needle up to 50° from the transducer surface. Beyond 50°, the needle may be less enhanced. (Needle Profiling has little or no benefit to out-of-plane procedures. Needle Profiling is intended for in-plane procedures only.)

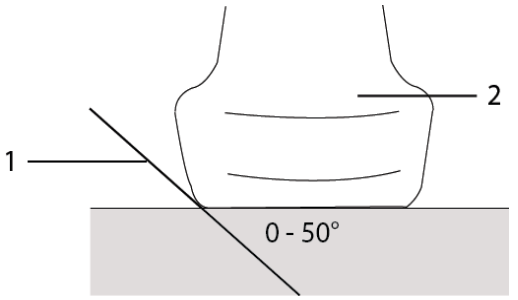


Figure 6–5 Needle size and angle: 1. Needle, 2. Transducer

Needle guide control

WARNING The needle tip may not be visible when performing a needle guide procedure, making it difficult to tell when the target has been reached. Use movement and fluid injection to verify the needle-tip location.

The Needle Guide control generates an on-screen graphical needle guide when using a supported transducer with an attached needle bracket. The system does not generate on-screen needle guides for variable angle needle brackets, which can be used with a number of transducers. For further information, see *Using CIVCO Products with Fujfilm Sonosite Systems.*

Two different types of graphics are generated depending on the type of bracket used:

- Fixed-angle, in-plane brackets: a pair of guidelines are generated that represent the anticipated path of the needle.
- Transverse-angle, out-of-plane brackets (depths are adjustable): the guidelines appear as dots down the center of the image.

Table 6–7: Needle guide control availability

Available with	Not available with
L19-5 (fixed-angle)	variable angle needle brackets
IC10-3 (transverse-angle)	a reduced field of view
	the centerline feature

To use the needle guide control

1 While scanning in 2D, tap **Needle Guide** on.

The needle guide graphic appears.

2 For transverse-angle brackets, use the touchpad to move the needle depth indicator.

CHAPTER 7

Managing Images and Clips

Sonosite PX includes tools for capturing, saving, labeling, and reviewing your ultrasound images and clips.

Saving an image or a clip

Images and clips can only be saved to the current study, which is the study that is open during the scan.

Caution To avoid mixing up images saved from multiple patients, make sure that the correct patient ID is displayed before you save an image. For more information about patient records, see **Chapter 5, "Entering Patient Information."**

The number of images and clips saved to the current study is displayed on the touch panel. The maximum number of images and video clips that you can save for an individual study depends on a number of factors. The system warns you when this limit is reached.

The system allows you to:

- Save an image during live or frozen imaging
- Save images from cine while the system is frozen

To save an image

❖ During live or frozen imaging, press  .

The system informs you that the image is saved.

To set clip controls

1 During live imaging, tap **Video Clip Settings** on the touch panel.

If this control is hidden, tap **+ More Controls** to access it.

2 In the Video Clip Settings panel, select one of the following under **Clip method**:

- **Prospective** captures frames after you tap . The system captures frames for the number of seconds you specify in the **Seconds** list. A forward clip symbol displays in the system status area 
- **Retrospective** captures frames from presaved data available before you tap . The system captures presaved frames for the number of seconds you specify in the **Seconds** list. A backward clip symbol displays in the system status area 

3 Under **Clip type**, select **Seconds** to capture clips based on the number of seconds and select the time duration from the drop-down list box.

4 Tap **Done**.

To save a clip

1 While scanning, press .

While the clip is being recorded, the clip control is blue and the clip symbol displays in the system status area (see the previous section).

2 To stop recording the clip, press .

If you have chosen a prospective clip, the control beeps letting you know that the clip is saved.

Labeling images

You can label live or frozen images by placing text (including predefined labels), arrows, and pictographs.

To display the labeling page

1 Press the **ABC** button to display the default text labels page.

An active cursor appears on the monitor in the default home location. You can move the cursor to another location using the touchpad.

2 To close the labeling page, press the **ABC**, **UPDATE/** , or freeze button.

Setting labeling options

To set labeling options

1 Press the **ABC** button to display the labeling page.

2 To switch the labeling package, tap the drop-down menu and select another package.

3 To clear all labels when unfreezing an image, do the following:

   a Tap  .

   b Tap **Clear on unfreeze** on.

   c To exit the menu, tap outside of the menu box.

Adding text labels

You can add text manually or add a predefined label.

To manually enter text on an image

1 Press the **ABC** button or tap **Text** to display the text text labels page.

2 To display the on-screen keyboard, tap the keyboard icon  .

3 Use the touchpad to move the cursor to the desired location on the monitor.

4 Use the on-screen keyboard to enter text (see **page 3–18** for how to use the keyboard).

   The text you enter appears in the text box and on the monitor.

5 Press  to set the label and save the image.

6 To begin a new label, press **SELECT/**  or tap the return key  on the on-screen keyboard.

To move or edit a text label

1 If the label is not selected, select the label by using the touchpad to move the cursor on the monitor over the label and pressing **SELECT/**  .Do one of the following:

   - To move the label, use the touchpad to drag the label to the desired location on the monitor.
   - To edit the label, use the touch panel to move the cursor within the text box and the on-screen keyboard to edit the text.

To place a predefined text label on an image

1 On the text label page, select a labeling package from the drop-down menu.

2 Scroll on the touch panel to view all of the labels within the group.

3 Use the touchpad to move the cursor to the desired location on the monitor.

4 Tap one or more predefined label.

   The labels appear in the text box and on the monitor. Press  to set the label and save the image.

5 To begin a new label, press **SELECT/** or tap the return key on the on-screen keyboard.

Adding arrows

You can add a maximum of five arrows to point out specific parts of the image.

To place an arrow on an image

1 Display the labeling page, then tap **Arrow** to display the arrows labels page.

An arrow appears on the arrow label page and the monitor.

2 Position and orient the arrow:

- To move the arrow, drag it using the touchpad.
- To rotate the arrow, press **SELECT/**. and use the touchpad to rotate the arrow.

You can cycle between moving and rotating the arrow by pressing the **SELECT/** button

3 Press to set the arrow and save the image.

4 To create a new arrow, tap **Add arrow** .

Adding pictographs

Available pictographs depend on the selected labeling package. Only one pictograph can be placed on each image.

To place a pictograph on an image

1 Display the labeling page, then tap **Picto** to display the pictograph page.

2 Tap the desired pictograph to display it on the monitor.Position and orient the transducer orientation icon included with the pictograph :

- To position the icon, drag it using the touchpad.
- To orient the icon, press **SELECT/** , and use the touchpad to rotate the icon.

3 Press **SELECT/** again to select the pictograph.

4 Drag the pictograph to the desired location using the touchpad.

To replace a pictograph

- Tap another pictograph on the page.

Using the home position

The home position is the position in which the system places labels by default.

To return a label to the home position

1 Select a text or picto label.

2 Tap **Move to Home**.

To change the home position

❖ Use the touchpad to move the text cursor or a selected label on the monitor, then tap **Set New Home**.

Deleting labels

1 To delete a text label, do one of the following:

- To delete text in the text box, tap the ⊗.
- To delete the last word of the most recently created or edited phrase, tap **Delete Word**. Continue deleting words by tapping the button multiple times.
- To delete the most recently created or edited phrase, tap **Delete Line**. Continue deleting phrases by tapping the button multiple times.
- To delete all text labels, tap **Delete All Text**.

2 To delete an arrow, tap the  or unfreeze the image  .

3 To delete a pictograph, tap the  .

4 To delete all labels, tap **Clear All Labels**.

Reviewing images and clips

You can review your images or video clip frames after you have taken them.

To review images and video clips

1 Do one of the following:

- Review the current study: To open the review page, tap thumbnail images and clips or tap **Review** on the right side of the touch panel. You can also tap **Review** from the Report & Worksheet page.
- Review a completed study: Tap **Patient List**. Select a study and tap **View** then **Review Images**, or double-tap to open the study review page.

2 Tap an image or clip on the review page to view it on the clinical monitor.

3 To view the previous or next page of images and clips, tap < or >.

4 (Video clips only) Do any of the following:

- To pause the video clip, tap the pause button ||.
- To play the video clip, tap the play button ▶.
- To select a playback speed, tap **1x**, **1/2x**, or **1/4x**.
- To move backward or forward through frames one at a time, tap ◀| or |▶.

5 To delete an image or video clip: select the image or video clip, and then tap **Delete**.

6 To exit the review, tap **Exit Review**.

Printing images

For information about printing studies, reports, and worksheets, see **"Printing studies"** on page 9-6. To adjust printer settings, refer to the user guide that comes with the printer.z

WARNING Use only accessories and peripherals recommended by Fujfilm Sonosite, including the printer. Connection of accessories and peripherals not recommended by Fujfilm Sonosite could result in electrical shock and system malfunction.

Caution Printing an image does not necessarily capture all of the characteristics of the image displayed on the monitor. The printout is intended for documentation purposes, and may not be suitable for diagnosis. The printed image is subject to degradation due to age and ambient light conditions.

Note The printer icon displayed on the clinical monitor tells you whether or not the printer is physically connected to the system.

To print while imaging

1 Make sure that the power button on the printer is in the On position.

2 With the image displayed, tap the **Print** control.

To print a saved image from the current study

1 Make sure that the power button on the printer is in the On position.

2 Open the review page by doing one of the following:

- Tap a thumbnail image or clip located on the right side of the touch panel.
- Tap **Review** at the bottom of the touch panel.

3 Tap the check box for each image you want to select.

4 Tap **Send to**.

5 Tap **Printer**.

To print a saved image from an ended study

1 Make sure that the power button on the printer is in the On position.

2 Tap **Patient List**.

3 To open a study review page, do one of the following.

- Tap a study to select it, tap **View** and then tap **Review Images**.

  Double-tap on the study.Tap the check box for each image you want to select.

4 Tap **Send to**.

5 Tap **Printer**.

Archiving and exporting images

Saved images and video clips are organized in patient studies. To export and archive studies, see **"Archiving studies"** on page 9-3 and **"Exporting studies"** on page 9-5.

Exporting individual images and clips

You can export individual images and clips to a USB storage device for viewing in the USB Image Gallery. Individually exported images and clips are saved as .jpg and .mp4 files, and do not contain other study information.

Note Use this method of export to produce only individual image and clip files. This method of export does not export the complete patient study, and the study does not display the USB export icon in the study list.

To export images

1 Insert a USB storage device into a USB port on the system.

2 Do one of the following to open the review page:

- For the current study, tap thumbnail images and clips or tap **Review** on the right side of the touch panel. You can also tap **Review** from the Report & Worksheet page.

- For a completed study, tap **Patient List**. Select a study and tap **View** then **Review Images**, or double-tap to open the study review page.On the review page, select the check box next to each image or clip that you want to export.

3 Tap **Send to**.

4 Tap **USB**.

5 To change the file name, tap the **Enter a file name** box. When the keyboard appears, type the new file name using upper and lower-case letters and numbers only. Special characters and spaces cannot be used in a file name.

Note All images and clips exported to the USB storage device are stored on the root level of the device. This is to facilitate viewing in Image Gallery. Files with the same name will have the name automatically incremented.

6 If more than one storage device is installed, tap to select the storage device you want to export to.

7 By default, patient information such as names and IDs are removed from images and clips before exporting. Patient information can be included during export by selecting the **Include patient information on images and video clips** check box.

Caution Patient information maybe a protected class of patient data subject to country-specific security guidelines. If you choose to include patient information when exporting images and clips, be sure your information storage and handling practices comply with country-specific security guidelines.

8 Tap **Export**.

Image gallery

The image gallery enables you to view images and video clips from a USB storage device. You should only display images provided by Fujifilm Sonosite or captured on the Sonosite PX system. Do not use a USB that contains any external clinical or non-clinical images in the image gallery.

WARNING Images in the image gallery should not be used for diagnostic purposes.

To view images using Image Gallery

1 Insert a USB storage device into a USB port on the system.

Note The image and clip files that you want to view must be stored on the root level of the USB storage device in order for Image Gallery to access them.

2 Tap the system menu ☰, and then tap **USB Image Gallery**.

3 On the USB Image Gallery page, select your desired storage device from the list.

A gallery of available images and clips appears.

4 To open a full-screen view of an image or clip on the clinical monitor, tap the thumbnail image.

5 To select multiple images or clips:

a Tap **Select Multiple**.

A check box for each thumbnail image appears.

b Select the check box for each image, or tap **Select All**.

6 To delete selected images, tap **Delete**.

To clear the check boxes, tap **Deselect All** or tap **Cancel**.

Chapter 8

Measurements and Calculations

This chapter provides information about measurements and calculations. Measurements and calculations, along with patient information and worksheet findings, are collected into the study report. See **Chapter 9, "Managing Patient Data."**

Performing measurements and calculations

WARNINGS

- To avoid incorrect calculations, verify that the patient information, date, and time settings are accurate.
- To avoid misdiagnosis or harming the patient outcome, make sure you end the previous study before starting a new patient study and performing calculations. Otherwise, the previous patient's data will be combined with the current patient. Tap **END STUDY** to end the previous study.
- To avoid misdiagnosis or harming the patient outcome, do not use single calculations as sole diagnostic criteria. Use calculations in conjunction with other clinical information.

Measurements and calculations are accessible through both the **CALIPER/** and **CALCS/** buttons. The **CALIPER/** button directly accesses basic measurements and calculations that are not saved to the patient report. You can always access measurements and calculations that are saved to the report by navigating to the **Calcs** page or by pressing the **CALCS/** button. Measurements and calculations that include a pound symbol (#) indicate a value that is out of range.

Working with calipers

You perform measurements by dragging active calipers (highlighted) into position with your touchpad. Calipers appear as cross-hairs when positioned at endpoints.

To use the calipers

1 On a live or frozen image, press the **CALIPER/** or **CALCS/** buttons. (To do most measurements, freeze the image first .)

A caliper for the default measurement appears on the clinical monitor, and a page with available measurements appears on the touch panel.

2 Tap the measurement you wish to perform, or continue if you want to perform the default measurement.

3 Use the touchpad to drag the caliper to the desired position on the monitor.

4 Press **SELECT/** to activate the next caliper, and use the touchpad to position it.

5 Do any of the following:

- To switch between calipers, press **SELECT/**.
- To perform a different measurement, tap on the measurement button.

6 To save an image with displayed calipers and results, press .

Note Measurements accessed from the Calipers page are only saved as part of the image, while measurements accessed from the Calcs page are also saved to the patient report (see **"Managing reports and worksheets"** on page 9-7).

7 To exit caliper mode, do one of the following:

- If performing a frozen measurement, press the freeze button or an imaging mode button to return to live imaging.
- If performing a live measurement, press **CALIPER/** again.

Viewing measurements and calculations

Measurement and calculation results appear on the clinical monitor (see **page 3-14**) and the touch panel (see **page 8-3**) in the order that they are completed. A maximum of 10 measurements can be displayed. If you make more than 10 measurements, the earliest measurements are replaced.

You can interact with the measurement display on the touch panel. Any change made to the measurements and calculations displayed in this area are reflected on the clinical monitor.

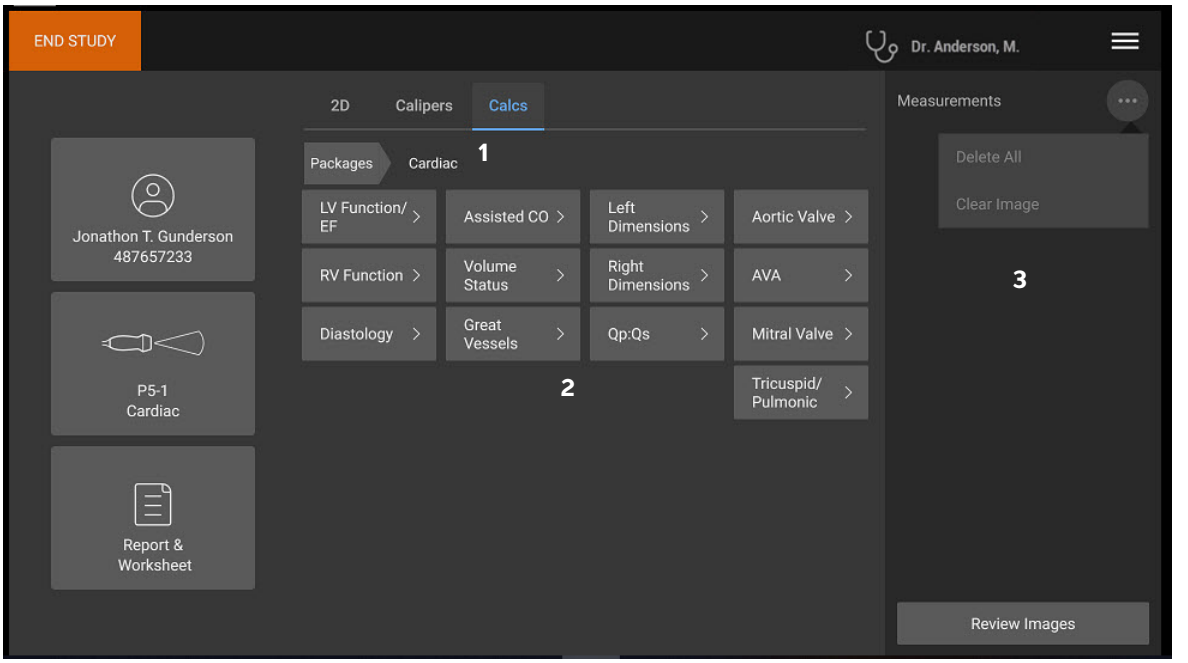


Figure 8–1 Example of a measurements and calculations page on the touch panel

1 Navigation menu

2 Measurement buttons

3 Results area

Reviewing measurements and calculations

To review measurements and calculations

❖ Do one of the following:

- To review images and clips with displayed measurements, tap **Review** on the right side of the touch panel.

  The review page opens.

- To view measurements and calculations saved to the report, tap **Report** from the review page or **Report & Worksheet** from the left side of the touch panel and open the **Calcs** tab.

Deleting or editing a measurement

You can delete, but not alter, measurements that have already been saved to a report.

To delete a measurement

❖ Do any of the following:

- On the right side of the touch panel, tap the delete icon next to the measurement.

  For calculations with multiple measurements, the measurement selected is deleted from the patient report. If it is the only measurement required for a calculation, the calculation result is deleted from the report.

- To remove all measurements visible on the clinical monitor and touch panel, tap **Clear Image** from the ••• menu (see **Figure 8-1** on page 8-3).

  Clear Image does not delete measurements from the report.

- To delete all visible measurements from the report, image, and system memory, tap **Delete All** from the ••• menu (see **Figure 8-1** on page 8-3).

  Delete All does not delete measurements that have been previously saved to the report and are no longer visible on the touch panel or the clinical monitor.

To edit a new measurement

1 Select an unsaved measurement to edit by tapping its name in the measurement list.

  The last caliper used for the measurement is activated.

2 Use the **SELECT/** button to switch between calipers, and the touchpad to reposition the calipers.

Basic measurements in 2D and Color

Note You can measure across images in Dual only with a linear transducer, and only when the images are at the same depth and magnification.

Basic measurement tools available in 2D/color imaging are:

- Distance (cm)
- Curved distance (cm)
- Ellipse (circumference, diameter, and area)

- Target depth (cm)
- Trace
- Angle (degrees)
- Volume
- Volume flow (includes a Doppler measurement as well; see **page 8-12**)

To measure the distance between two points

1 On a frozen 2D/color image, press the **CALIPER/** button.

The default distance caliper appears.

2 If you have been performing other measurements, tap **Distance** on the caliper page.

3 Use the touchpad to drag the active caliper to the first point.

4 Press **SELECT/**.

A second caliper appears.

5 Use the touchpad to position the second caliper at the second point.

6 As needed, use the **SELECT/** button and the touchpad to switch between and reposition the calipers.

7 Press to save an image with the measurement.

To measure a curved distance

1 On a frozen 2D/color image, tap **Curved Distance** on the caliper page.

A caliper appears.

2 Use the touchpad to drag the active caliper to the first point.

3 Press **SELECT/**.

A pencil icon appears, indicating that the start location is set and you can begin your trace.

4 Use the touchpad to drag the caliper around the area you want to trace.

To make a correction, trace backward on the line

5 Press to save an image with the measurement.

To measure circumference, diameter, or area using an ellipse

1 On a frozen 2D/color image, tap **Ellipse** on the caliper page.

A caliper appears.

2 Use the touchpad to position the caliper.

3 Press **SELECT/**.

An ellipse appears at the selected position with two calipers.

4 Use the **SELECT/** button and the touchpad to switch between moving, resizing, and reshaping the ellipse.

5 Press to save an image with the measurement.

To measure circumference or area by tracing

1 On a frozen 2D/color image, tap **Trace** on the caliper page.

A caliper appears.

2 Use the touchpad to drag the caliper to the start point.

3 Press **SELECT/**.

A pencil icon appears, indicating that the start location is set and you can begin your trace.

4 Use the touchpad to drag the caliper around the area you want to trace.

To make a correction, trace backward on the line.

5 Lift your finger from the touchpad.

The trace closes automatically and the measurement results appear.

Note Even after completing the trace, you can still adjust the measurement by dragging the cursor. Drag the cursor backward to erase your trace or forward to extend it.

6 Press to save an image with the measurement.

To perform a target depth measurement

You can measure the distance from the skinline to a specified point on the image.

Note The target depth measurement resets when you change imaging modes, depths, certain optimization settings, zoom settings, or use needle guides.

1 On a live or frozen 2D/color image, press the **CALIPER/** button.

The caliper defaults to the target depth measurement during live imaging.

2 If the image is frozen, tap **Target Depth**.

A dotted line appears extending from the skin line to a single caliper at the end.

3 Use the touchpad to position the caliper.

Note Pressing the measurement button again while the caliper is selected will remove the caliper and result from the touch panel and monitor.

4 Press to save an image with the measurement.

To measure an angle between two connected lines

1 On a frozen 2D/color image, tap **Angle** on the caliper page.

A caliper appears.

2 Use the touchpad to position the caliper.

3 Press **SELECT/**.

Two additional calipers appear.

4 Use the touchpad to position the second caliper.

5 Press **SELECT/** again to switch to the third caliper.

6 Use the touchpad to position the third caliper.

7 To continue adjusting the angle, use the **SELECT/** button and the touchpad to switch between and position all three calipers.

8 Press to save an image with the measurement.

To measure volume

The volume measurement is based on one, two, or three 2D distance measurements for height, width, and length. After any measurement is saved, the volume calculation appears on the monitor. You can calculate up to three volumes.

1 On the frozen 2D/color image, tap **Volume 1**, **Volume 2**, or **Volume 3** on the caliper page.

2 Do the following for each measurement you need to take:

a Tap the measurement button (**Length**, **Width**, or **Height**).

Note You can only take two of the three measurements on any one imaging plane. Use the cine control (see **page 6–18**), or freeze/unfreeze, to select a different frame and take the third measurement.

b Use the touchpad to position the first caliper.

c Press **SELECT/**, and use the touchpad to position the second caliper.

d Press to save an image with the measurement.

Basic measurements in M Mode

To measure distance and time

You can measure distance in centimeters, time in seconds, and slope in centimeters per second.

1 On a frozen M Mode sweep, press the **CALIPER/** button.

The default distance time caliper appears.

2 If you have been performing other measurements, tap **Distance Time** on the caliper page.

3 Use the touchpad to position the caliper.

4 Press **SELECT/**.

A second caliper appears.

5 Use the touchpad to position the second caliper.

6 Press to save an image with the measurement.

To measure heart rate (M Mode)

1 On a frozen M Mode sweep, tap **Heart Rate** on the caliper page.

A vertical caliper appears.

2 Use the touchpad to drag the caliper to the peak of the heartbeat.

3 Press **SELECT/**.

A second vertical caliper appears.

4 Use the touchpad to drag the second caliper to the peak of the next heartbeat.

5 Press to save an image with the measurement.

Saving the heart rate measurement to the patient report does not overwrite the heart rate entered on the patient form.

Basic measurements in Doppler

The basic measurements that you can perform in Doppler imaging are:

- Velocity/Velocity pair (cm/s)
- Heart rate
- Time (msec)
- Slope cm/s^2
- Manual trace
- Auto trace
- Volume flow (includes a 2D measurement as well; see **page 8-12**)

Performing these measurements can also calculate the following, depending on the analysis package:

- Slope
- Time
- End diastolic velocity (EDV)
- Mean pressure gradient (PG Mean)
- Mean velocity (VMean)
- Minimum diastolic velocity (MDV)
- Minimum velocity (VMin)
- Peak systolic velocity (PSV)
- Peak velocity (VMax)
- Pressure gradient or max pressure gradient (PG or PG Max)
- Pulsatility index (PI)
- Resistive index (RI)
- S/D ratio (S/D)
- Time average mean (TAM)
- Time average peak (TAP)
- Velocity time integral (VTI)

To measure heart rate (Doppler)

See **"To measure heart rate (M Mode)"** on page 8-8, but start from a frozen Doppler spectral trace.

To measure velocity

This measurement involves a single caliper from the baseline.

In cardiac analysis packages, measuring velocity also calculates PG.

1 On a frozen Doppler spectral trace, press the **CALIPER/** button.

   The default velocity caliper appears.

2 If you have been performing other measurements, tap **Velocity** on the caliper page.

3 Use the touchpad to drag the caliper to a peak velocity waveform.

4 Press to save an image with the measurement.

To measure a velocity pair

This measurement replaces the single velocity measurement in certain calculations. Depending on the analysis package, a velocity pair can measure PSV, EDV, RI, and S/D.

1 On a frozen Doppler spectral trace, press the **CALIPER/** button.

   The default velocity caliper appears.

2 If you have been performing other measurements, tap **Velocity** on the caliper page.

3 Use the touchpad to drag the caliper to a peak systolic waveform.

4 Press **SELECT/**.

   A second caliper appears.

5 Use the touchpad to drag the second caliper to the end diastole on the waveform.

6 Press to save an image with the measurement.

To measure time duration

1 On a frozen Doppler spectral trace, tap **Time** on the caliper page.

   A vertical caliper appears.

2 Use the touchpad to position the caliper.

3 Press **SELECT/**.

   A second caliper appears.

4 Use the touchpad to position the second caliper.

5 Press to save an image with the measurement.

To measure slope

You can measure slope using one or two calipers. A single caliper measures velocity and PG, while two calipers measures Slope, Time, VMax, VMin, and PG Max (depending on the analysis package).

1 On a frozen Doppler spectral trace, press the **CALIPER/** button.

   The default slope caliper appears.

2 If you have been performing other measurements, tap **Slope** on the caliper page.

3 Use the touchpad to drag the caliper where desired.

   Velocity and PG results appear on the touch panel and the monitor.

4 To measure slope, time, VMax, VMin, and PG Max instead of velocity and PG, press **SELECT/**.

   A second caliper appears.

5 Use the touchpad to drag the caliper where desired.

6 Press to save an image with the measurement.

   The absolute slope between the calipers is calculated. If the absolute velocity of the earlier caliper is greater than that of the later caliper (and they are on the same side of the baseline), the system calculates time, VMax, VMin, and PG Max.

Performing Doppler trace measurements

Trace measurements depend upon the analysis package and measurement tool.

Table 8-1: Doppler trace measurements available by exam type

Exam type						
Cardiac	**OB/Gyn/ Venous**	**Nerve/ Spine**	**Arterial/ Carotid**	**TCD/Orbital**	**Lung**	**Abdomen/Breast MSK/Ophthalmic/ Superficial**
▸ VMax	▸ PI	▸ PI	▸ PI	▸ PI	VMax	▸ PI
▸ VTI	▸ RI	▸ RI	▸ RI	▸ RI		▸ RI
▸ PG Max	▸ S/D	▸ S/D	▸ S/D	▸ S/D		▸ S/D
▸ PG Mean	▸ PSV	▸ PSV	▸ PSV	▸ PSV		▸ PSV
▸ VMean	▸ EDV	▸ EDV	▸ EDV	▸ EDV		▸ EDV
	▸ MDV	▸ MDV	▸ MDV	▸ MDV		▸ MDV
		▸ VTI	▸ VTI	▸ TAP		
				▸ Gate Depth		

To perform manual trace measurements

1 On a frozen Doppler spectral trace, tap **Manual Trace** on the caliper page.

2 Use the touchpad to drag the caliper to the beginning of the desired waveform.

3 Press **SELECT/**.

A pencil icon appears, indicating that the start location is set and you can begin your trace.

4 Use the touchpad to trace the waveform with the caliper.

To make a correction, trace backward.

5 Press to save an image with the measurement.

Note Even after completing the trace, you can still adjust the measurement by dragging the cursor. Drag the cursor backward to erase your trace or forward to extend it.

To perform automatic trace measurements

After measuring automatically, confirm that the system-generated boundary is correct. If you are not satisfied with the trace, trace manually.

1 On a frozen Doppler spectral trace, tap **Auto Trace** on the caliper page and select your settings (see **page 6-8**).

A vertical caliper appears.

2 Use the touchpad to drag the caliper to the beginning of the waveform.

If calipers are not positioned correctly, the calculation result is inaccurate.

3 Press **SELECT/**.

4 Use the touchpad to drag the second caliper to the end of the waveform.

5 Press to save an image with the measurement.

Volume flow

The volume flow measurement requires you to perform a basic measurement in 2D and a basic measurement on a Doppler trace.

WARNING Diagnostic conclusions about blood flow based on VTI alone can lead to improper treatment. Accurate blood flow volume calculations require both the vessel area and velocity of blood flow. In addition, accurate blood flow velocity is dependent on a correct Doppler angle of incidence.

Consider the following factors when performing volume flow measurements:

- You should follow current medical practice for volume flow calculation applications.
- The accuracy of the volume flow calculation largely depends on the user's measurement technique.
- The factors identified in the literature that affect the accuracy are as follows:
  - Using the diameter method for 2D area
  - Precision in placing the caliper
  - Difficulty ensuring uniform insonation of the vessel

For more information about the considerations and degree of accuracy for volume flow measurements and calculations, see the following reference:

- Allan, Paul L. et al. *Clinical Doppler Ultrasound,* 1st Ed. Harcourt Publishers Limited, (2000), p.36–38.

To calculate volume flow

Repeat the following steps for each volume flow measurement you need to perform.

1 On a frozen 2D or Doppler trace, tap **Volume Flow** on the caliper page.

Steps 2 and 3 can be done in either order. To display both 2D and Doppler images at the same time, see **"Display Format"** on page 6-6.

2 Measure blood vessel diameter:

a On a frozen 2D image, tap **Diameter** from the **Volume Flow** page.

b Use the touchpad to position the first caliper.

c Press **SELECT/**  , and use the touchpad to position the second caliper.

d Press  to save an image with the measurement.

3 Calculate the blood velocity:

a On a frozen Doppler trace, tap **Trace** from the **Volume Flow** page.

b Press **SELECT/**  , and use the touchpad to position each vertical caliper.

c Press  to save an image with the measurement.

Calculations and analysis packages

You can perform measurements associated with analysis packages with the same measurement types used in the caliper menu. Tap on the measurement name to bring up the caliper.

To access and navigate analysis packages

1 Freeze the image .

2 Press the **CALCS/** button.

3 Navigate by tapping on a calculation type or analysis package.

4 Return to the previous menu or navigate to a different set of analysis packages by tapping on the **Packages** button in the navigation menu.

5 To exit calculations, do one of the following:

- Press the freeze button to return to live imaging.
- Press the **2D** button.
- Press **CALCS/** again.

Abdominal measurements and calculations

Abdominal measurements are listed in the following table along with calculation results that appear on the clinical monitor and in the report. For an explanation of terms and abbreviations, see the **"Glossary."**

Table 8-2: Abdominal measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
Vessels	▸ Ao Prox D, Mid D, and Dist D (2D)	Distance (see **page 8-5**)	—
	▸ IVC Max D and Min D (2D or M Mode)	IVC Collapse/Distensibility (see **page 8-33**)	IVC collapse
Abdomen	▸ Liver L (2D) ▸ CHD (2D) ▸ CBD (2D) ▸ Spleen L (2D)	Distance (see **page 8-5**)	—
Gallbladder	▸ GB Wall, Trans, and Long (2D)	Distance (see **page 8-5**)	—

Table 8-2: Abdominal measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
Renal	▸ Lt and Rt Kidney L (2D)	Distance (see page 8-5)	—
Bladder	Pre-Void and Post-Void Bladder (2D) ▸ L ▸ H ▸ W	Volume (see page 8-7)	▸ Bladder Vol ▸ Post-Void Bladder Vol
Renal Aortic Ratio	▸ Ao Prox (Doppler)	Velocity (see page 8-9)	—
	▸ Rt and Lt Renal Art (Doppler)		▸ Rt Renal/Ao Ratio ▸ Lt Renal/Ao Ratio

To perform an abdominal measurement or calculation

1 On a frozen image, tap the **Abdomen** analysis package on the Calcs page.

2 Tap a measurement button or select a measurement from the next page.

3 Perform the measurement according to its measurement type.

4 Press  to save the results

Cardiac measurements and calculations

This section lists the procedures required to make certain cardiac calculations. You can also refer to the basic measurements section for details on how to use the calipers. The ultrasound system has two cardiac analysis packages; cardiac and focused cardiac.

Cardiac measurements are listed in the following tables along with calculation results that appear on the clinical monitor and in the report. For an explanation of terms and abbreviations, see the **"Glossary."**

Table 8-3: Cardiac measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
LV Function/EF	EF (2D) ▸ LVDd and LVDs	EF/FS (see page 8-27)	▸ LV EF ▸ LV FS
	Left FAC (2D) ▸ LV EDA and ESA	FAC (see page 8-29)	Left FAC

Table 8–3: Cardiac measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
LV Function/EF	CO ▸ LVOT D (2D) ▸ LVOT VTI (Doppler) ▸ CO HR (Doppler)	SV and CO (see **page 8–28**)	▸ CO ▸ CI ▸ SV ▸ SI
	Simpson´s EF (2D) ▸ A4Cd and A4Cs Vol ▸ A2Cd and A2Cs Vol	LV volume and EF (see **page 8–28**)	▸ Biplane EF ▸ A4C EF ▸ A2C EF ▸ LVs Biplane Vol ▸ LVd Biplane Vol
Function	EF (M Mode) ▸ LVDd and LVDs	EF/FS (see **page 8–27**)	▸ LV EF ▸ LV FS
	▸ MAPSE (M Mode)	MAPSE/TAPSE (see **page 8–29**)	—
	▸ EPSS (M Mode)	M Mode distance (see **page 8–27**)	—
	▸ LVET (M Mode)	Time (see **page 8–10**)	—
	▸ TAPSE (M Mode)	MAPSE/TAPSE (see **page 8–29**)	—
Assisted CO	Pre ▸ CO (Doppler) ▸ LVOT D (2D) Post ▸ Post CO (Doppler)	ACO (see page **page 8–35**)	▸ CO % change ▸ SV % change ▸ Pre VTI % Variation ▸ Post VTI % Variation

Table 8-3: Cardiac measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
Left Dimensions	Diastole (2D) ▸ RVDd ▸ IVSd ▸ LVDd ▸ LVPWd Systole (2D) ▸ IVSs ▸ LVDs ▸ LVPWs	▸ EF/FS (see **page 8-27**) ▸ Qp:Qs (see **page 8-30**)	▸ EF ▸ FS ▸ IVS FT ▸ LVPW FT ▸ Qp:Qs
	LA/Ao (2D) ▸ LA D ▸ LA Vol A4C and A2C ▸ Ao Root D ▸ Asc Ao D ▸ LVOT D	▸ Distance (see **page 8-5**) ▸ Atrial volumes (see **page 8-31**)	▸ LA/Ao ▸ LA Biplane Vol ▸ LA Biplane Vol Index
	LV Mass (2D) ▸ Epi and Endo Area ▸ Apical D	LV mass (see **page 8-32**)	▸ LV Mass ▸ LV Mass Index
Aortic Valve	LVOT (Doppler) ▸ LVOT VMax ▸ LVOT VTI ▸ CO HR	SV and CO (see **page 8-28**)	▸ CO ▸ CI ▸ SV ▸ SI
	AS (Doppler) ▸ AV VMax ▸ AV VTI ▸ AVA HR ▸ LVET	▸ Velocity (see **page 8-9**) ▸ VTI (see **page 8-26**) ▸ HR (see **page 8-8**) ▸ Time (see **page 8-10**)	▸ AVA (VTI) ▸ AVA Index (VTI) ▸ AVA (VMax) ▸ AVA Index (VMax) ▸ AV Velocity Ratio

Table 8–3: Cardiac measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
Aortic Valve	AI (Doppler) ▸ PHT ▸ VTI	 ▸ PHT (see **page 8–34**) ▸ VTI (see **page 8–26**)	—
	2D ▸ AI Vena Con ▸ AVA Planim ▸ LVOT D	Area trace (see **page 8–6**)	—
RV Function	FAC (2D) ▸ RV EDA and ESA	FAC (see **page 8–29**)	Right FAC
	TDI (Doppler) ▸ RV s′	TDI (see **page 8–35**)	—
	RIMP (Doppler) ▸ RVET ▸ IVCT ▸ IVRT	RIMP (see **page 8–33**)	RIMP
Volume Status	Pre ▸ Pre LVOT VTI (Doppler) ▸ Pre HR (Doppler) ▸ LVOT D (2D) Post (Doppler) ▸ Post LVOT VTI ▸ Post HR	SV and CO (see **page 8–28**)	▸ CO % change ▸ SV % change ▸ VTI % change ▸ pre-CO ▸ pre-SV ▸ post-CO ▸ post-SV
	IVC Collapse ▸ IVC Max and Min (2D) ▸ RAP	▸ IVC Collapse/Distensibility (see **page 8–33**) ▸ RAP (see **page 8–34**)	▸ IVC Collapse ▸ RVSP

Table 8-3: Cardiac measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
Respiratory Variation (navigate to this page from Volume Status)	Velocity ▸ Max LVOT VMax (Doppler) ▸ Min LVOT VMax (Doppler)	SV and CO (see **page 8-28**)	▸ SV % Variation ▸ VTI % Variation ▸ VMax % Variation ▸ Max SV ▸ Min SV
	VTI (Doppler) ▸ Max LVOT VTI ▸ Min LVOT VTI		
	▸ LVOT D		
	Distensibility (2D) ▸ IVC Max D and Min D	IVC Collapse/Distensibility (see **page 8-33**)	Distensibility index (DI)
Right Dimensions	RV Apical (2D) ▸ Basal and Mid D ▸ Length ▸ Wall RV Outflow (2D) ▸ RV Prox D ▸ RVOT D	Distance (see **page 8-5**)	▸ Pulm SV ▸ Qp:Qs ▸ RA Vol Index
	Right Atrium (2D) ▸ RA Vol	Area trace (see **page 8-6**)	—

Table 8–3: Cardiac measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
Dimensions	Diastole (M Mode) ▸ RVDd ▸ IVSd ▸ LVDd ▸ LVPWd Systole (M Mode) ▸ IVSs ▸ LVDs ▸ LVPWs	LV mass (see **page 8–32**)	▸ EF ▸ FS ▸ IVS FT ▸ LVPW FT ▸ IVSd/LVPWd ▸ IVSs/LVPWs ▸ LV Mass ▸ LV Mass Index ▸ RVSP
	LA/Ao (M Mode) ▸ Ao ▸ LA D	M Mode distance (see **page 8–27**)	LA/Ao
	IVC (M Mode) ▸ IVC Max and Min ▸ RAP[a]	▸ IVC Collapse/Distensibility (see **page 8–33**) ▸ RAP (see **page 8–34**)	IVC Collapse
AVA	▸ LVOT D (2D) ▸ AVA HR (Doppler) ▸ VMax (Doppler) ▸▸ LVOT VMax ▸▸ AV VMax ▸ VTI (Doppler) ▸▸ LVOT VTI ▸▸ AV VTI	AVA (see **page 8–34**)	▸ AVA (VTI) ▸ AVA Index (VTI) ▸ AVA (VMax) ▸ AVA Index (VMax) ▸ AV Velocity Ratio
	2D ▸ AVA Planim	Area trace (see **page 8–6**)	—

Table 8-3: Cardiac measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
Diastology	TDI ▸ Sep e′ and a′ ▸ Lat e′ and a′ ▸ Inf e′ ▸ Ant e′	TDI (see **page 8-35**)	▸ Sep E/e′ ▸ Lat E/e′ ▸ Ant E/e′ ▸ Inf E/e′
	MV (Doppler) ▸ MV E, Decel, A, and Adur ▸ IVRT	▸ Velocity (see **page 8-9**) ▸ Time (see **page 8-10**)	MV E/A
	Pulmonary Vein (Doppler) ▸ P Vein S, D, A, and Adur	▸ Velocity (see **page 8-9**) ▸ Time (see **page 8-10**)	—
	RVSP ▸ TR VMax (Doppler) ▸ RAP	RVSP (see **page 8-35**)	RVSP
	LA Vol ▸ LA Vol A4C and A2C	Atrial volumes (see **page 8-31**)	▸ LA Biplane Vol ▸ LA Biplane Vol Index
Great Vessels	IVC (2D) ▸ IVC Max and Min ▸ RAP[a]	▸ IVC Collapse/Distensibility (see **page 8-33**) ▸ RAP (see **page 8-34**)	▸ IVC Collapse ▸ RVSP
	Aorta (2D) ▸ Ao Root D ▸ Asc Ao D ▸ LVOT D ▸ Abd Ao	Distance (see **page 8-5**)	—

Table 8–3: Cardiac measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
Great Vessels	Surgical Aorta (2D) ▸ Ao Ann D ▸ Sinus Val D ▸ STJ D	Distance (see **page 8–5**)	—
Qp:Qs	Left ▸ LVOT D (2D) ▸ LVOT VTI (Doppler)	Qp:Qs (see **page 8–30**)	▸ Qp:Qs ▸ SV
	Right ▸ RVOT D (2D) ▸ RVOT VTI (Doppler)		Pulm SV
Mitral Valve	Inflow (Doppler) ▸ MV E ▸ MV Decel Time ▸ MV A	▸ Velocity (see **page 8–9**) ▸ Slope (see **page 8–10**)	▸ MV E/A ▸ Sep E/e´ ▸ Lat E/e´ ▸ Inf E/e´ ▸ Ant E/e´
	MS ▸ MV Ann D (2D) ▸ MV VTI (Doppler) ▸ HR (MVA) (Doppler) ▸ MV PHT (Doppler)	▸ Distance (see **page 8–5**) ▸ VTI (see **page 8–26**) ▸ Area trace (see **page 8–6**)?	▸ MVA (PHT) ▸ MVA (VTI)
Mitral Valve	MR ▸ MR VTI (Doppler) ▸ MV dP/dt (CW Doppler)	▸ VTI (see **page 8–26**) ▸ dP/dt (see **page 8–33**)	—
	2D ▸ MVA Planim ▸ MR Vena Con	Area trace (see **page 8–6**)	—

Table 8-3: Cardiac measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
Valves	TV (M Mode) ▸ TAPSE	MAPSE/TAPSE (see **page 8-29**)	—
	MV (M Mode) ▸ MAPSE ▸ EPSS ▸ D-E Slope ▸ E-F Slope	▸ MAPSE/TAPSE (see **page 8-29**) ▸ M Mode distance (see **page 8-27**) ▸ distance time (see **page 8-8**)	—
	AV (M Mode) ▸ ACS ▸ LVET	M Mode distance (see **page 8-27**)	—
Tricuspid/Pulmonic	RVSP ▸ TR VMax (Doppler) ▸ RAP	RVSP (see **page 8-35**)	RVSP
	PV (Doppler) ▸ AT ▸ VTI ▸ VMax	 ▸ Time (see **page 8-10**) ▸ VTI (see **page 8-26**) ▸ Velocity (see **page 8-9**)	—
	TV (Doppler) ▸ VTI ▸ E ▸ A ▸ PHT	PHT (see **page 8-34**)	—
HR	HR (M Mode and Doppler)	HR (see **page 8-8**)	—

Table 8-4: Focused cardiac measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
Left Heart	EF (2D and M Mode) ▸ LVDd and LVDs	EF/FS (see **page 8-27**)	▸ LV EF ▸ LV FS
	Left FAC (2D) ▸ LV EDA and ESA	FAC (see **page 8-29**)	LV FAC
	CO ▸ LVOT D (2D) ▸ LVOT VTI (Doppler) ▸ CO HR (Doppler)	SV and CO (see **page 8-28**)	▸ LVOT CO ▸ LVOT CI ▸ LVOT SV ▸ LVOT SI
	▸ MAPSE (M Mode)	MAPSE/TAPSE (see **page 8-29**)	—
	▸ EPSS (M Mode)	M Mode distance (see **page 8-27**)	—
Volume Status	Pre ▸ Pre LVOT VTI (Doppler) ▸ Pre HR (Doppler) ▸ LVOT D (2D) Post (Doppler) ▸ Post LVOT VTI ▸ Post HR	SV and CO (see **page 8-28**)	▸ CO % change ▸ SV % change ▸ VTI % change ▸ pre-CO ▸ pre-SV ▸ post-CO ▸ post-SV
	IVC Collapse (2D and M Mode) ▸ IVC Max D and Min D ▸ RAP	▸ IVC Collapse/Distensibility (see **page 8-33**) ▸ RAP (see **page 8-34**)	▸ IVC Collapse ▸ RVSP

Table 8-4: Focused cardiac measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
Volume Status > Respiratory Variation	Max ▸ LVOT VMax (Doppler) ▸ LVOT VTI (Doppler) ▸ LVOT D (2D) Min (Doppler) ▸ LVOT VMax ▸ LVOT VTI	SV and CO (see **page 8-28**)	▸ SV % variation ▸ VTI % variation ▸ VMax % variation ▸ SV Max ▸ SV Min
Assisted CO	Pre ▸ CO (Doppler) ▸ LVOT D (2D) Post ▸ Post CO (Doppler)	ACO (see page **page 8-35**)	▸ CO % change ▸ SV % change ▸ Pre VTI % variation ▸ Post VT % variation
Right Heart	Right FAC (2D) ▸ RV EDA and ESA	FAC (see **page 8-29**)	Right FAC
	▸ TAPSE (M Mode)	MAPSE/TAPSE (see **page 8-29**)	—
	RVSP (Doppler) ▸ TR VMax ▸ RAP	RVSP (see **page 8-35**)	RVSP
Great Vessels	IVC Collapse (2D and M Mode) ▸ IVC Max and Min ▸ RAP[a]	▸ IVC Collapse/Distensibility (see **page 8-33**) ▸ RAP (see **page 8-34**)	IVC collapse
	Thoracic Aorta (2D) ▸ Ao Root D ▸ Asc Ao D	Distance (see **page 8-5**)	—
Great Vessels > Respiratory Variation	Distensibility (2D and M Mode) ▸ IVC Max D and Min D	IVC Collapse/Distensibility (see **page 8-33**)	Distensibility index (DI)

Table 8-4: Focused cardiac measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
HR	HR (M Mode and Doppler)	HR (see page 8-8)	—

To perform a cardiac calculation

1 On a frozen image, tap the **Focused Cardiac** or **Cardiac** analysis package on the Calcs page.

2 Tap a measurement button or select a measurement from the next page.

3 Perform the measurement according to its measurement type.

4 Press to save the results.

WARNING Moving the baseline, scrolling, or inverting the trace while frozen clears the displayed results.

Note Many cardiac calculations require both 2D and Doppler measurements. To display both 2D and Doppler scans on the monitor, see "Display Format" on page 6-6.

To measure Velocity Time Integral (VTI)

This measurement calculates other results in addition to VTI including VMax, PG Max, VMean, and PG Mean.

1 On a frozen Doppler spectral trace, press **CALCS/** and navigate to the cardiac package.

2 From an analysis package page, tap and select **Manual Trace** or **Auto Measure** from the drop-down list on a VTI measurement button (for example, LVOT VTI).

WARNING Trace only a single heartbeat. The VTI calculation is not valid if measured with more than one heartbeat.

3 Tap the button, and follow the Doppler manual trace or auto trace procedure to perform the measurement (see page 8-11 or page 8-12).

4 Press to save the results.

To measure distance in M Mode

You can measure many of the cardiac distance measurements in M Mode.

1 On a frozen M Mode sweep, press **CALCS/** and navigate to the cardiac package.

2 Tap a measurement button (for example, **LA D** under **Dimensions**).

3 Drag your finger on the touchpad to take the distance measurement on the M Mode trace.

Press to save the results.

To calculate Ejection Fraction (EF) and Fractional Shortening (FS)

1 On a frozen 2D image or M Mode sweep, press **CALCS/** and navigate to the cardiac package.

2 Tap **Left Heart** or **LV Function/EF**.

3 Do the following for LVDd and then for LVDs:

a Tap the measurement button.

b Use the touchpad and **SELECT/** button to position the calipers.

4 Press to save the results.

Note If you are measuring in 2D, use the cine control to find the appropriate frame (see **page 6-18**).

To calculate fractional area change (FAC)

1 On a frozen 2D image, press **CALCS/** and navigate to the cardiac package.

2 Do one of the following:

- Tap **Left Heart** or **LV Function/EF**.
- Tap **Right Heart** or **RV Function**.

3 Do the following for EDA and then for ESA:

a Tap the measurement button.

b Use the calipers to trace the desired area (see **page 8-6**).

4 Press to save the results.

Note If you are measuring in 2D, use the cine control to find the appropriate frame (see **page 6-18**).

To calculate Stroke Volume (SV), Stroke Index (SI), Cardiac Output (CO), and Cardiac Index (CI)

These calculations require a measurement in 2D and a measurement in Doppler. SI and CI also require Body Surface Area (BSA). On the Volume Status page, you can also calculate percent change and percent variation.

1 (SI and CI only) Fill in the **Height** and **Weight** fields on the patient form. The BSA is calculated automatically.

2 Measure LVOT diameter:

   a On a frozen 2D image, press **CALCS/** and navigate to the cardiac package.

   b Tap **LVOT D** from a measurement list and perform a distance measurement (see **page 8-5**).

3 Measure LVOT VTI:

   a If necessary, scan in Doppler and freeze the image .

   b Tap **LVOT VTI** from a measurement list. Follow the Doppler manual trace or auto trace procedure to perform the measurement (see **page 8-11** or **page 8-12**).

4 Measure HR as described in **"To measure heart rate (Doppler)"** on page 8-9.

To calculate LV volume and EF (Simpson's Rule)

Note To calculate biplane EF, you need to make all four measurements.

1 On a frozen 2D image, press **CALCS/** and navigate to the **Cardiac** package.

2 Tap **LV Function/EF**, then tap **A4Cd Vol**, **A4Cs Vol**, **A2Cd Vol**, or **A2Cs Vol** under Apical EF.

3 Do the following for each measurement:

   a Use the touchpad to position the caliper at the annulus.

   b Follow the area trace procedure to trace the ventricular cavity (see **page 8-6**) starting at the mitral annulus and ending at the other annulus.

c Adjust ventricle length as needed.

4 Press  to save the results.

To measure Tricuspid or Mitral Annular Plane Systolic Excursion (TAPSE or MAPSE)

TAPSE is used to evaluate right ventricular systolic function. MAPSE is a similar measurement used to assess left ventricular function.

1 On a frozen M Mode sweep, press **CALCS/**  and navigate to the cardiac package.

2 Tap **Right Heart**, **Left Heart**, or **Function**.

3 Tap **TAPSE** or **MAPSE**.

A right-angled caliper pair appears.

4 Use the touchpad and **SELECT/**  button to position the calipers.

5 Press  to save the results.

To use assisted cardiac output (ACO)

Assisted CO requires a measurement in 2D and a measurement in Doppler. Make sure that the heart rate is between 30–200. You may also want to optimize your Doppler sweep speed (see **page 6-9**.

WARNINGS

- To avoid incorrect calculation results, make sure that the Doppler signal does not alias.
- To avoid an incorrect diagnosis:
  - Do not use assisted cardiac output calculations as the sole diagnostic criteria. Use them only in conjunction with other clinical information and patient history.
  - Do not use assisted cardiac output calculations in neonatal or pediatric patients.
  - Make sure that the flow rate is 1 L/min or greater to maintain measurement accuracy.

1 Measure LVOT diameter:

a On a frozen 2D image, press **CALCS/**  and navigate to the cardiac package.

b Tap **LVOT D** from a measurement list and perform a distance measurement (see **page 8-5**).

c Press to save the measurement.

Note You must save this measurement before taking the Doppler measurement. LVOT D is available on the Assisted CO page.

2 Trace automatically in Doppler:

a On a live or frozen Doppler spectral trace, press **CALCS/** .

b If necessary, navigate to the **Assisted CO** page and tap on a **CO** measurement button.

The system automatically traces and measures the cardiac output on well-defined waveforms..

Notes

- If the system is measuring CO on a live trace, only one waveform is measured at a time. On a frozen trace, the system displays up to five measurements.
- Tap on a CO measurement button to change where the system traces the waveform. The default is set to below the baseline.
- If you change anything about how the image is displayed, such as inverting the image or moving the baseline, the results are cleared.

c If you need to correct a trace, do any of the following:

- To adjust the measurement, select the measurement in the results area on the touch panel then use the **SELECT/** button and the touchpad to adjust the goalposts.
- To find a more well-defined waveform, use the cine control to move the Doppler display (see **page 6-18**). You will need to tap the measurement button again to redo the trace.

d Freeze the image if necessary, then tap **Confirm** or next to the measurements in the results area.

If you delete a trace, the system automatically adds a new one to the display if one is available.

e Press to save the results.

Note The system will not save any unconfirmed measurements.

To calculate Qp:Qs

The Qp:Qs calculation requires two measurements in 2D and two measurements in Doppler.

1 On a frozen 2D image, press **CALCS/** and navigate to the **Cardiac** package.

2 Do the following to measure from LVOT D and again to measure from RVOT D:

   a Tap **Qp;Qs**, then tap **LVOT D** under Left or **RVOT D** under Right.

   b Use the touchpad and **SELECT/** button to position the calipers.

3 Press to save the results.

4 Do the following to measure from LVOT VTI and again to measure from RVOT VTI:

   a If necessary, scan in Doppler and freeze the image

   b Tap **Qp;Qs**, then tap **LVOT VTI** under Left or **RVOT VTI** under Right.

   c Follow the Doppler manual trace or auto trace procedure to perform the measurement (see **page 8-11** and **page 8-12**).

5 Press to save the results.

To calculate atrial volumes (Simpson's Rule)

Some of these measurements also generate LV EF calculations.

1 On a frozen 2D image, press **CALCS/** and navigate to the **Cardiac** package.

2 Tap **Left Dimensions**, **Diastology**, or **Right Dimensions**.

3 Tap **LA Vol A4C**, **LA Vol A2C**, or **RA Vol**.

4 Do the following for each measurement:

   a Use the touchpad to position the caliper at the annulus.

   b Follow the area trace procedure to trace the atrial cavity (see **page 8-6**) ending at the other annulus.

> **Note** The recommended method is to trace from annulus to annulus and allow the system to automatically close the trace.

   c You can adjust the atrial length by dragging the cursor.

5 Press to save the results.

Note To calculate atrial volume indexes, BSA is required.

To calculate LV mass

You can calculate LV mass in 2D or M Mode.

1 On a frozen 2D image or M Mode sweep, press **CALCS/** and navigate to the **Cardiac** package.

2 To calculate LV mass in 2D:

   a Tap **Left Dimensions**.

   b Trace the desired area for **Epi Area** and then for **Endo Area** (see **page 8-6**).

   c Tap **Apical D** and use the calipers to measure the ventricular length (see **page 8-5**).

   d Press to save the results.

3 To calculate LV mass in M Mode:

   a Tap **Dimensions**.

   b Take an M Mode distance measurement for **LVDd**, **LVPWd**, and **IVSd**.

   c Press to save the results.

To measure Pressure Half Time (PHT)

You can use this measurement to calculate Mitral Valve Area (MVA).

1 On a frozen Doppler spectral trace, press **CALCS/** and navigate to the **Cardiac** package.

2 From an analysis package page, tap a **PHT** measurement (for example, TV PHT)

3 Use the touchpad to position the first caliper at the peak.

4 Press **SELECT/**, and use the touchpad to position the second caliper.

   - In MV, drag the caliper along the E wave deceleration slope.
   - In AV, drag the caliper to the end diastole.

5 Press to save the results.

To measure a Tissue Doppler Imaging (TDI) waveform

1 Ensure that TDI is on (see "Doppler Mode" on page 6-8).

2 On a frozen Doppler spectral trace, press **CALCS/** and navigate to the **Cardiac** package.

3 Do the following for each measurement you want to take:

   a Under **Diastology** or **RV Function**, tap **TDI** then tap the measurement name.

   b Perform a velocity measurement (see page 8-9).

4 Press to save the results.

To calculate Right Ventricular Index of Myocardial Performance (RIMP)

1 On a frozen 2D image, press **CALCS/** and navigate to the **Cardiac** package.

2 Tap **RV Function**.

3 Measure **IVRT**:

   a Use the touchpad to position the vertical caliper at the aortic valve closure.

   b Press **SELECT/**, and use the touchpad to position the second caliper at the onset of mitral inflow.

4 Measure **ICRT**:

   a Use the touchpad to position the vertical caliper at the tricuspid valve closure.

   b Press **SELECT/**, and use the touchpad to position the second caliper at the pulmonic valve opening.

5 Measure **RVET**:

   a Use the touchpad to position the vertical caliper at the pulmonic valve opening.

   b Press **SELECT/**, and use the touchpad to position the second caliper at the aortic valve closure.

6 Press to save the results.

To calculate Inferior Vena Cava (IVC) Collapse and Distensibility Index

1 On a frozen 2D image or M Mode sweep, press **CALCS/** and navigate to the cardiac package.

2 Tap **Great Vessels**, **Dimensions**, or **Volume Status**. (You may also navigate to **Respiratory Variation**).

3 Measure the maximum diameter:

   a Cine the image to show maximum expansion.

   b In the measurement list, tap **IVC Max D**.

c Use the calipers to measure the diameter (see **page 8-5**).

4 Press  to save the results.

5 Measure the minimum diameter:

a Cine the image to show minimum contraction (see **"To view frames in the cine buffer"** on page 6-18).

b In the measurement list, tap **IVC Min D**.

c Use the calipers to measure the diameter (see **page 8-5**).

6 Press  to save the results.

To select the RA pressure (RAP)

1 On a frozen Doppler spectral trace, press **CALCS/**  and navigate to the cardiac package.

2 On an analysis package page (for example, Right Heart), tap **RAP**.

3 Select the desired value from the RA list.

To calculate Aortic Valve Area (AVA)

The AVA calculation requires a measurement in 2D and two measurements in Doppler.

1 On a frozen 2D image, press **CALCS/**  and navigate to the **Cardiac** package.

2 Tap the **LVOT D** measurement button under **Aortic Valve** or **AVA**.

3 Use the touchpad and **SELECT/**  button to position the calipers.

4 In Doppler, measure either by VMax or VTI.

- by VMax – For both **LVOT VMax** and **AV VMax**, drag the caliper to the peak velocity waveform.
- by VTI – For both **LVOT VTI** and **AV VTI**, trace the Doppler waveform (see **page 8-11** or **page 8-12**).

Notes

- If VTI is chosen, the VMax value derived from the trace is used as input to the AVA calculation.
- If VTI measurements are made for both LVOT and AV, both AVA (VMax) and AVA (VTI) are calculated.

To calculate delta pressure/delta time (dP/dt)

To perform the dP/dt measurements, the CW Doppler scale must include velocities of 300 cm/s or greater on the negative side of the baseline.

1 Ensure that CW Doppler is on (see "Doppler Mode" on page 6-8).

2 On a frozen Doppler spectral trace, press **CALCS/** and navigate to the **Cardiac** package.

3 Tap **Mitral Valve**, then tap **MV dP/dt** under MR.

A horizontal dotted line with an active caliper appears at 100 cm/s.

4 Use the touchpad to drag the first caliper along the waveform at 100 cm/s.

A second horizontal dotted line with an active caliper appears at 300 cm/s.

5 Use the touchpad to drag the second caliper along the waveform at 300 cm/s.

6 Press to save the results.

To calculate the Right Ventricular Systolic Pressure (RVSP)

1 On a frozen Doppler spectral trace, press **CALCS/** and navigate to the cardiac package.

2 Tap **Right Heart** or **Tricuspid/Pulmonary**

3 Tap **TR VMax** under **RVSP**.

4 Position the caliper by dragging your finger on the touchpad.

5 Tap **RAP** and select a value from the drop-down list.

6 Press to save the results.

Gynecological measurements and calculations

The Gynecological calculations include 2D measurements for uterus, ovaries, and follicles. You can also calculate volume.

Table 8-5: Gynecological measurements and calculations

Page or list	Measurements (2D mode)	Procedure	Calculation results
Uterus	▸ Uterus L, H, and W	▸ Distance (see page 8-5) ▸ Volume (see page 8-7)	Uterus Vol
—	Endometrium	▸ Distance (see page 8-5)	—
Right Ovary	▸ Rt Ovary L, H, and W	▸ Distance (see page 8-5) ▸ Volume (see page 8-7)	Rt Ovary Vol
Left Ovary	▸ Lt Ovary L, H, and W	▸ Distance (see page 8-5) ▸ Volume (see page 8-7)	Lt Ovary Vol

Table 8-5: Gynecological measurements and calculations

Page or list	Measurements (2D mode)	Procedure	Calculation results
Fertility > Follicles	Right and Left ▸ Foll 1-10	▸ Distance (see page 8-5)	—

Measuring uterus

You can measure uterus length (L), width (W), height (H), and endometrial thickness. If you measure length, width, and height, the system also calculates the volume (see "To measure volume" on page 8-7).

To measure uterus

1 On the frozen 2D image, tap the **Gynecology** analysis package on the Calcs page.

2 Under **Uterus Volume**, tap a measurement button.

3 Take a distance measurement (see page 8-5).

4 Press to save the results.

Measuring ovaries

You can measure ovary length (L), width (W), and height (H). If you measure length, width, and height, the system also calculates the volume (see "To measure volume" on page 8-7).

To measure ovaries

1 On the frozen 2D image, tap the **Gynecology** analysis package on the Calcs page.

2 Do the following for each measurement you want to take:

   a Tap the measurement button under **Right Ovary** or **Left Ovary**.

   b Take a distance measurement (see page 8-5).

   c Press to save the results.

Measuring follicles

On each side, you can save up to three distance (D) measurements per follicle, for up to ten follicles.

To measure follicles

1 On the frozen 2D image, press **CALCS/** .

2 Tap the **Gynecology** analysis package, then tap **Follicles**.

3 From the **Right** (if measuring the right side) or **Left** (if measuring the left side) list, do the following for each measurement you want to take:

a Tap the follicle number. If this is the first follicle you are measuring, tap **Foll 1**.

b Take a distance measurement (see **page 8-5**).

c Tap the same follicle to measure a second dimension of the same follicle or press  to save just the first measurement.

After you have saved a measurement, a superscripted measurement number appears after the follicle number.

d Follow steps b and c to take a third measurement.

e Press  to save the measurement.

Obstetrics measurements and calculations

WARNINGS

- Make sure that you have selected the obstetrics exam type and the OB author for the obstetrical calculations you intend to use. See **"Obstetrics calculations settings"** on page 4-23.
- To avoid incorrect obstetrics calculations, verify with a local clock and calendar that the system's date and time settings are correct before each use of the system.
- To avoid misdiagnosis or harming the patient outcome, make sure you end the previous study before starting a new patient study and performing calculations. Otherwise, the previous patient's data will be combined with the current patient. Tap **END STUDY** to end the previous study.

In the Obstetrics analysis package, you can calculate gestational age , fetal heart rate, as well as middle cerebral and umbilical artery blood flow velocities.

Estimated Fetal Weight (EFW) can be calculated using biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL) values that are within range. The measurements used in the calculation depend on the method chosen in the **"Obstetrics calculations settings"** on page 4-23. If the BPD and HC values are out of range, the system calculates the EFW using only the AC and FL values.

Obstetric measurements are listed in the following table along with calculation results that appear on the clinical monitor and in the report. For an explanation of terms and abbreviations, see the **"Glossary."**

Table 8-6: OB measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
Biometry	▸ BPD (2D) ▸ HC (2D) ▸ AC (2D) ▸ FL (2D)	▸ Distance (see **page 8-5**) ▸ Ellipse (see **page 8-5**) ▸ Ellipse (see **page 8-5**) ▸ Distance (see **page 8-5**)	▸ HC/AC ▸ FL/AC ▸ FL/BPD ▸ FL/HC ▸ EFW ▸ EFW Percentile ▸ EDD by LMP[a] ▸ EDD by AUA ▸ GA by LMP[a] ▸ GA by EDD[b] ▸ AUA ▸ CI ▸ CI (HC)
More Biometry	Head (2D) ▸ OFD ▸ OOD ▸ IOD Brain (2D) ▸ Lat Vent ▸ CM ▸ Cerebellum	Distance (see **page 8-5**)	—
BPP	▸ Breathing ▸ Movement ▸ Tone ▸ Fluid ▸ NST	—	BPP

Table 8-6: OB measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
AFI	▸ Q1 (2D) ▸ Q2 (2D) ▸ Q3 (2D) ▸ Q4 (2D)	Distance (see **page 8-5**)	AFI
Maternal	Cervix (2D)	Curved distance (see **page 8-5**)	—
—	FHR (M Mode and Doppler)	HR (see **page 8-8**)	—
MCA	MCA Trace (Doppler)	Manual or auto trace (see **page 8-11**)	—
Umbilical Art	▸ UA S/D Ratio (Doppler) ▸ UA Trace (Doppler)	Manual or auto trace (see **page 8-11**)	—

a. To make this calculation, you must enter LMP in the patient form.
b. To make this calculation, you must enter EDD in the patient form.

To perform OB measurements (2D)

For each 2D obstetrical measurement (except AFI), the system saves up to three individual measurements and their average.

1 Make sure that the obstetrics exam type is selected.

2 On the patient form, select **LMP** or **EDD** under **Obstetrics**. Select the number of multiples, if applicable (see **Chapter 5, "Entering Patient Information."**)

Note To make an OB calculation based on the LMP or EDD, you must enter one of these values in the patient form.

3 On a frozen 2D image, press **CALCS/** to go to the **OB** analysis page.

4 For multiples, tap the appropriate fetus (A, B, C, or D).

5 Tap a measurement button and perform the measurement according to its measurement type.

6 Press to save the results.

7 If doing a biophysical profile (BPP) measurement, select a value from the drop-down list.

To measure fetal heart rate (M Mode)

1 Make sure that the obstetrics exam type is selected.

2 On the patient form, select the number of multiples, if applicable.

3 On a frozen M Mode sweep, press **CALCS/** to go to the **OB** analysis page.

4 For multiples, tap the appropriate fetus (A, B, C, or D).

5 Take a heart rate measurement (see **page 8-8**).

6 Press to save the results.

To calculate the Middle Cerebral Artery (MCA) trace, the Umbilical Artery (UA) trace, or the UA S/D ratio

1 Make sure that the obstetrics exam type is selected.

2 On the patient form, select the number of multiples, if applicable.

3 On a frozen Doppler spectral trace, press **CALCS/** to go to the **OB** analysis page.

4 For multiples, tap the appropriate fetus (A, B, C, or D).

5 Do the following for each measurement you need to take:

a Tap the measurement button under **MCA** or **Umbilical Art**.

b Take the measurement:

- For the MCA and UA traces, tap to select between manual or auto trace, and follow the procedure on **page 8-11** or **page 8-12**.
- For the UA S/D ratio, drag the caliper to the peak systole on the waveform. Press **SELECT/**, and then drag the second caliper to the end diastole.

WARNING If calipers are positioned imprecisely, the calculation result is inaccurate.

6 Press to save the results.

Early OB calculations

To measure ovaries, see page 8-36. To measure fetal heart rate, see page 8-40. Measurements are listed in the following table along with calculation results that appear on the clinical monitor and in the report. For an explanation of terms and abbreviations, see the "Glossary."

Table 8-7: Early OB measurements and calculations

Page or list	Measurements (mode)	Procedure	Calculation results
Fetus	▸ CRL (2D) ▸ BPD (2D) ▸ NT (2D)	Distance (see page 8-5)	▸ EDD by LMP[a] ▸ EDD by AUA ▸ GA by LMP[a] ▸ GA by EDD[b] ▸ AUA
Mean Gest Sac GA	▸ Gest Sac 1, 2, and 3 (2D)	Distance (see page 8-5)	▸ Mean Gest Sac D ▸ GA
Right Ovary	▸ Rt Ovary L, H, and W (2D)	▸ Distance (see page 8-5) ▸ Volume (see page 8-7)	Rt Ovary Vol
Left Ovary	▸ Lt Ovary L, H, and W (2D)	▸ Distance (see page 8-5) ▸ Volume (see page 8-7)	Lt Ovary Vol
Yolk Sac	Yolk Sac (2D)	▸ Distance (see page 8-5)	—
Maternal	▸ Cervix (2D) ▸ Myometrial Mantle (2D)	▸ Area trace (see page 8-6) ▸ Distance (see page 8-5)	—
—	FHR (M Mode)	HR (see page 8-8)	—

a. To make this calculation, you must enter LMP in the patient form.
b. To make this calculation, you must enter EDD in the patient form.

To measure gestational sacs

The gestational age (GA) and mean sac diameter only appear if you have made all three measurements. You can take each measurement multiple times, but only the latest measurement is saved.

1 Make sure that the **Early OB** exam type is selected.

2 On a frozen 2D image,press **CALCS/**  to go to the **OB** analysis page.

3 Tap **Mean Gest Sac GA**.

4 Tap **Gest Sac 1** and perform a distance measurement (see **page 8-5**).

5 Tap **Gest Sac 2** and perform a distance measurement (see **page 8-5**).

6 Press to save the results.

7 To obtain the third measurement, acquire and freeze a new image, press **CALCS/** , and then tap **Gest Sac 3**.

8 Press to save the results.

MSK calculations

The following table shows the measurements available for musculoskeletal (MSK) calculations. Calculation results appear on the clinical monitor and in the report.

Table 8-8: MSK measurements and calculations

Page or list	Measurements (2D mode)	Procedure	Calculation results
Right Hip Angle	▸ Rt Baseline ▸ Rt Roof Line ▸ Rt Inclination Line	Angle (see **page 8-7**)	▸ Rt Hip α ▸ Rt Hip β
Right d:D Ratio	▸ Rt Femoral Head ▸ Rt Baseline	Ellipse (see **page 8-5**)	Rt Hip d:D Ratio
Left Hip Angle	▸ Lt Baseline ▸ Lt Roof Line ▸ Lt Inclination Line	Angle (see **page 8-5**)	▸ Lt Hip α ▸ Lt Hip β
Left d:D Ratio	▸ Lt Femoral Head ▸ Lt Baseline	Ellipse (see **page 8-5**)	Lt Hip d:D Ratio

To calculate hip angle

1 On a frozen 2D image, press **CALCS/** .

2 Do the following under **Right Hip** and again under **Left Hip**:

a Under **Hip Angle**, tap **Baseline**.

A baseline with calipers appears.

b Use the **SELECT/** button and the touchpad to activate and position each caliper.

c Tap **Roof Line**.

d Use the **SELECT/** button and the touchpad to activate and position the calipers.

e Tap **Inclination Line**

f Use the **SELECT/** button and the touchpad to activate and position the calipers.

g Press to save the results.

To calculate hip ratio

1 On a frozen 2D image, press **CALCS/** .

2 Do the following under **Right Hip** and again under **Left Hip**:

a Under **d:D Ratio**, tap **Femoral Head**.

A circle appears.

b Use the touchpad to position the circle.

c Press **SELECT/** .

Two calipers appear.

d Use the **SELECT/** button and the touchpad to resize the circle by activating and dragging the calipers.

e Tap **Baseline**.

The baseline appears.

f Use the touchpad to position the baseline caliper.

g Press to save the results.

CHAPTER 9

Managing Patient Data

Sonosite PX offers tools for managing patient data, including study management, reports, and worksheets. Studies organize and consolidate all of the data associated with an exam. Reports provide a summary of study information, including the study date and time, patient information, exam type, notes, and any calculations made.

Managing studies

Caution When attaching a file to a report from an external sensor or other source, be sure to verify it is for the correct patient.

Using the patient list

The **Patient List** module lists the current, active study (in blue), as well as completed and saved studies. You can sort the list, view and delete studies, edit patient information, and append images and video clips to an existing study.

From the list, you can also archive studies to a DICOM archive server or export studies to a USB storage device. For more information, see **"Archiving studies"** on page 9-3 and **"Exporting studies"** on page 9-5.

The patient list contains the following information:

- **Patient name**
- **MRN** Medical Record Number
- **Exam type** (for example, cardiac)
- **Date/time** The date and time of the study
- **Performing** The user who performed the study
- The number of video clips and images saved with the study
- **Status** The archive status of the study

- The export status of the study

To display the patient list

❖ Tap **Patient List** on the touch panel, at the bottom of the patient form or report form, or from the menu .

To sort the patient list

By default, the list is sorted by date and time, with the most recent patient listed first. You can re-sort the list.

❖ Tap the column heading that you want to sort by. Tap it again to sort in reverse order.

To search the patient list

1 Tap the **Search** field at the top of the page.

The on-screen keyboard pops up.

2 Type in the following search terms in the search field:

- Patient name (first, last, middle)
- MRN

Matching results appear in the list.

3 To delete terms, tap the on the keyboard.

To select one or more studies

❖ In the list, tap one or more studies.

Selected studies display a check mark and are highlighted in blue.

To select all studies in the list

❖ Tap **Select All**.

To deselect all studies, tap **Deselect All**.

To delete a study

1 In the list, select a study by tapping it.

2 Tap **Delete**.

To open and review a study

❖ Do one of the following:

- Double-tap a study in the list.

- Tap a study, then tap **View** at the bottom of the page.

  The review page opens.

To append images and clips to a study

Although you cannot add images and video clips to a study that is ended, you can automatically start a new study that has the same patient information. Depending on your archiver, the two studies appear as one study when exported or archived.

1 In the list, select the study by tapping it.

2 Tap **Append**.

  A new patient form appears. The form has the same information as the study you selected.

To edit patient information from the list

You can edit patient information from the patient list instead of from the patient form if the study is ended but has not been exported or archived. You cannot edit the patient's name or MRN.

1 Do one of the following:

  - Double-tap a study in the list to open the review page.
  - Tap a study to select it, then tap **View**.

2 To access the patient form, tap **Patient**.

3 Fill in the text boxes.

Archiving studies

If you have configured the system for DICOM transfer (see **page 4-14**), the system automatically archives saved images, along with the patient report, to DICOM devices. To archive video clips, make sure to select **Include video clips** on the **Archiver** configuration page. Archiving occurs either during the study or at the end of the study, depending on the settings you have chosen in the **Transfer images** setting on the Location configuration page. You can also manually archive studies to DICOM devices.

Pending studies are archived starting at the top of the study list.

To verify that studies transferred

1 Tap **Patient List**.

  The **Status** column shows the status of the transfer.

  -  The study is successfully archived.

-  The study is archive suspended or has failed. Network connection settings may be wrong (see **"DICOM configuration pages"** on page 4-16), or there may be a network or server problem. The study needs to be manually archived (see **page 9-4**).

-  Storage commit is successful.

-  Storage commit has failed.

Exams with no status markers are pending archiving.

To display archive status information

You can display information about a study, including transfer details.

1 Tap **Patient List**.

2 Select the desired study in the list by tapping it.

3 Tap **View**.

4 Tap **Status**.

For each configured archive, the following information displays: Images/clips that have successfully been archived, storage committed, MPSS, suspended or in progress. If progress is suspended, you can cancel the transfer process and resend the data.

To manually archive studies

1 Verify the following:

- The correct location is selected (see **"To specify the system location"** on page 4-14).
- If the system is connected to a network via an Ethernet connection, the Ethernet connected icon  appears in the system status area on the monitor.
- For a wireless connection, the wireless connected icon  appears in the system status area on the monitor.

2 Tap **Patient List**.

3 In the list, select one or more studies by tapping them.

4 Tap **Send to**.

5 From the menu, tap **Archive**.

6 Choose an archive from the Archive dialog, and tap **Send**.

To discontinue MPPS for a study

You can discontinue MPPS for a study before completing the study.

1 On the patient form, tap **Discontinue**.

A dialog displays.

2 Do one of the following:

- Tap **Yes** to end the study.
- Tap **Cancel** to return to the patient form.

Exporting studies

You can export studies to a USB storage device for archiving. Make sure you archive patient studies regularly.

Caution To avoid losing data from or damaging the USB storage device, do not remove the USB storage device or turn off the ultrasound system while exporting. In addition, do not bump or apply pressure to the USB storage device while it is connected to the system. The connector could break.

You can export patient studies if they are ended and if the system administrator has not disabled USB export. Studies include images, video clips, and the patient report.

To export patient studies manually to a USB storage device

1 Specify the file format for exported images (see **"USB settings"** on page 4-29).

1 Tap **Patient List**.

2 Connect a USB device (see **page 3-12**).

3 In the study list, select one or more studies by tapping them.

4 Tap **Send to**.

5 From the menu, tap **USB**.

A list of USB storage devices appears.

6 Select the USB storage device from the list.

7 Enter a file name.

8 If you want to show patient information, select **Include patient information on images and video clips**.

By default, patient information such as names and IDs are removed from images and clips before exporting to protect patient confidentiality.

Caution Patient information may be a protected class of patient data subject to country-specific security guidelines. If you choose to include patient information when exporting images and clips, be sure your information storage and handling practices comply with country-specific security guidelines.

9 Tap **Export**.

The files are finished exporting approximately five seconds after the USB animation  stops.

Removing the USB storage device or turning off the system while exporting may cause exported files to be corrupted or incomplete. To stop in-progress exporting, tap **Cancel**.

The  column of the patient list indicates whether the system has exported the study.

Printing studies

When you print a study, you are printing all of the data associated with that study including the patient report.

Note You can only use the printer installed on the stand.

To print a study

1 Make sure that the power button on the printer is in the On position.

2 Tap **Patient List**.

3 In the study list, select one or more studies by tapping them.

4 Tap **Send to**.

5 Tap **Printer**.

Managing internal storage space

After archiving or exporting patient data, regularly delete data from the system. Low internal storage can impact system performance. The save available icon in the system status area (see **Figure 3-4** on page 3-14) shows the percentage of space available in internal storage. If storage is full, the system displays

a . If your system administrator has enabled an internal storage alert (see **page 4-11)**, the system alerts you that internal storage is low and prompts you to delete archived or storage committed patient studies.

Data can be deleted from the system in several ways:

- Your system administrator can configure the system to auto-delete all studies or studies that have been transferred to your DICOM server (see **page 4-10**)
- Manually delete studies from the patient list (see **page 9-2**)
- Completely wipe all patient data from the system (see the following procedure)

To wipe patient data

Caution Back up patient data prior to performing this action.

1 Simultaneously press the **AUTO,** , and **M** buttons.

2 Make sure the system is connected to AC power, and tap **Yes** to continue.

Deleting patient data takes approximately thirty-five minutes.

Note If your system does not have enough power, you will need to restart the process.

3 When the wipe is complete, tap **OK** to restart the system.

Managing reports and worksheets

Twenty-six default exam-specific worksheets are available on the system, based on ACEP guidelines. Only one worksheet is supported for each study. The report includes the information provided in these worksheets, exam-specific measurements and calculations, and patient data. You can continue to add data to the report before you end the study.

Using worksheets

To display the worksheet page

❖ On the touch panel, tap **Report & Worksheet**.

The workspace displays with the default Worksheet tab open.

To select and fill out a worksheet

1 In the Worksheet tab, click or tap the ⌄ in the Worksheet type drop-down list box to view the available worksheets.

2 Select a worksheet from the list.

Worksheet-specific fields appear.

3 Fill in the exam overview and worksheet fields with the desired information.

Your changes are auto-saved.

4 To clear the worksheet fields, tap **Reset**.

Custom worksheets

The ultrasound system supports custom remote worksheets created or edited using an ultrasound workflow application, such as Sonosite Synchronicity Workflow Manager You can import up to thirty custom worksheets from your server to your system, fill out and sign the worksheets on the system, and transfer the remote worksheet data back to the server. Any worksheet data that you enter can be transferred to the DICOM archiver that has been configured to work with your workflow application. Custom worksheets must be configured by a system administrator (see **"Configuring remote worksheets access"** on page 4-11).

Note Downloading remote worksheets from the server replaces the default worksheets on the system. The same set of default non-customizable worksheets continue to be available from the remote worksheets server.

To access and complete a custom worksheet

1 In the worksheet tab, click or tap the ⌄ in the Worksheet type drop-down list box to view the available worksheets.

2 Select a worksheet from the list.

3 In the Exam drop-down list box, click or tap the ⌄ to view the available exam types.

4 Select an exam type from the list.

Worksheet-specific fields appear following the non-specific exam fields.

5 Fill in the worksheet fields with the desired information.

6 Select whether or not to submit the worksheet to the EMR.

7 To sign a worksheet, tap **Signature** at the bottom of the worksheet tab.

You are unable to make any more changes to the worksheet.

WARNING To be able to sign a custom worksheet, the physician **User** ID must be filled out under **Provider** in the patient information form.

8 To make further changes to the worksheet, tap **Remove Signature**.

9 Tap **Done** to exit the worksheet.

Note You must sign each remote worksheet separately.

Editing a report

You can edit the report only while the study is active.

To display the report preview

1 On the touch panel, tap **Report & Worksheet**.

The workspace displays with the default Worksheet tab open.

2 To view the report, tap the **Report** tab.

Scroll down on the touch panel to view the entire report.

To delete calculation values from the report

1 On the touch panel, tap **Report & Worksheet**.

The workspace displays with the default Worksheet tab open.

2 To view calculations, tap the **Calcs** tab.

3 Select the value, and then tap **Delete** at the bottom of the touch panel.

Deleting some measurements also deletes related measurements. Deleted measurements are not included in the summary information.

To save the report as an image

1 On the touch panel, tap **Report & Worksheet**.

2 Tap the **Report** tab.

3 To save the report:

- Tap  to save an image of the displayed information.
- Tap **Save as Image** to save and images of the report.

Obstetrics reports

Like all other reports, the obstetrics report consists of worksheet data, calculations, and patient information. If you need a report for multiples, make sure to fill out the number of multiples in the patient form before completing any calculations.

To generate an obstetrics report

1. Under **Obstetrics** in the patient form, fill in patient information including the number of multiples, if applicable.
2. Perform OB measurements including biophysical profile values (see **page 8–39**).
3. Select an OB worksheet and fill out the anatomy checklist (see **page 9–8**).

Displaying reports after the study has ended

When you end a study, the system saves the patient report with all measurements and calculations performed during the study.

To display the report after the exam has ended

1. Tap **Patient List**.
2. In the study list, select the study by tapping it.
3. Tap **View**.
4. Tap **Report**.

   The system displays the read-only report.
5. Tap **Done** to return to scanning.

CHAPTER 10

Measurement References

This section provides information about measurement accuracy, publications, and terminology.

Measurement accuracy

The measurements from the system are of a physical property such as distance for evaluation by the clinician. The accuracy values require that you can place the calipers over one pixel. The values do not include acoustic anomalies of the body.

The 2D linear distance measurement results are displayed in centimeters or millimeters. The decimal place value depends on the measurement.

The linear distance measurement components have the accuracy and range shown in the following tables.

Sources of measurement errors

Table 10-1: 2D measurement and calculation accuracy and range

2D measurement	System tolerance[a]	Accuracy by	Test method	Range (cm)
Axial distance	≤ +/- (2% of measurement + 1% full scale screen depth)	Acquisition	Phantom[b]	0–35 cm
Lateral distance	≤ +/- (2% of measurement + 1% full scale screen depth)	Acquisition	Phantom[b]	0–48 cm
Diagonal distance	≤ +/- (2% of measurement + 1% full scale screen depth)	Acquisition	Phantom[b]	0–48 cm
Area	≤ +/- (4% + 0.2% of the current image depth divided by the smallest axis dimension) of the measurement	Acquisition	Phantom[c]	0.0–1800 cm^2
Circumference	≤ ± (2% of measurement + 0.36% of current image depth)	Acquisition	Phantom[b]	0–150 cm

a. Full scale for distance implies the maximum depth of the image.
b. Fujifilm Sonosite special test equipment was used.
c. A Gammex 403 model phantom was used.

Table 10-2: M Mode measurement and calculation accuracy and range

M Mode measurement	System tolerance	Accuracy by	Test method
Axial distance	≤ +/- (2% of measurement + 1% full scale screen depth[a])	Acquisition	Phantom[b]
Time	≤ +/- (2% + 1% of full scale[c])	Acquisition	Phantom[d]
Heart rate	≤ +/- (2% + 1% of the inverse of the full scale[c])	Acquisition	Phantom[d]

a. Full scale implies the maximum depth of the image.
b. A Gammex 403 model phantom was used.
c. Full scale implies the total time displayed on the scrolling graphic image.
d. Fujifilm Sonosite special test equipment was used.

Table 10-3: PW Doppler mode measurement and calculation accuracy and range

Doppler mode measurement	System tolerance	Accuracy by	Test method[a]
Velocity cursor	≤ +/- (2% + 1% of full scale[b])	Acquisition	Phantom
Time	≤ +/- (2% + 1% of full scale[c])	Acquisition	Phantom
Heart rate	≤ +/- (2% + 1% of the inverse of the full scale[c])	Acquisition	Phantom

a. Fujifilm Sonosite special test equipment was used.
b. Full scale implies the velocity magnitude displayed on the scrolling graphic image.
c. Full scale implies the total time displayed on the scrolling graphic image.

In general, two types of errors can be introduced into the measurement:

- **Acquisition Error:** Includes errors introduced by the ultrasound system electronics relating to signal acquisition, signal conversion, and signal processing for display. Additionally, computational and display errors are introduced by the generation of the pixel scale factor, application of that factor to the caliper positions on the screen, and the measurement display.
- **Algorithmic Error:** The error introduced by measurements, which are input to higher order calculations. This error results from imprecision in the method used to carry out mathematical computations, usually associated with either rounding or truncation of numbers.

Measurement publications and terminology

The following are the publications and terminology used for each calculation result.

Terminology and measurements comply with American Institute of Ultrasound in Medicine (AIUM) published standards.

Cardiac references

Aortic Valve Area (AVA) in cm^2 by VMax

Baumgartner, H., Hung, J. et al. "Recommendations on the Echocardiographic Assessment of Aortic Valve Stenosis: A Focused Update from the European Association of Cardiovascular Imaging and the American Society of Echocardiography." *Journal of the American Society of Echocardiography* (2017), 30: p.372–392.

$A2 = A1 * V1 / V2$

where:

A2 = Ao valve area
A1 = LVOT area (CSA)
V1 = LVOT velocity
V2 = Ao valve velocity

LVOT = Left Ventricular Outflow Tract

Aortic Valve Area (AVA) in cm^2 by VTI

Baumgartner, H., Hung, J. et al. "Echocardiographic assessment of valve stenosis: EAE/ASE recommendations for clinical practice." *Eur J Echocardiogr.* (2009), 10: p.1–25.

$AVA = (CSA_{LVOT} \times VTI_{LVOT}) / VTI_{AV}$

where:

CSA_{LVOT} = LVOT area (CSA)
VTI_{LVOT} = LVOT velocity
VTI_{AV} = Ao valve velocity

LVOT = Left Ventricular Outflow Tract

Aortic Valve Area (AVA) index

Baumgartner, H., Hung, J. et al. "Echocardiographic assessment of valve stenosis: EAE/ASE recommendations for clinical practice." *Eur J Echocardiogr.* (2009), 10: p.1–25.

AVA/BSA

where:

AVA is AVA by VMax or AVA by VTI
BSA = Body Surface Area in m^2

Aortic Valve Velocity ratio

Baumgartner, H., Hung, J. et al. "Echocardiographic assessment of valve stenosis: EAE/ASE recommendations for clinical practice." *Eur J Echocardiogr.* (2009), 10: p.1–25.

AV velocity ratio = V_{LVOT} / V_{AV}

where:

V_{LVOT} = The maximum velocity recorded at the left ventricular outflow tract
V_{AV} = The maximum velocity recorded at the aortic valve

Body Surface Area (BSA) in m^2

Grossman, W. *Cardiac Catheterization and Angiography*. Philadelphia: Lea and Febiger (1980), p.90.

$BSA = 0.007184 * Weight^{0.425} * Height^{0.725}$

Weight = kilograms

Height = centimeters

Cardiac Index (CI) in l/min/m^2

Oh, J.K., Seward, J.B., A.J. Tajik. *The Echo Manual.* 3rd ed., Lippincott, Williams, and Wilkins (2007), p.69–70.

CI = CO/BSA

where:

CO = Cardiac Output
BSA = Body Surface Area

Cardiac Output (CO) from dimensions in l/min

Hayashi, T., Kihara, Y. et al. "The Terminology and Diagnostic Criteria Committee of The Japan Society of Ultrasonics in Medicine Standard measurement of cardiac function indexes." *J Med Ultrasonic* (2006), 33: p.123–127 DOI 10.1007/s10396-006-0100-4 © The Japan Society of Ultrasonics in Medicine 2006, page 123.

CO = SV * HR

where:

CO = Cardiac Output
SV = Stroke Volume (ml)
HR = Heart Rate

Cardiac Output (CO) from Doppler VTI in l/min

Porter, T.R., Shillcutt, S.K. et al. "Guidelines for the Use of Echocardiography as a Monitor for Therapeutic Intervention in Adults: A Report from the American Society of Echocardiography." *J Am Soc Echocardiogr.* (2015), 28: p.40–56.

CO = (SV* HR)/1000

where:

CO = Cardiac Output
Stroke Volume (SV) = CSA * VTI in ml
CSA = Cross Sectional Area of the site
HR = Heart Rate

Cardiac Output (CO) percent change

Evans, D., Ferraioli, G. et al. "Volume Responsiveness in Critically Ill Patients." AIUM (2014), *J Ultrasound Med* (2014), 33: p.3–7.

CO % change = [(post C0 − pre CO)/post CO] * 100

Cross Sectional Area (CSA) in cm^2

Allan, P.L., Pozniak, M.A. et al. *Clinical Doppler Ultrasound*. 4th ed., Harcourt Publishers Limited (2000), p.36–38.

$CSA = \pi/4 * D^2$

where: D = diameter of the anatomy of interest

Delta Pressure/Delta Time (dP/dt) in mmHg/s

Kolias, T.J., Aaronson, K.D., and W. F. Armstrong. "Doppler-Derived dP/dt and -dP/dt Predict Survival in Congestive Heart Failure." *J Am Coll Cardiol.* (2000), p.1594-1599.

Rate of change in pressure over the measured time interval in mmHg/second.

$$\frac{dP}{dt} = \frac{32\ mmHg}{time\ interval}$$

where:

$P = 4v^2$
$P = 32$ mmHg
$32\ mmHg = 4V_2^2 - 4V_1^2$
V_1 = 1 meters/second velocity
V_2 = 3 meters/second velocity

Distensibility Index of Inferior Vena Cava (dIVC) in percent

Barbier, C., Loubières, Y. et al."Respiratory changes in inferior vena cava diameter are helpful in predicting fluid responsiveness in ventilated septic patients." *Intensive Care Med.* (2004), 30: p.1740.

dIVC = [(Dmax – Dmin) / Dmin] * 100

where:

Dmax = IVC diameter at end-inspiration
Dmin = IVC diameter at end-expiration

E/A ratio

Caballero, L., Kou, S. et al. "Echocardiographic reference ranges for normal cardiac Doppler data: results from the NORRE Study." *Cardiovascular Imaging* (2015), 16: p.1031-1041.

mitral valve E wave velocity/PW A wave velocity

where:

E velocity = Peak velocity of early diastolic transmitral flow
A velocity = Peak velocity of late transmitral flow

with the sample volume placed at the mitral leaflet tips

E/e′ ratios

Caballero, L., Kou, S. et al. "Echocardiographic reference ranges for normal cardiac Doppler data: results from the NORRE Study." *Cardiovascular Imaging* (2015), 16: p.1031-1041.

mitral valve E wave velocity/TDI-PW e′ velocity

where:

TDI-PW e' velocity can be measured for septal, lateral, inferior or anterior ventricular walls

Elapsed Time (ET) in msec

ET = time between velocity cursors in milliseconds

Heart Rate (HR) in bpm

HR = three digit value input by user or measured on M Mode and Doppler image in one heart cycle

Interventricular Septum Fractional Thickening (IVSFT) in percent

Laurenceau, J.L. and M.C. Malergue. *The Essentials of Echocardiography*. Le Hague: Martinus Nijhoff (1981), p.71.

IVSFT = [(IVSs – IVSd)/IVSd] * 100

where:

IVSs = Interventricular Septal Thickness at systole
IVSd = Interventricular Septal Thickness at diastole

Interventricular Septum (IVS)/Left Ventricular Posterior Wall (LVPW) ratio

Kansal, S., Roitman, D., and L.T. Sheffield. "Interventricular septal thickness and left ventricular hypertrophy. An echocardiographic study." *Circulation* (1979), 60: p.1058.

IVS/LVPW ratio = IVS/LVPW

where:

IVS = Interventricular Septum length
LVPW = Left Ventricular Posterior Wall length

Isovolumic Relaxation Time (IVRT) in msec

Quiñones, M.A., Otto, C.M. et al. "Recommendations for quantification of Doppler echocardiography: a report from the Doppler Quantification Task Force of the Nomenclature and Standards Committee of the American Society of Echocardiography." *J Am Soc Echocardiogr.* February (2002), 15(2): p.167–184.

IVC Percentage Collapse

Lyon, M. and N. Verma. "Ultrasound guided volume assessment using inferior vena cava diameter." *The Open Emergency Medicine Journal* (2010), 3: p.22–24.

IVC Collapse = (IVCd exp – IVCd insp)/IVCd exp * 100

where:

IVCd exp = Inferior Vena Cava diameter with expiration (maximum diameter)
IVCd insp = Inferior Vena Cava diameter with inspiration (minimum diameter)

Left Atrial/Aorta (LA/Ao)

Feigenbaum, H. *Echocardiography*. Philadelphia: Lea and Febiger (1994), p.206, Figure 4-49.

where:

LA = Left Atrial dimension
Ao = Aortic root dimension

Left Atrial Volume: Biplane Method in ml

Lang, R., Bierig, M. et al. "Recommendations for Cardiac Chamber Quantification by Echocardiography in Adults: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging." *J Am Soc Echocardiogr.* January (2015), 28: p.1–39.

$$V = \left(\frac{\pi}{4}\right) \sum_{i=1}^{n} a_i b_i \left(\frac{L}{n}\right)$$

Simpson's method is used to model the chamber as a stack of elliptical disks.

where:

V = volume in ml
a_i = diameter of major axis of elliptical disk *i* in mm
b_i = diameter of minor axis of elliptical disk *i* in mm
n = number of disks (n = 20)
L = length of the chamber
i = disk index

Left Atrial Volume: Single Plane Method in ml

Lang, R., Bierig, M. et al. "Recommendations for Cardiac Chamber Quantification by Echocardiography in Adults: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging." *J Am Soc Echocardiogr.* January (2015), 28: p.1–39.

$$V = \left(\frac{\pi}{4}\right) \sum_{i=1}^{n} a_i^{\,2} \left(\frac{L}{n}\right)$$

Simpson's method is used to model the chamber as a stack of circular disks.

where:

V = volume in ml
a_i = diameter of disk *i* in mm
n = number of disks (n = 20)
L = length of chamber, measured from the midpoint of the line connecting the two opposite sides of the mitral ring and the most distant point (apex) of the chamber contour
i = disk index

Left Atrial Volume index

Lang, R., Bierig, M. et al. "Recommendations for Cardiac Chamber Quantification by Echocardiography in Adults: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging." *J Am Soc Echocardiogr.* January (2015), 28: p.1–39.

LAVI = LA Vol/BSA

where:

LAVI = Left Atrial Volume Index
LA Vol = volume in mL
BSA = Body Surface Area in m^2

Left Ventricular Dimension Fractional Shortening (FS) in percent

Hayashi, T., Kihara, Y. et al. "The Terminology and Diagnostic Criteria Committee of The Japan Society of Ultrasonics in Medicine Standard measurement of cardiac function indexes." *J Med Ultrasonics* (2006), 33: p.123–127 DOI 10.1007/s10396-006-0100-4 © The Japan Society of Ultrasonics in Medicine 2006, page 123.

LVDFS = [(LVDd – LVDs)/LVDd] * 100

where:

LVDd = Left Ventricle Dimension at diastole
LVDs = Left Ventricle Dimension at systole

Left Ventricular (LV) Ejection Fraction in percent

Schiller, N.B., Shah, P.M. et al. "Recommendations for Quantification of the Left Ventricle by Two-Dimensional Echocardiography." *J Am Soc Echocardiogr.* September-October (1989), 2: p.364.

EF =[(End Diastolic Volume - End Systolic Volume)/End Diastolic Volume] * 100.

Hayashi, T., Kihara, Y. et al. "The Terminology and Diagnostic Criteria Committee of The Japan Society of Ultrasonics in Medicine Standard measurement of cardiac function indexes." *J Med Ultrasonics* (2006), 33: p.123–127 DOI 10.1007/s10396-006-0100-4 © The Japan Society of Ultrasonics in Medicine 2006, page 123.

EF = [(LVEDV – LVESV)/LVEDV] * 100

where:

LVEDV = Left Ventricular End Diastolic Volume = $(7.0 * LVDD^3)/(2.4 + LVDD)$
LVDD = LV Dimension at Diastole (cm)
LVESV = Left Ventricular End Systolic Volume = $(7.0 * LVDD^3)/(2.4 + LVDD)$
LVDS = LV Dimension at Systole (cm)

Left Ventricular End Volumes linear dimensions in ml

Hayashi, T., Kihara, Y. et al. "The Terminology and Diagnostic Criteria Committee of The Japan Society of Ultrasonics in Medicine Standard measurement of cardiac function indexes." *J Med Ultrasonics* (2006), 33: p.123–127 DOI 10.1007/s10396-006-0100-4 © The Japan Society of Ultrasonics in Medicine 2006, page 123.

LVESV = $(7.0 * LVDs^3)/(2.4 + LVDs)$

where:

LVESV = Left Ventricular End Systolic Volume (ml)
LVDs = Left Ventricular Dimension at systole (cm)

$LVEDV = (7.0 * LVDd^3)/(2.4 + LVDd)$

where:

LVEDV = Left Ventricular End Diastolic Volume (ml)
LVDd = Left Ventricular Dimension at diastole (cm)

Left Ventricular Fractional Area Change (FAC) in percent

Dennis, A.T., Castro, J. et al. "Haemodynamics in women with untreated pre-eclampsia." *Anaesthesia* (2012), 67: p.1105-1118.

LV FAC (%) = (LV EDA – LV ESA) / LV EDA * 100

where:

LV FAC = Left Ventricular Fractional Area Change (%)
LV EDA = Left Ventricular End-Diastolic Area (cm^2)
LV ESA = Left Ventricular End-Systolic Area (cm^2)

Left Ventricular mass in gm for 2D

Schiller, N., Shah, P. et al. "Recommendations for Quantification of the Left Ventricle by Two-Dimensional Echocardiography." *J Am Soc Echocardiogr.* September - October (1998), 2: p.364.

$LV\ mass = 1.05 * \{[(5/6) * A_1 * (a + d + t)] - [(5/6) * A_2 * (a + d)]\}$

where:

A_1 = short axis area, diastole (Epi)
A_2 = short axis area, diastole (Endo)
a = long or semi major axis
d = truncated semi major axis from the widest short axis epicardal and cavity areas

a + d = LV Len = length of epicardium (Apical)
t = myocardial thickness = √ (Epi /π) - √ (Endo /π)

Left Ventricular mass in gm for M Mode

Lang, R., Badano, L., et al. "Recommendations for Cardiac Chamber Quantification by Echocardiography in Adults: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging." *J Am Soc Echocardiogr.* (2015), 13: p.1-39.

$LV\ mass = 1.04\ [(LVDd + LVPWd + IVSd)^3 - LVDd^3] * 0.8 + 0.6$

where:

LVDd = diastolic LV internal dimension
LVPWd = diastolic inferolateral wall thickness
IVSd = diastolic interventricular septal thickness
1.04 = specific gravity of the myocardium

Left Ventricular mass index

Hashem, M.S., Kalashyan, H. et al. "Left Ventricular Relative Wall Thickness Versus Left Ventricular Mass Index in Non-Cardioembolic Stroke Patients." *Medicine* (2015), 94: e872.

LV mass index = LV Mass/BSA

where:

LV mass = The left ventricular mass in grams

BSA = Body Surface Area in m^2

Left Ventricular Outflow Tract (LVOT) area in cm^2

Quinones, M.A, Otto, C.M. et al. "Recommendations for quantification of Doppler echocardiography: a report from the Doppler Quantification Task Force of the Nomenclature and Standards Committee of the American Society of Echocardiography." *J Am Soc Echocardiogr.* Februrary (1989), 15: p.170.

LVOT area = $(\pi/4) * (\text{LVOT D})^2$

where:

LVOT D = Left Ventricular Outflow Tract Diameter

Left Ventricular Outflow Tract (LVOT) peak velocity percent variation

Miller, A. and J. Mandeville. "Predicting and Measuring Fluid Responsiveness with Echocardiography", *Echo Res Pract.* (2016), 3(2):G1-G12 DOI: 10.1530/ERP-16-0008.

LVOT peak velocity % variation = 100 x {(LVOT peak velocity max – LVOT peak velocity min) / [(LVOT peak velocity max + LVOT peak velocity min) x 0.5]}

Left Ventricular Outflow Tract (LVOT) Velocity Time Integral (VTI) percent variation

Miller, A. and J. Mandeville. "Predicting and Measuring Fluid Responsiveness with Echocardiography", *Echo Res Pract.* (2016), 3(2):G1-G12 DOI: 10.1530/ERP-16-0008.

LVOT VTI % variation = 100 x {(LVOT VTI Max – LVOT VTI Min) / [(LVOT VTI Max + LVOT VTI Min) x 0.5]}

Left Ventricular Posterior Wall Fractional Thickening (LVPWFT) in percent

Laurenceau, J. L. and M.C. Malergue. *The Essentials of Echocardiography*. Le Hague: Martinus Nijhoff (1981), p.71.

LVPWFT = [(LVPWS – LVPWD)/LVPWD] * 100

where:

LVPWS = Left Ventricular Posterior Wall Thickness at Systole

LVPWD = Left Ventricular Posterior Wall Thickness at Diastole

Left Ventricular Volume: Biplane Method in ml

Schiller, N.B., Shah, P.M. et al. "Recommendations for Quantitation of the Left Ventricle by Two-Dimensional Echocardiography." *Journal of American Society of Echocardiography*. September-October (1989), 2: p.362.

$$V = \left(\frac{\pi}{4}\right) \sum_{i=1}^{n} a_i b_i \left(\frac{L}{n}\right)$$

Simpson's method is used to model the chamber as a stack of elliptical disks.

where:

V = volume in ml
a_i = diameter of major axis of elliptical disk *i* in mm
b_i = diameter of minor axis of elliptical disk *i* in mm
n = number of disks (n = 20)
L = length of the chamber
i = disk index

Left Ventricular Volume: Single Plane Method in ml

Schiller, N.B., Shah, P.M. et al. "Recommendations for Quantitation of the Left Ventricle by Two-Dimensional Echocardiography." *Journal of American Society of Echocardiography*. September-October (1989), 2: p.362.

$$V = \left(\frac{\pi}{4}\right) \sum_{i=1}^{n} a_i^{\,2} \left(\frac{L}{n}\right)$$

Simpson's method is used to model the chamber as a stack of circular disks.

where:

V = volume
a_i = diameter of disk *i* in mm
n = number of disks (n = 20)
L = length of chamber, measured from the midpoint of the line connecting the two opposite sides of the mitral ring and the most distant point (apex) of the chamber contour
i = disk index

Mean Pressure Gradient (PG) in mmHG

Baumgartner, H., Hung, J., et al. "Echocardiographic Assessment of Valve Stenosis: EAE/ASE Recommendations for Clinical Practice". *Journal of American Society of Echocardiography*. January (2009), p. 4-5.

$$PGmean = \frac{4}{N} \sum_{i=1}^{N} v_i^{\,2}$$

where:

v_i = instantaneous traced maximum Doppler velocity at time i (in m/s)

N = the number of evenly distributed times at which the maximum velocity is taken between two delimiters

Mitral Annual Plane Systolic Excursion (MAPSE)

Matos, J., Kronzon, I., et al. "Mitral Annular Plane Systolic Excursion as a Surrogate for Left Ventricular Ejection Fraction." *Journal of the American Society of Echocardiograph* (2012), p.969-974.

M Mode distance measurement of systolic excursion of the left ventricle.

Mitral Valve Area (MVA) by PHT in cm^2

Quinones M, Otto C, et al. *Recommendations for Quantification of Doppler Echocardiography: A Report from the Doppler Quantification Task Force of the Nomenclature and Standards Committee of the American Society of Echocardiography.* (2002), p.176-177.

MVA = 220/PHT

where: PHT = pressure half time

Mitral Valve Area (MVA) by VTI in cm^2

Nakatani, S., Masuyama, T., et al. "Value and limitations of Doppler echocardiography in the quantification of stenotic mitral valve area: comparison of the pressure half-time and the continuity equation methods." *Circulation* (1988), 77: p.78-85.

MVA = Stroke volume/VTI_{mitral}

where:

Stroke volume = Cross Sectional Area of the orifice (LVOT area) * Velocity Time Integral of the orifice (LVOT VTI)

VTI_{mitral} = VTI of flow out of the mitral valve

Pressure Gradient (PGMax) in mmHG

Oh, J.K., Seward, J.B., and A.J. Tajik. *The Echo Manual.* 3rd ed., Philadelphia: Lippincott, Williams, and Wilkins (2007), p.63-66.

PGMax = 4 * $(Velocity)^2$ (velocity units must be meters/second)

Pressure Half Time (PHT) in msec

Teague, S.M., Heinsimer, J.A. et al. "Quantification of aortic regurgitation utilizing continuous wave Doppler ultrasound." *Journal of the American College of Cardiology* (1986), p.592-599.

PHT = DT * 0.29 (time required for the pressure gradient to fall half its maximum level)

where:

DT = Deceleration time

Qp/Qs ratio

Kitabatake, A., Inoue, M. et al. *Noninvasive evaluation of the ratio of pulmonary to systemic flow in atrial septal defect by duplex Doppler echocardiography*, (1984), p.73–79.

Qp/Qs = RSV/LSV

where:

Qp = Pulmonic flow
Qs = Systemic flow
RSV = Right Ventricular Stroke Volume
LSV = Left Ventricular Stroke Volume

Right Atrial Volume: Single Plane Method in ml

Lang, R., Bierig, M., et al. "Recommendations for chamber quantification: a report from the American Society of Echocardiography's guidelines and standards committee and the chamber quantification writing group, Developed in conjunction with the European Association of Echocardiography, a branch of the European Society of Cardiology." *J Am Soc Echocardiogr.*(2005), 18: p.1440–1463.

Lang, R., Badano, L.P. et al. "Recommendations for Cardiac Chamber quantification by Echocardiography in Adults: An update from the American Society of Echocardiography and European Association of Cardiovascular Imaging." *J Am Soc Echocardiogr.* January (2015), 28: p.1–39.

$$V = \left(\frac{\pi}{4}\right) \sum_{i=1}^{n} a_i^2 \left(\frac{L}{n}\right)$$

Simpson's method is used to model the chamber as a stack of circular disks.

where:

V = Volume
a_i = Diameter of disk *i* in mm
n = Number of disks (n = 20)
L = Length of chamber, measured from the midpoint of the line connecting the two opposite sides of the mitral ring and the most distant point (apex) of the chamber contour
i = Disk index

Right Atrial Volume Index in ml/m^2

Darahim, K. "Usefulness of right atrial volume index in predicting outcome in chronic systolic heart failure." *Journal of the Saudi Heart Association*. April (2014), 26(2): p. 73–79.

RA Vol Index = RA Vol/BSA (ml/m^2)

where:

RAVI = Right Atrial Volume Index
RA Vol = Right Atrial Volume in ml
BSA = Body Surface Area in m^2

Right Ventricular Fractional Area Change (FAC) in percent

Lang, R., Badano, L.P. et al. "Recommendations for Cardiac Chamber quantification by Echocardiography in Adults: An update from the American Society of Echocardiography and European Association of Cardiovascular Imaging." *J Am Soc Echocardiogr.* January (2015), 28: p.1–39.

RV FAC (%) = (RV EDA – RV ESA) / RV EDA * 100

where:

RV FAC = Right Ventricular Fractional Area Change (%)
RV EDA = Right Ventricular End-diastolic area (cm^2)
RV ESA = Right Ventricular End-systolic area (cm^2)

Right Ventricular Index of Myocardial Performance (RIMP)

Rudski, L.G., Lai, W.W. et al. "Guidelines for the Echocardiographic Assessment of the Right Heart in Adults: A Report from the American Society of Echocardiography." *J Am Soc Echocardiogr.* (2010), 23: p.685–713.

RIMP = (IVRT + IVCT)/ET

where:

IVCT = Isovolumic Contraction Tme
IVRT = Isovolumic Relaxation Time
ET = Ejection Time

Right Ventricular Systolic Pressure (RVSP) in mmHg

Armstrong, D.WJ., Tsimiklix G., and Matangi, M.F. "Factors influencing the echocardiographic estimate of right ventricular systolic pressure in normal patients and clinically relevant ranges according to age." *Can J Cardiol.* (2010), 26(2): p.e35–e39.

$RVSP = 4 * (TR\ VMax)^2 + RAP$

where:

RAP = Right Atrial Pressure
TR VMax = Tricuspid Regurgitation Maximum Velocity

S/D

Zwiebel, W. J. *Introduction to Vascular Ultrasonography*, 4th Edition. W.B. Saunders Company (2000), p.52.

|S velocity/D velocity|

where:

S velocity = Peak systolic velocity
D velocity= End diastolic velocity

Stroke Index (SI) in cc/m^2

Mosby's Medical, Nursing, & Allied Health Dictionary, 4th ed. (1994), p.1492.

SI = SV/BSA

where:

SV = Stroke Volume
BSA = Body Surface Area

Stroke Volume in ml

Hayashi, T., Kihara, Y. et al. "The Terminology and Diagnostic Criteria Committee of The Japan Society of Ultrasonics in Medicine Standard measurement of cardiac function indexes." *J Med Ultrasonics* (2006), 33: p.123–127.

SV = End Diastolic Volume – End Systolic Volume

Stroke Volume (Doppler) in ml

Porter, T.R., Shillcutt, S.K. et al. "Guidelines for the Use of Echocardiography as a Monitor for Therapeutic Intervention in Adults: A Report from the American Society of Echocardiography." *J Am Soc Echocardiogr* (2015), 28:p.40-56.

SV = (CSA * VTI)

where:

CSA = Cross Sectional Area of the orifice (LVOT area)
VTI = Velocity Time Integral of the orifice

Stroke Volume (Doppler) percent change

Evans, D., Ferraioli, G. et al. "Volume Responsiveness in Critically Ill Patients." AIUM (2014), *J Ultrasound Med.* (2014), 33: p.3–7.

% change SV = [(post SV – pre SV)/post SV] * 100

Stroke Volume (Doppler) percent variation

Miller, A. and J. Mandeville. "Predicting and Measuring Fluid Responsiveness with Echocardiography." *Echo Res Pract.* (2016), 3(2):G1–G12 DOI: 10.1530/ERP–16–0008.

SV % variation = 100 x {(SV Max – SV Min) / [(SV Max + SV Min) x 0.5]}

Tricuspid Annular Plane Systolic Excursion (TAPSE)

Rudski, L., Lai W. et al. "Guidelines for the echocardiographic assessment of the right heart in adults: a report from the American Society of Echocardiography." *J Am Soc Echocardiogr.* (2010), p.685–713.

M Mode distance measurement of systolic excursion of the right ventricle

Velocity Time Integral (VTI) percent change

Evans, D., Ferraioli, G. et al. "Volume Responsiveness in Critically Ill Patients." AIUM (2014), *J Ultrasound Med.* (2014), 33: p.3-7.

% change LVOT VTI = [(post LVOT VTI – pre LVOT VTI)/post LVOT VTI] * 100

Obstetrical references

Amniotic Fluid Index (AFI)

Jeng, C. J., Jou, T.J. et al. "Amniotic Fluid Index Measurement with the Four Quadrant Technique During Pregnancy." *The Journal of Reproductive Medicine*. July (1990), 35:7, p.674-677.

Average Ultrasound Age (AUA)

The system provides an AUA derived from the component measurements.

Biophysical Profile (BPP)

Manning, F.A. "Dynamic Ultrasound-Based Fetal Assessment: The Fetal Biophysical Profile Score." Clinical Obstetrics and Gynecology (1995), Volume 32, Number 1: p.26-44.

Cephalic Index (CI)

Hadlock, F.P., Deter, R.L. et al. "Estimating Fetal Age: Effect of Head Shape on BPD." *American Journal of Roentgenology* (1981), 137: p.83-85.

Estimated Date of Delivery (EDD) by Average Ultrasound Age (AUA)

Results are displayed as month/day/year.

EDD = system date + (280 days – AUA in days)

Estimated Date of Delivery (EDD) by Last Menstrual Period (LMP)

The date entered into the patient information for LMP must precede the current date.

Results are displayed as month/day/year.

EDD = LMP date + 280 days

Estimated Fetal Weight (EFW)

Hadlock, F.P., Harrist, R.B. et al. "Estimation of Fetal Weight with the Use of Head, Body, and Femur Measurements, A Prospective Study." *American Journal of Obstetrics and Gynecology*. February 1 (1985),151:3, p.333-337.

Estimated Fetal Weight percentile (EFW%)

Hadlock, F.P., Harrist, R.B. and J. Martinex-Poyer."In-utero Analysis of Fetal Growth: A Sonographic Weight Standard" *Radiology* (1991), Vol 181: p. 129-133 (Table1).

Gestational Age (GA) by Last Menstrual Period (LMP)

The gestational age derived from the LMP date entered on the patient form.

Results are displayed in weeks and days, and is calculated as follows:

GA (LMP) = System date – LMP date

Gestational Age (GA) by Estimated Due Date (EDD)

The gestational age derived from the EDD date entered on the patient form.

Results are displayed in weeks and days, and is calculated as follows:

GA (EDD) = System date – (EDD – 280)

Gestational age references

Abdominal Circumference (AC)

Hadlock, F.P., Deter, R.L. et al. "Estimating Fetal Age: Computer-Assisted Analysis of Multiple Fetal Growth Parameters." *Radiology*. (1984),152: p.497-501.

Australasian Society for Ultrasound in Medicine (ASUM) Standards of Practice. "Guidelines, Policies and Statements, Normal Ultrasonic Fetal Measurements Standard." (1991, Revised 2018). Variability: +/– 2SD from Westerway, S.C. Fetal-Measurements, Personal Communication (Sep 2019).

Biparietal Diameter (BPD)

Hadlock, F.P., Deter, R.L. et al. "Estimating Fetal Age: Computer-Assisted Analysis of Multiple Fetal Growth Parameters." *Radiology* (1984),152: p.497-501.

Australasian Society for Ultrasound in Medicine (ASUM) Standards of Practice. "Guidelines, Policies and Statements, Normal Ultrasonic Fetal Measurements Standard." (1991, Revised 2018). Variability: +/– 2SD from Westerway, S.C. Fetal-Measurements, Personal Communication (Sep 2019)

Crown Rump Length (CRL)

Hadlock, F.P., Shah, Y.P. et al. "Fetal Crown-Rump Length: Re-evaluation of Relation to Menstrual Age (5-18 weeks) with High-Resolution, Real-Time Ultrasound." *Radiology*. February (1992), 182: p.501-505.

Westerway, S.C., Davison, A., and Cowell, S. "Ultrasonic Fetal Measurements: New Australian standards for the new millennium". *Aust N Z J Obstet Gynaecol.* (2000), 40:297-302, p. 299.

Papageorghiou, A.T., Kennedy, S.H. et al. "International standards for early fetal size and pregnancy dating based on ultrasound measurement of crown-rump length in first trimester of pregnancy." *Ultrasound Obstet Gynecol.* (2014), 44(6): p. 641-8.

Femur Length (FL)

Hadlock, F.P., Deter, R.L. et al. "Estimating Fetal Age: Computer-Assisted Analysis of Multiple Fetal Growth Parameters." *Radiology* (1984), 152: p.497-501.

Australasian Society for Ultrasound in Medicine (ASUM) Standards of Practice. "Guidelines, Policies and Statements, Normal Ultrasonic Fetal Measurements Standard." (1991, Revised 2018). Variability: +/– 2SD from Westerway, S.C. Fetal-Measurements, Personal Communication (Sep 2019).

Gestational Sac (GS)

Hansmann, M., Hackelöer, B.-J. et al. *Ultrasound Diagnosis in Obstetrics and Gynecology*. New York: Springer-Verlag (1986), p.36 (Figure 4.2).

Nyberg, D.A., Hill, L.M. et al. "Transvaginal Ultrasound." *Mosby Yearbook* (1992), p.76.

Gestational sac measurements provide a fetal age based on the mean of one, two, or three distance measurements; however, Nyberg's gestational age equation requires all three distance measurements for an accurate estimate.

Head Circumference (HC)

Hadlock, F.P., Deter, R.L. et al. "Estimating Fetal Age: Computer-Assisted Analysis of Multiple Fetal Growth Parameters." *Radiology* (1984), 152: p.497-501.

Australasian Society for Ultrasound in Medicine (ASUM) Standards of Practice. "Guidelines, Policies and Statements, Normal Ultrasonic Fetal Measurements Standard." Appendix 4. (1991, Revised 2018).

Occipito-Frontal Diameter (OFD)

Hansmann, M., Hackelöer, B.-J. and Staudach, A. *Ultrasound Diagnosis in Obstetrics and Gynecology*. New York: Springer-Verlag (1985), p. 431 (Table 1).

Australasian Society for Ultrasound in Medicine (ASUM) Standards of Practice. "Guidelines, Policies and Statements, Normal Ultrasonic Fetal Measurements Standard." Appendix 4. (1991, Revised 2018).

Ratio calculations

FL/AC Ratio

Hadlock, F.P., Deter, R. L. et al. "A Date Independent Predictor of Intrauterine Growth Retardation: Femur Length/Abdominal Circumference Ratio," *American Journal of Roentgenology*. November (1983), 141: p.979-984.

FL/BPD Ratio

Hohler, C.W. and T.A. Quetel. "Comparison of Ultrasound Femur Length and Biparietal Diameter in Late Pregnancy," *American Journal of Obstetrics and Gynecology*. Dec. 1 (1981),141:7, p.759-762.

FL/HC Ratio

Hadlock, F.P., Harrist, R. B. et al. "The Femur Length/Head Circumference Relation in Obstetric Sonography." *Journal of Ultrasound in Medicine*. October (1984),3: p.439-442.

HC/AC Ratio

Campbell, S. and A. Thoms. "Ultrasound Measurements of the Fetal Head to Abdomen Circumference Ratio in the Assessment of Growth Retardation." *British Journal of Obstetrics and Gynaecology*. March (1977), 84: p.165-174.

General references

+/x or S/D Ratio

+/x = (Velocity A/Velocity B)

where:

A = velocity cursor +
B = velocity cursor x

Area in cm^2

Beyer, W.H. *Standard Mathematical Tables*. 28th ed., CRC Press, Boca Raton, FL. (1987), p.131.

A = abs{0.5 * ∑[x_i y_(i+1) - x_(i+1) y_i]}

where the sum is over the list of points i, with rectilinear coordinates x_i and y_i, that define the traced contour around the area to be computed.

Circumference (ellipse)

$L = \pi(a + b)\ (64 - 3h^4)/(64 - 16h^2)$

where:

h = (a – b)/(a + b)
a = major radius
b = minor radius

Bronshtein, I.N. and K.A. Semendyayev. *Handbook of Mathematics*. 3rd English ed., Van Nostrand Reinhold Co., New York (1985), p. 202.

Hip Angle/d:D Ratio

Graf, R. "Fundamentals of Sonographic Diagnosis of Infant Hip Dysplasia." *Journal of Pediatric Orthopedics* (1984), Vol. 4, No. 6: p.735-740.

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

Peak velocity (VMax)

Walker, D. W., Acker, J. D., and C. A. Cole. "Subclavian steal syndrome detected with duplex pulsed Doppler sonography." *American Journal of Neuroradiology* (1982) 3.6: p. 615-618.

VMax = The maximum velocity magnitude within the period of time corresponding to the measurement tool, where VMax still maintains its +/- sign.

Pulsatility Index (PI)

Petersen, L.J., Petsen, J.R. et al. "The pulsatility index and the resistive index in renal arteries. Associations with long-term progression in chronic renal failure." *Nephrol Dial Transplant* (1997), 12: p.1376-1380.

PI = (PSV – MDV)/V

where:

PSV = Peak systolic velocity
MDV = Minimum diastolic velocity
V = TAP (Time Averaged Peak) flow velocity throughout the cardiac cycle.

Renal Aortic Ratio (RAR)

RAR = peak velocity of the renal artery/peak velocity of the aorta

Kohler, T.R., Zierler, R.E. et al. "Noninvasive diagnosis of renal artery stenosis by ultrasonic diagnosis of renal duplex scanning." *Journal of Vascular Surgery* (1986), Vol. 4, No 5: p. 450–456.

Resistive Index (RI)

~~Petersen, L.J., Petsen, J.R. et al. "The pulsatility index and the resistive index in renal arteries. Associations with long-term progression in chronic renal failure." *Nephrol Dial Transplant* (1997), 12: p.1376–1380.~~

Kurtz, A.B. and W.D. Middleton. *Ultrasound-the Requisites.* Mosby Year Book, Inc. (1996), p.467.

RI = [(Peak Systolic Velocity –End Diastolic Velocity)/ Peak Systolic Velocity)] in cm/s.

Slope in cm/s^2

Slope = abs (delta velocity/delta time)

Zwiebel, W.J. *Introduction to Vascular Ultrasonography*. 4th ed., W.B. Saunders Company (2000), p.52.

Time (ET)

ET = time between velocity cursors in milliseconds

Time Averaged Mean (TAM) in cm/s

TAM = mean (mean Trace)

Time Averaged Peak (TAP) in cm/s

TAP = mean (peak Trace)

Velocity Time Integral (VTI) in cm

Oh, J.K., Seward, J.B., and A.J. Tajik. *The Echo Manual*. 3rd ed., Philadelphia: Lippincott, Williams, and Wilkins (2007), p.69-70.

VTI = Area enclosed by the baseline and Doppler spectrum = abs (Mean Velocity * duration of Doppler Trace)

Volume (Vol)

Beyer, W.H. *Standard Mathematical Tables*. 28th ed., CRC Press, Boca Raton, FL. (1987), p.131.

Volume = $4/3\pi * (D_1/2 * D_2/2 * D_3/2)$

Volume = $4/3\pi * [D_1/2 * (D_2/2)^2]$

Volume = $4/3\pi * (D_1/2)^3$

where:

D = linear distance

Volume Bladder in ml

Bih, L.-I., Ho, C.-C. et al. "Bladder shape impact on the accuracy of ultrasonic estimation of bladder volume." *Arch Phys Med Rehabil.* (1998), 79: p.1553-6.

Bladder volume = Height * transverse depth * width * 0.72 ≡ H*Dt*W*0.72

where:

H, Dt, and W are in cm

Volume Flow in ml/m

Allan, P.L., Pozniak, M.A. et al. *Clinical Doppler Ultrasound.* 4th ed., Harcourt Publishers Limited. (2000), p.36-38

Volume Flow = CSA (cm^2) * TAM (cm/s) * 60

where:

TAM is the calculated Time Averaged Velocity from the mean trace

CSA = Cross Sectional Area of area of anatomy of interest = (π/4) * $(Diameter)^2$, calculated based on 2D distance measurement for diameter.

Volume Ovarian

Balen, A.H., Laven, J.S., et al. "Ultrasound assessment of the polycystic ovary: international consensus definitions." *Human Reproduction Update* (2003), Vol. 9, No. 6, p. 505-514.

Ovarian volume = 4/3π * (Height/2 * Length/2 * Width/2)

Volume Uterine

Wiener, J. J. and R. G. Newcombe. "Measurements of uterine volume: a comparison between measurements by ultrasonography and by water displacement." *J. Clin. Ultrasound* (1992), 20 (7), p.457–460.

Uterine volume = 4/3π * (Height/2 * Length/2 * Width/2)

CHAPTER 11

Troubleshooting and Maintenance

This section contains information to help correct problems with system operation, to enter a software license, and to take proper care of the system, transducer, and accessories.

Troubleshooting

If you encounter difficulty with the system, use the following list to help troubleshoot the problem. In the case of a warning dialogue, perform the suggested action. If the problem persists, contact Fujfilm Sonosite Technical Support (see **"Getting help"** on page 1-2).

- **System does not turn on:**
  - Unplug and plug back in the power supply cables.
  - Check the status of the power indicators (see **page 3-10**). You may be able to narrow the problem to a specific connection.
- **System image quality is poor:**
  - Adjust the monitor to improve viewing angle.
  - Adjust the monitor brightness (see **page 4-28**).
  - Adjust the 2D gain (see **page 6-15**).
  - Adjust 2D power (see **"Power"** on page 6-4)
  - If adjusting the above settings does not improve image quality, assess your transducer's element status by viewing the transducer diagnostics report in the Logs settings page (see **page 4-31**). If the report identifies elements that are performing poorly, close the log and then repeat the transducer diagnostics test by disconnecting all transducers and reconnecting the transducer of interest. You can then review the updated report in the Diagnostics log.
- **No color or CPD image.** Adjust the gain, color power, or the color scale. Color and CPD have a **Hide Color** control. Ensure that this control is not activated.
- **No measurement selections.** Ensure the desired exam type has been selected and that the image is frozen. Press the **CALCS/**  button.

- **No sound.** If you do not hear system sounds when you use the system, make sure that you have configured audio settings correctly (see **page 4-13**). If you still do not hear system sounds, cycle power: turn the system off and back on (see **page 3-7**). Some connections, such as connecting to the HDMI port, turn the system speakers off.

  WARNING Use only accessories and peripherals recommended by Fujfilm Sonosite. Connection of accessories and peripherals not recommended by Fujfilm Sonosite could result in electrical shock and system malfunction.

- **Printing does not work.** If you are printing to a local printer, do any of the following:
  - Check the printer connections. The system will automatically detect the printer.

    Note If you are using the AC printer, the system must be connected to AC mains.

  - Ensure that the local printer is turned on and set up properly. See the printer manufacturer's instructions, if necessary.

  Only saved images and video clips and the current patient's worksheets can be printed.

- **System does not recognize the transducer.**
  - Disconnect and reconnect the transducer.
  - Check that the Triple Transducer Connect (TTC) latch is secured.

- **The assert page appears on screen.** Follow the prompts on the page in the correct order: Note the information in the error message, including the number that appears on the C: line. Contact Fujfilm Sonosite or your Fujfilm Sonosite representative, then restart the system.
- **System prompts you to ensure the USB storage device is valid.**
  - Use the USB storage device included with the system.
  - Make sure that the USB storage device is not defective.
- **System prompts you to ensure the USB storage device contains valid data.** Make sure that the data are present on the USB storage device.

  Re-export the original data onto the USB storage device. Contact your system administrator.
- **USB storage device does not appear in the list.** Check that the USB storage device has been properly inserted into an available USB slot. Use the USB storage device that came with the system.
- **System displays the alert "...internal storage device is full."** Free internal storage space by ending the current study, archiving or exporting patient studies, and then deleting them from the system.
- **Cannot access patient form. Cannot access patient list.** Ensure that you are logged in as a user, not as a guest.

- **System does not export or transfer video clips (DICOM).** In the **Archiver** settings of DICOM Config, make sure that **Exclude video clips** is not checked.

Software licensing

Fujfilm Sonosite software is controlled by a license key. After you install new software, the system prompts you for a license key. You must obtain one key for each system and transducer package that uses the software. Software updates are available on a USB storage device or can be downloaded.

The software will operate for a short time (the grace period) without a license key. During the grace period, all system functions are available. After the grace period, the system is not usable until you enter a valid license key. Grace period time is not used while the system is off or asleep. Grace period time remaining appears on the license update screen.

Caution After the grace period expires, all system functions except licensing are unavailable until you enter a valid license key.

To obtain a license key

1 Turn on the system.

2 Navigate to System Information to gather version information:

   a Tap the menu and then tap **System Settings**.

   b Tap **System Information** in the list on the left and scroll to display System Licensing and Scanhead Licensing.

3 Contact Fujfilm Sonosite Technical Support (see **"Getting help"** on page 1-2). You will be asked for the following information from System Information:

   a Your name

   b System serial number

   The serial number is located on the bottom of the system. To read it, lift up the back end of the system.

   c Software version

   d PCBA serial number

   e Previous license update

4 After you obtain a license key, you must enter it into the system. You can enter it either at startup or in System Settings.

To enter the license key at startup

1 Turn on the system.

The license update appears.

2 Enter the license key in the **Enter license** box.

3 Tap **Enter**.

4 If the license update reappears, verify that you entered the license key correctly. If the license update still appears, contact Fujfilm Sonosite Technical Support (see **"Getting help"** on page 1-2).

To enter the license key in System Settings

1 Tap the ☰ menu, and then tap **System Settings**.

2 Tap **System Information** in the list on the left.

3 Enter the license key in the **Enter license key** area in the **System Licensing** section.

4 Tap **Enter**.

Note Do not tap **Done**. This will close the form without entering the key.

Maintenance

WARNINGS

- No modification of this equipment, except as described in this manual or the *Sonosite PX Service Manual,* is allowed.
- Do not service or perform maintenance procedures on the system while it is in use with a patient.

No periodic or preventive maintenance, testing, or calibration is required for the system, transducer, or accessories other than cleaning and disinfecting transducers and inspecting them for cracks, adequate insulation, and other signs of damage after every use. Make sure that transducers and transducer cables do not have cracks or splitting that allow fluids or gel to enter. For information on cleaning and disinfecting your ultrasound system, see **Chapter 12, "Cleaning and Disinfecting."**

Fujfilm Sonosite recommends that you plug the system in when not in use to fully charge the batteries.

Performing maintenance procedures not described in this document or the service manual may void the product warranty. Contact Fujfilm Sonosite Technical Support for any maintenance questions (see **"Getting help"** on page 1-2).

System backups

To safeguard against loss of data, Fujfilm Sonosite recommends that you routinely back up:

- Patient data
- System configuration settings
- DICOM configuration settings

Patient data

Digital Imaging and Communications in Medicine (DICOM) provides a way to archive patient data by connecting your ultrasound system over a local area network (LAN) with various archivers for storage after every patient study. Fujfilm Sonosite recommends that you configure and use DICOM transfer to prevent patient data loss in the event of a system fault. For more information, see **"About DICOM"** on page 4-14.

If you do not use DICOM networking, then Fujfilm Sonosite recommends that you export patient data to a USB storage device after every study. For more information, see **"USB settings"** on page 4-29.

System configuration settings

In addition to patient data, Fujfilm Sonosite recommends that you back up ultrasound system configuration settings, called presets, after you have fully configured the system and any time you modify these settings. These backups preserve your customized settings in case of a fault in the system. For more information, see **"General settings"** on page 4-27.

Servicing

Your ultrasound system may be repaired or replaced at the manufacturer's discretion. If servicing is necessary, then you must remove the ultrasound system from the stand (see **page 3-5**).

Before the system is shipped to a repair facility, you must take precautions to protect patient data and to preserve your customized settings.

Cautions

- To protect patient privacy, all patient procedure information must be exported to a USB storage device or archived to a secure repository via DICOM transfer and then deleted from the study list.
- You can remove the internal storage device for service purposes, but data on the device is encrypted for HIPAA compliance and will be lost.
- To preserve your configuration settings, export Presets and DICOM settings to a USB storage device and store the device in a secure location.

To prepare your system for service

1. End any in-progress procedures.
2. Export all patient procedure information to a USB storage device or archive it to a DICOM device. For complete instructions, see **"Archiving studies"** on page 9-3 and **"Exporting studies"** on page 9-5.
3. To delete all patient data, tap **Patient List** to access the study list.
4. Tap **Select All** and then tap **Delete**.
5. If using DICOM, delete worklist data by tapping **Worklist** then **Clear**.
6. Export the following items to a USB storage device:
   - System preferences (that is, presets)
   - System log file
   - Assert log file (exporting the assert log file requires administrator access)
   - User log file
   - DICOM log file (DICOM users only)
   - DICOM settings (DICOM users only)

   For information on importing and exporting, see **"Controlling data import and export"** on page 4-8 and **"Importing and exporting connectivity settings"** on page 4-22.
7. Prepare the system for shipping by isolating it from power (see **page 13-7**).

CHAPTER 12

Cleaning and Disinfecting

This section instructs you on how to clean and disinfect the ultrasound system, stand, transducers, and accessories.

Use the Fujfilm Sonosite recommendations when cleaning or disinfecting your ultrasound system, stand, transducer, and accessories. Use the cleaning recommendations in the peripheral manufacturer's instructions when cleaning or disinfecting your peripherals.

The system and transducers must be cleaned and disinfected after each exam. It is important to follow these cleaning and disinfecting instructions without skipping any steps.

See **www.sonosite.com/products/transducers**, for transducer images.

Before getting started

- Follow the disinfectant manufacturer's recommendations regarding appropriate personal protective equipment (PPE), such as **protective eyewear** and **gloves**.
- Inspect the system and transducer to determine that it is free of any unacceptable deterioration, such as corrosion, discoloration, pitting, or cracked seals. If damage is evident, discontinue use, and contact Fujfilm Sonosite or your local representative.
- Confirm that cleaning and disinfecting materials are appropriate for your facility's use. Fujfilm Sonosite tests cleaners and disinfectants for use with Fujfilm Sonosite systems and transducers.
- Disinfectants and cleaning methods listed in this chapter are recommended by Fujfilm Sonosite for efficacy and material compatibility with the products.
- Ensure that the disinfectant type, concentration, and contact time are appropriate for the equipment and application.
- Follow manufacturer recommendations and local regulations, when preparing, using and disposing of chemicals.

Note Do not let contaminating material dry on the transducer. Immediately after use, wipe the transducer using an approved cleaner then follow the detailed cleaning procedures presented in this chapter.

WARNINGS

- Ensure that cleaners and disinfectants are not expired.
- Some cleaners and disinfectants can cause an allergic reaction in some individuals.

Cautions

- Do not allow cleaning solution or disinfectant into the system connectors or transducer connector.
- Do not use strong solvents such as thinner or benzene, or abrasive cleansers, since these will damage the exterior surfaces. Use only Fujfilm Sonosite-approved cleaners or disinfectants.

Determining the required cleaning and disinfecting level

WARNINGS

- The cleaning instructions contained in this chapter are based on requirements mandated by the U.S. Food and Drug Administration (FDA)[a]. Failure to follow these instructions may result in cross contamination and patient infection.
- Even if you have used a transducer cover or sheath, you must follow the instructions to clean and disinfect the transducer.

a. *Reprocessing Medical Devices in Health Care Settings: Validation Methods and Labeling Guidance for Industry and Food and Drug Administration Staff.* Issued March 17, 2015, updated June 9, 2017.

The level of cleaning and disinfecting required for the system, stand, and transducer is determined by the type of tissue they have contacted or will contact during use. Use **Table 12-1** on page 12-3 to determine the level of cleaning and disinfecting required.

Table 12-1: Choosing a cleaning and disinfecting method

Did, or will, any part of the system or transducer come in contact with broken skin or mucosal membranes?	
YES →	**Option A** Go to **"Option A: Clean and disinfect system, stand, and transducer to a high-level (semi-critical uses)"** on page 12-5
NO →	**Option B** Go to **"Option B: Clean and disinfect system, stand, and transducer to a low-level (non-critical uses)"** on page 12-10

Spaulding classifications[a]

Spaulding classifications determine the approach for cleaning and disinfecting medical equipment based on the device, the way it has been used, and the risk of infection.

- **Critical devices:** Critical devices are devices that are introduced directly into the bloodstream, or which contact a normally sterile tissue or body-space during use.
- **Semi-critical devices:** Semi-critical devices are devices that contact intact mucous membranes or non-intact skin.
- **Non-critical devices:** Non-critical devices are instruments and other devices whose surfaces contact only intact skin and do not penetrate it, or do not contact the patient at all but may become contaminated during patient care.

The system and transducers are designed for use within the Spaulding classifications of non-critical and semi-critical uses.

a. Spaulding, E.H. "The Role of chemical disinfection in the prevention of nosocomial infections". In: Brachman, P.S. and Eickof, T.C. (ed). Proceedings of International Conference on Nosocomial Infections, (1970). Chicago, IL: American Hospital Association, (1971), p. 254-274.

Cleaning and disinfection definitions[b]

- **Cleaning:** Physical removal of soil and contaminants from an item to the extent necessary for further processing or for the intended use
- **Low-level disinfection:** A lethal process using an agent that kills vegetative forms of bacteria, some fungi, and lipid viruses
- **Intermediate disinfection:** A lethal process using an agent that kills viruses, mycobacteria, fungi and vegetative bacteria, but no bacterial spores
- **High-level disinfection:** A lethal process using a sterilant under less than sterilizing conditions. The process kills all forms of microbial life except for large numbers of bacterial spores.

b. *Reprocessing Medical Devices in Health Care Settings: Validation Methods and Labeling Guidance for Industry and Food and Drug Administration Staff.* Issued March 17, 2015, updated June 9, 2017.

Option A: Clean and disinfect system, stand, and transducer to a high-level (semi-critical uses)

Use this procedure to clean and high-level disinfect the ultrasound system and transducer **whenever they have, or will, come into contact with broken skin or mucosal membranes**.

Follow the manufacturer's instructions when using cleaners and disinfectants. The cleaners and disinfectants listed in the procedure are both chemically compatible and have been tested for efficacy with the system and transducers. Confirm that the cleaners and disinfectants are appropriate for your facility's use.

WARNINGS

- To avoid electrical shock before cleaning, turn off the system and disconnect it from the power supply.
- Wear the appropriate personal protective equipment (PPE) recommended by the chemical manufacturer, such as **protective eyewear** and **gloves**.

Cautions

- Do not skip any steps or abbreviate the cleaning and disinfecting process in any way.
- Do not spray cleaners or disinfectants directly on the system surfaces or on system and transducer connectors. Doing so may cause solution to leak into the system, damaging it and voiding the warranty.
- Do not attempt to disinfect a transducer or transducer cable using a method that is not included here. Do not use a chemical not listed in this guide or on **www.sonosite.com/sales-support/cleaners-disinfectants**. This can damage the transducer and void the warranty.
- Use only Fujfilm Sonosite-approved cleaners and disinfectants. Using a non-approved disinfecting solution or incorrect solution strength can damage the system and transducer and void the warranty. Follow the disinfectant manufacturer's recommendations for solutions strengths.

Note After every use, you must clean and disinfect both the ultrasound system, stand, and transducer (up to an intermediate level). However, only the transducer can be disinfected to a high-level.

To clean and disinfect the system, stand, and transducer

1 **Turn off** the system by pressing the Power button.

2 **Unplug** the power cord from the outlet.

3 **Remove** the disposable transducer sheath, if applicable.

4 **Disconnect** the transducer from the system. Temporarily place it where it will not cross-contaminate clean equipment or surfaces while you clean the ultrasound system.

5 **Remove** the system from the stand if you need to clean between the system and the platform (see page 3-5).

6 **Clean** the exterior surfaces of the **ULTRASOUND SYSTEM** to remove any debris. Use the following procedure:

a Use either a pre-moistened wipe or a soft cloth dampened with cleaner or a low- or intermediate-level disinfectant. Choose a cleaner from the list of approved cleaners in **Table 12-2**.

Table 12-2: Approved cleaners/intermediate-level disinfectants for the system, stand, platform, and all transducers

Product[a, b]
SaniCloth Prime
SaniCloth Bleach
Oxivir TB

a. Refer to the manufacturer's instructions for concentration, temperature, and duration.
b. For a complete list of approved cleaners and disinfectants, refer to the cleaners and disinfectants tool available at **www.sonosite.com/sales-support/cleaners-disinfectants.**

b Remove all gel and debris, from the system.

c With a new wipe, clean the system, including the displays, by wiping from clean areas to soiled areas. This method helps to avoid cross-contamination.

Caution Do not use over-saturated wipes to clean the system. Over-saturated wipes may cause liquid to leak into the system.

d Refer to manufacturer's instructions for the wet contact time. Monitor the system for wet appearance. Reapply with a new wipe if no longer wet.

e Allow the ultrasound system to air dry in a clean, well-ventilated space.

Note If the cleaner leaves a residue on the system's surfaces, wipe with distilled water or a clean, dry cloth.

7 **Clean** the ultrasound system **STAND AND PLATFORM** using the following procedure:

a Use either a pre-moistened wipe or a soft cloth dampened with cleaner or a low- or intermediate-level disinfectant. Choose a cleaner from the list of approved cleaners in **Table 12-2** on page 12-6.

b Remove all gel and debris from the system.

c With a new wipe, clean the stand and platform by wiping from clean areas to soiled areas. This method helps to avoid cross-contamination.

d Refer to manufacturer's instructions for the wet contact time. Monitor the stand for wet appearance. Reapply with a new wipe if no longer wet.

e Allow the stand and platform to air dry in a clean, well-ventilated space.

8 Clean the **TRANSDUCER CABLE AND BODY** to remove any debris. Use the following procedure:

a Use either a pre-moistened wipe or a soft cloth dampened with cleaner or a low- or intermediate-level disinfectant. Choose a cleaner from the list of approved cleaners in **Table 12-2** on page 12-6.

b Remove all gel and debris from the transducer.

c With a new wipe, clean the cable and transducer, starting from the cable, wiping toward the scanhead. This method helps to avoid cross-contamination.

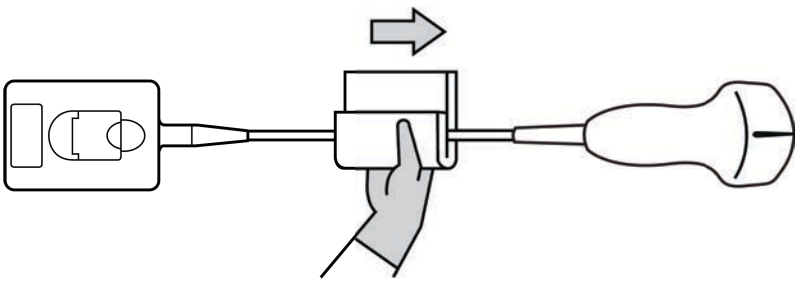


Figure 12-1 Wiping the cable and transducer

Caution Do not allow moisture near the electronic components of the connector.

d Refer to manufacturer's instructions for the wet contact time. Monitor the transducer for wet appearance. Reapply with a new wipe if no longer wet.

9 Verify that all gel and debris have been removed from the system, stand, and transducer. If necessary, repeat steps 6, 7, and 8 with a new wipe.

WARNING Failure to remove all gel and debris could leave contaminants on the transducer.

10 Prepare the high-level disinfectant for use.

a Choose a high-level disinfectant from the list of approved disinfectants.

High-level disinfectants compatible with Sonosite PX transducers:

Product[a, b]	Compatible transducers
Cidex OPA	C5-1, IC10-3, L12-3, L15-4, L19-5, P5-1
Revital-Ox RESERT	C5-1, IC10-3, L12-3, L15-4, L19-5, P5-1

a. Refer to the manufacturer's instructions for concentration, temperature, and duration.
b. For a complete list of approved cleaners and disinfectants, refer to the cleaners and disinfectants tool available at **www.sonosite.com/sales-support/cleaners-disinfectants**.

b **Check** the expiration date on the bottle to ensure that the disinfectant has not expired.

c **Check** that the disinfection chemical has the concentration recommended by the manufacturer (for example, use a **chemical strip test**).

d **Check** that the temperature of the disinfectant is within the manufacturer's recommended limits.

11 **Perform** a high-level disinfection of the transducer by immersing the transducer in a high-level disinfectant and ensuring that the connector and at least 12 inches (31 cm) of the connecting cable remain out of the fluid (see **Figure 12-2** on page 12-9).

Cautions

- Do not soak the transducer longer than recommended by the chemical manufacturer.
- Do not immerse the transducer connector in any disinfecting solution.
- Use only Fujfilm Sonosite-approved cleaners and disinfectants. Using a non-recommended disinfecting solution or incorrect solution strength can damage or discolor the transducer and void the warranty.

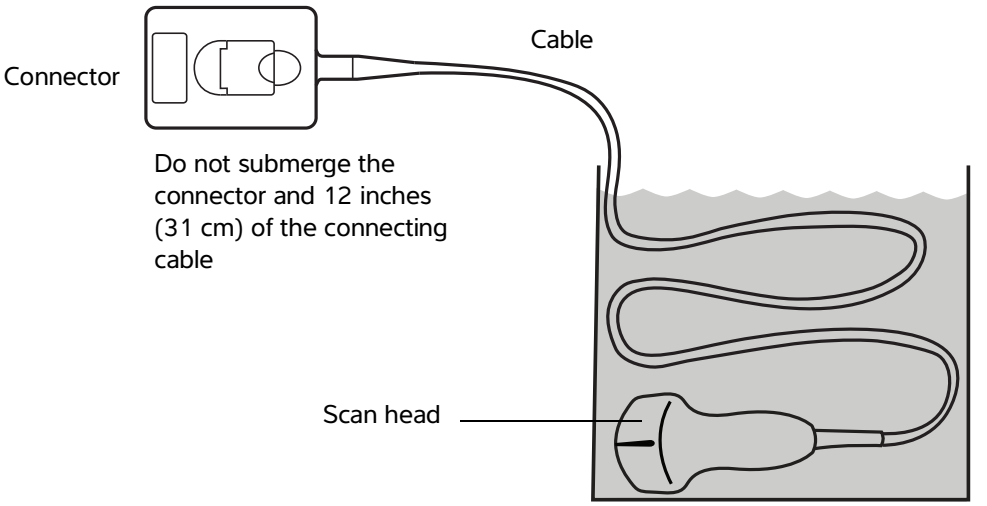


Figure 12-2 Soaking the transducer in high-level disinfectant

WARNING High-level disinfectants can cause harm to the patient if not completely removed from the transducer. Follow the manufacturer's rinse instructions to remove chemical residue.

12 Rinse the transducer **three separate times** in clean, running water or in a basin filled with clean water according to the disinfectant manufacturer's instructions, ensuring that the connector and at least 12 inches (31 cm) of the connecting cable remain out of the fluid.

13 Dry the transducer with a sterile, lint-free cloth.

14 Dispose of the disinfectant according to the manufacturer's guidelines.

15 Examine the transducer and cable for damage, such as cracks or splitting where fluid can enter.

If damage is evident, discontinue use of the transducer, and contact Fujfilm Sonosite or your local representative.

Option B: Clean and disinfect system, stand, and transducer to a low-level (non-critical uses)

Use the following procedure to clean and disinfect the ultrasound system and transducer **if they have not, or will not, come into contact with broken skin or mucosal membranes**.

WARNING If the system or transducer has come into contact with any of the following, use the high-level cleaning and disinfection procedure. See **"Option A: Clean and disinfect system, stand, and transducer to a high-level (semi-critical uses)"** on page 12-5.

- Broken skin
- Mucosal membranes

Follow the manufacturer's instructions when using cleaners and disinfectants. The cleaners and disinfectants listed in the procedure are both chemically compatible and have been tested for efficacy with the system and transducers. Confirm that the cleaners and disinfectants are appropriate for your facility's use.

WARNINGS

- To avoid electrical shock, before cleaning, turn off the system, and disconnect it from the power supply.
- Wear the appropriate personal protective equipment (PPE) recommended by the chemical manufacturer, such as **protective eyewear** and **gloves**.

Cautions

- Do not skip any steps or abbreviate the cleaning and disinfecting process in any way.
- Do not spray cleaners or disinfectants directly on the system surfaces or on system and transducer connectors. Doing so may cause solution to leak into the system, damaging it and voiding the warranty.
- Do not attempt to disinfect a transducer or transducer cable using a method that is not included here. Do not use a chemical not listed in this guide or on **www.sonosite.com/sales-support/cleaners-disinfectants**. This can damage the transducer and void the warranty.
- Use only Fujfilm Sonosite-approved cleaners and disinfectants. Using a non-approved disinfecting solution or incorrect solution strength can damage the system and transducer and void the warranty. Follow the disinfectant manufacturer's recommendations for solutions strengths.

To clean and disinfect the system, stand, and transducer

1 **Turn off** the system by pressing the Power button.

2 **Unplug** the power cord from the outlet.

3 **Remove** the transducer sheath, if applicable.

4 **Disconnect** the transducer from the system. Temporarily place it where it will not cross-contaminate clean equipment or surfaces while you clean the ultrasound system.

5 **Remove** the system from the stand if you need to clean between the system and the platform (see page 3-5).

6 **Clean** the exterior surfaces of the **ULTRASOUND SYSTEM** to remove any debris. Use the following procedure:

a Use either a pre-moistened wipe or a soft cloth dampened with cleaner or a low- or intermediate-level disinfectant. Choose a cleaner from the list of approved cleaners in **Table 12-3**.

Table 12-3: Approved cleaners/intermediate-level disinfectants for the system, stand, platform, and all transducers:

Product[a, b]
SaniCloth Prime
SaniCloth Bleach
Oxivir TB

a. Refer to the manufacturer's instructions for concentration, temperature, and duration.
b. For a complete list of approved cleaners and disinfectants, refer to the cleaners and disinfectants tool available at **www.sonosite.com/sales-support/cleaners-disinfectants**.

b Remove all gel and debris from the system.

c With a new wipe, clean the system, including the displays, by wiping from clean areas to soiled areas. This method helps to avoid cross-contamination.

Caution Do not use over-saturated wipes to clean the system. Over-saturated wipes may cause liquid to leak into the system.

d Refer to manufacturer's instructions for the wet contact time. Monitor the system for wet appearance. Reapply with a new wipe if no longer wet.

7 **Clean** the surfaces of the ultrasound system **STAND AND PLATFORM** using the following procedure:

a Use either a pre-moistened wipe or a soft cloth dampened with cleaner or a low- or intermediate-level disinfectant. Choose a cleaner from the list of approved cleaners in **Table 12-3** on page 12-11.

b Remove all gel and debris from the system.

c With a new wipe, clean the stand and platform by wiping from clean areas to soiled areas. This method helps to avoid cross-contamination.

d Refer to manufacturer's instructions for the wet contact time. Monitor the stand for wet appearance. Reapply with a new wipe if no longer wet.

e Allow the stand and platform to air dry in a clean, well-ventilated space.

8 Clean the **TRANSDUCER CABLE AND BODY** to remove any debris. Use the following procedure:

a Use either a premoistened wipe or a soft cloth dampened with cleaner or a low- or intermediate-level disinfectant. Choose a cleaner from the list of approved cleaners in **Table 12-3** on page 12-11.

b Remove all gel and debris from the transducer.

c With a new wipe, clean the cable and transducer, starting from the cable, wiping toward the scanhead. This method helps to avoid cross-contamination.

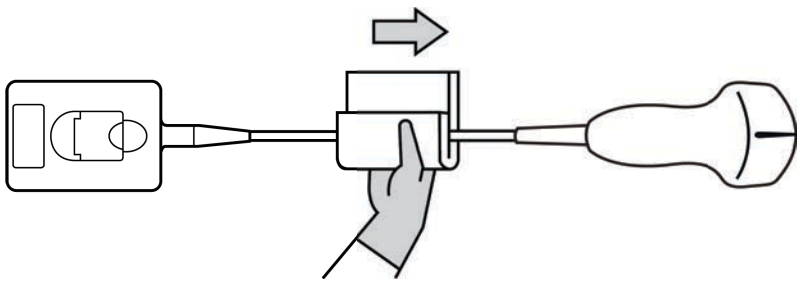


Figure 12-3 Wiping the cable and transducer

Caution Do not allow moisture near the electronic components of the connector.

d Refer to manufacturer's instructions for the wet contact time. Monitor the transducer for wet appearance. Reapply with a new wipe if no longer wet.

9 Verify that all gel and debris have been removed from the system, stand, and transducer. If necessary, repeat steps 6, 7, and 8 with a new wipe.

10 Remove residual cleaner from the transducer by wiping with a sterile cloth or sponge moistened with sterile water.

To thoroughly remove any residue, you may want to rinse the transducer three separate times in clean, running water or in a basin filled with clean water. Make sure that the connector and at least 12 inches (31 cm) of the connecting cable remain out of the fluid.

11 **Allow** the ultrasound system, including all surfaces and transducer, to air dry in a clean, well-ventilated space.

Note If the cleaner leaves a residue on the system's surfaces, wipe with distilled water or a clean, dry cloth.

12 **Examine** the system, transducer and cable for damage, such as cracks or splitting where fluid can enter.

If damage is evident, do not use the transducer. Instead, contact Fujfilm Sonosite or your local representative.

Storing the transducer

To store the transducer

1 Make sure the transducer has been cleaned and disinfected as detailed in the previous section.

2 Store the transducer so that it hangs freely and vertically, and observe the following precautions:

- Store the transducer away from any contaminated transducers.
- Store the transducer in an environment that is safe and has good airflow. Do not store the transducer in closed containers or where condensation may occur.
- Avoid direct sunlight and exposure to x-rays. Recommended storage temperature range is between 0^{o} C (32^{o} F) and $+45^{o}$ C (113^{o} F).
- If using a wall-mounted rack for storage, ensure that:
  - It is securely mounted.
  - The storage slots do not mar the transducer or cause damage to the cable.
  - The rack is sized and positioned to prevent the transducer from inadvertently falling.
  - Make sure the connector is supported and secure.

Transporting the transducer

When transporting the transducer, you must take precautions to protect the transducer from damage and avoid cross-contamination. Be sure to use a container approved by your organization.

To transport a soiled transducer for cleaning

A soiled transducer is one that has been contaminated and must be cleaned before using it in an exam.

1 Place the transducer in a clean, approved container.

WARNING To prevent cross-contamination or unprotected exposure of personnel to biological material, containers used to transport contaminated transducers should carry an ISO biohazard label similar to the following:

Caution Ensure the transducer is dry before placing it in a closed container. Condensation from a damp transducer can damage the connector.

2 Transport the transducer in the container to the point of processing. Do not open the container until the transducer is ready to be cleaned.

Caution Do not leave the transducer in a sealed container for long periods of time.

To transport a clean transducer

A clean transducer is one that has completed the cleaning and disinfection process, has been stored properly, and is ready to be used in an examination.

1 Place the transducer in a clean, approved container. To identify the transducer as clean, containers used to transport clean transducers should carry a cleanliness verification sticker or certificate.

2 Transport the transducer in the container to the point of use. Do not open the container until the transducer is ready to be used.

To ship a transducer

WARNING Whenever possible, avoid shipping a contaminated transducer. Before shipping, ensure the transducer has been cleaned and disinfected using the steps detailed in this chapter or according to special instructions received from Fujfilm Sonosite. If you are returning the transducer to Fujfilm Sonosite, document the disinfection on a "Declaration of Cleanliness," and attach it to the packing list.

1 Place the transducer in the shipping container and seal it. Do not allow any part of the transducer to protrude from the container.

2 Ship the transducer using the following precautions:

- Clearly label the container as fragile.

- Do not stack items on top of the shipping container.
- Do not exceed the shipping temperature range: -35° C (-31° F) to +65° C (149° F).
- Do not open the shipping container until it reaches its final destination.
- After arrival, the transducer must be cleaned and disinfected before it can be used in an exam.

Cleaning and disinfecting accessories

Clean accessories prior to disinfecting. You can disinfect the exterior surface of accessories using an approved disinfectant. Refer to the cleaners and disinfectants tool available at **www.sonosite.com/sales-support/cleaners-disinfectants**.

The following procedure applies to most Sonosite PX accessories. For detailed instructions, see the accessory user guide or use the cleaning and disinfecting recommendations in the peripheral manufacturer's instructions.

WARNING To avoid electrical shock, always disconnect the power supply before cleaning the PowerPark.

To clean and disinfect accessories

1. If necessary, unplug the power supply, and detach any cables.
2. Clean the exterior surfaces of the accessory using a pre-moistened wipe or soft cloth lightly dampened with an approved cleaner or mid-level disinfectant.

   Apply the solution to the cloth rather than the surface.
3. With a new wipe or moistened cloth, wipe the surfaces by wiping from clean areas to soiled areas
4. Air dry or towel dry with a clean cloth.

CHAPTER 13

Safety

This section contains general safety information that applies to the ultrasound system, transducers, accessories, and peripherals.

Ergonomic safety

These scanning guidelines are intended to assist you in the comfortable and effective use of your ultrasound system.

WARNINGS

- To prevent musculoskeletal disorders, follow the guidelines in this section.
- Use of an ultrasound system may be linked to musculoskeletal disorders (MSDs).[a,b,c]
- Use of an ultrasound system is defined as the physical interaction between the operator, the ultrasound system, and the transducer.
- When using an ultrasound system, as with many similar physical activities, you may experience occasional discomfort in your hands, fingers, arms, shoulders, eyes, back, or other parts of your body. However, if you experience symptoms such as constant or recurring discomfort, pain, throbbing, aching, tingling, numbness, burning sensation, or stiffness, do not ignore these warning signs. Promptly see a qualified health professional. Symptoms such as these can be linked with MSDs. MSDs can be painful and may result in potentially disabling injuries to the nerves, muscles, tendons, or other parts of the body. Examples of MSDs include carpal tunnel syndrome and tendonitis.

a. Magnavita, N., L. Bevilacqua, P. Mirk, A. Fileni, and N. Castellino. "Work-related Musculoskeletal Complaints in Sonologists." *Occupational Environmental Medicine*. 41:11 (1999), p. 981–988.

b. Craig, M. "Sonography: An Occupational Hazard?" *Journal of Diagnostic Medical Sonography.* 3 (1985), p.121–125.
c. Smith, C.S., G.W. Wolf, G. Y. Xie, and M. D. Smith. "Musculoskeletal Pain in Cardiac Ultrasonographers: Results of a Random Survey." *Journal of American Society of Echocardiography.* (May1997), p. 357–362.

WARNING While researchers are not able to definitively answer many questions about MSDs, there is a general agreement that certain factors are associated with their occurrence including preexisting medical and physical conditions, overall health, equipment and body position while doing work, frequency of work, duration of work, and other physical activities that may facilitate the onset of MSDs[a]. This section provides guidelines that may help you work more comfortably and may reduce your risk of MSDs[b,c].

a. Wihlidal, L.M. and S. Kumar. "An Injury Profile of Practicing Diagnostic Medical Sonographers in Alberta." *International Journal of Industrial Ergonomics.* 19 (1997), p.205–216.
b. Habes, D.J. and S. Baron. "Health Hazard Report 99-0093-2749." *University of Medicine and Dentistry of New Jersey.* (1999).
c. Vanderpool, H.E., E.A. Friis, B.S. Smith, and K.L. Harms. "Prevalence of Carpal Tunnel Syndrome and Other Work-related Musculoskeletal Problems in Cardiac Sonographers." *Journal of Medicine.* 35:6 (1993), p. 605–610.

Position the system

Minimize eye and neck strain

- If possible, position the system within reach.
- Adjust the angle of the clinical monitor or touch panel to minimize glare.
- Adjust the height so that the clinical monitor is at or slightly below eye level.

Position yourself

Support your back during an exam

- Use a chair that supports your lower back, that adjusts to your work surface height, that promotes a natural body posture, and that allows quick height adjustments.
- Always sit or stand upright. Avoid bending or stooping.

Minimize reaching and twisting

- Use a bed that is height adjustable.
- Position the patient as close to you as possible.
- Face forward. Avoid twisting your head or body.
- Move your entire body front to back, and position your scanning arm next to or slightly in front of you.

- Stand for difficult exams to minimize reaching.
- Position the monitor directly in front of you.

Promote comfortable shoulder and arm postures

- Keep your elbow close to your side.
- Relax your shoulders in a level position.
- Support your arm using a support cushion or pillow, or rest it on the bed.

Promote comfortable hand, wrist, and finger postures

- Hold the transducer lightly in your fingers.
- Minimize the pressure applied on the patient.
- Keep your wrist in a straight position.

Take breaks, exercise, and vary activities

- Minimizing scanning time and taking breaks can effectively allow your body to recover from physical activity and help you avoid MSDs. Some ultrasound tasks may require longer or more frequent breaks. However, simply changing tasks can help some muscle groups relax while others remain or become active.
- Work efficiently by using the software and hardware features correctly.
- Keep moving. Avoid sustaining the same posture by varying your head, neck, body, arm, and leg positions.
- Do targeted exercises. Targeted exercises can strengthen muscle groups, which may help you avoid MSDs. Contact a qualified health professional to determine stretches and exercises that are right for you.

Electrical safety

This system meets EN 60601-1, Class I/internally-powered equipment requirements and Type BF (transducers) isolated patient-applied parts safety requirements.

The system complies with the safety and EMC standards listed in the Standards section of this document (see **page 13-32**).

For maximum safety observe the following warnings and cautions.

WARNINGS

- To avoid discomfort or minor risk of patient injury, keep hot surfaces away from the patient.
- To avoid the risk of injury, do not operate the system in the presence of flammable gases or anesthetics. Explosion can result.
- To avoid the risk of electrical shock or injury, do not open the system enclosures. All internal adjustments and replacements, except battery replacement, must be made by a qualified technician.

WARNING To avoid the risk of electrical shock:

- Use only properly grounded equipment. Shock hazards exist if the power supply is not properly grounded. Grounding reliability can only be achieved when equipment is connected to a receptacle marked "Hospital Only", "Hospital Grade", or the equivalent. Do not remove or defeat the grounding wire.
- Connect this equipment to a supply mains with protective earth.
- When using the system in an environment where the integrity of the protective earth conductor arrangement is in doubt, operate the system on battery power only without using the power supply.
- Do not let any part of the system (including the power supply or power supply connector), except for the transducer, touch the patient.
- Do not touch the system, stand, or connected accessories (except for patient applied parts) while you are touching the patient.
- Do not touch any of the following:
  - The signal input/output connectors on the system and the stand.
  - The system battery contacts (inside the battery compartment).
  - The transducer connector on the bottom of the system when the system is used off the stand and the transducer is disconnected.
  - Any unused transducer connector when the system is installed on the stand.
- Do not connect the system's AC power cord to mains power using an MPSO (power strip) or extension cord.
- Before using the transducer, inspect the transducer face, housing, and cable. Do not use the transducer if the transducer or cable is damaged.
- Turn the system off and disconnect the power supply from the system before cleaning the system.
- Do not use any transducer that has been immersed beyond the specified cleaning or disinfection level. See **Chapter 12, "Cleaning and Disinfecting."**
- Use only accessories and peripherals recommended by Fujfilm Sonosite, including the power supply. Connection of accessories and peripherals not recommended by Fujfilm Sonosite could result in electrical shock. Contact Fujfilm Sonosite or your local representative for a list of accessories and peripherals available from or recommended by Fujfilm Sonosite.
-

WARNINGS

- To avoid the risk of electrical shock and fire hazard:
  - Inspect the AC power cords, cables, and plugs on a regular basis. Ensure that they are not damaged.
  - The power cord set that connects the power supply of the ultrasound system or the stand to mains power must only be used with the power supply, and cannot be used to connect other devices to mains power.
- To prevent injury to the operator/bystander, the transducer must be removed from patient contact before the application of a high-voltage defibrillation pulse.
- Because the only method of completely removing AC power from the stand is to disconnect the AC input power cord from the stand base, ensure that you place the stand in a location in which you can easily remove the AC input power cord if necessary.
- Failures in the electrical safety design of connected devices may result in a voltage on the ultrasound system. To minimize the risk of electrical shock to the patient and/or operator:
  - Use medical-grade devices.
  - After connections are made, test the electrical safety utilizing biomedical department electrical safety procedures.
- Under certain conditions, the area where the system docks to the stand may become hot to the touch. Use caution when handling.

Cautions

- Do not use the system if an error message appears on the image display: note the error code; call Fujfilm Sonosite or your local representative; turn off the system by pressing and holding the power key until the system powers down.
- To avoid increasing the system and transducer connector temperature, do not block the airflow to the ventilation openings on the front and back of the system.
- If the system overheats, it will shut down automatically.
- If the system's handle becomes too hot to touch, allow the system to cool for a few minutes before relocation or use gloves for protection.

Note A potential equalization terminal compliant with IEC 60601-1, subclause 8.6.7 is provided at the base of the system to be used in situations where potential equalization bonding is required at the site of installation.

Electrical safety classification

Class I equipment	The ultrasound system is classified as Class I equipment when powered from the external power supply or mounted on the stand because the external power supply is a Class 1 protectively earthed power supply.
Internally powered equipment	The ultrasound system is classified as internally powered equipment when powered from internal battery packs (not connected to AC power).
Type BF applied parts	Ultrasound transducers
Ingress protection IPX0	Ultrasound system (on the stand)
Ingress protection IP22	Ultrasound system (off the stand)
Ingress protection IPX7	Ultrasound transducers
Non AP/APG	Ultrasound system including power supply, stand elements, and connected peripherals is not suitable for use in the presence of flammable anaesthetic mixture with air or oxygen or nitrous oxide.
Mode of operation	Continuous

Isolating the ultrasound system and stand from power

The Sonosite PX ultrasound system does not become completely isolated from power by pressing the power button. Follow the procedure below to completely isolate the system (including the stand) from power.

To isolate the system and stand from power

1 Press the power button.

2 Listen for the audio tone.

Caution Unplugging the AC power cord before you hear the tone may result in loss of data. If you don't hear a tone, then your system may be set up to mute all sounds. To reinstate sounds, see **"Audio settings"** on page 4-13.

3 If the system is connected to AC power, unplug the AC power cord from the mains outlet.

4 Do one of the following:

- If the system is docked to the stand, remove it from the stand.
- If the system is being used off the stand, disconnect the portable power supply from the system.

5 Disconnect any devices attached to the system ports, including transducers (see page 3-23).

6 Remove the batteries from the system (see page 3-8).

Equipment safety

To protect your ultrasound system, transducer, and accessories, follow these precautions.

WARNING When transporting your system, to avoid possible injury from the system tipping, always lower the clinical monitor and push forward on the bar on the platform instead of pushing downward on the bar or pushing the clinical monitor.

Cautions

- Excessive bending or twisting of cables can cause a failure or intermittent operation.
- Improper cleaning or disinfecting of any part of the system can cause permanent damage. For cleaning and disinfecting instructions, see **Chapter 12, "Cleaning and Disinfecting."**
- Do not submerge the transducer connector in solution. The cable is not liquid-tight beyond the transducer connector/cable interface.
- Do not use solvents such as thinner or benzene, or abrasive cleaners on any part of the system.
- Do not spill liquid on the system.
- Position the system to allow access to the mains power-cord connector.

Battery safety

To prevent the batteries from bursting, igniting, or emitting fumes and causing personal injury or equipment damage, observe the following precautions.

WARNINGS

- The battery has a safety device. Do not disassemble or alter the battery.
- Charge the batteries only when the ambient temperature is between 0° and 40°C (32° and 104°F).
- Do not short-circuit the battery by directly connecting the positive and negative terminals with metal objects.

WARNINGS

- Do not touch battery contacts.
- Do not heat the battery or discard it in a fire.
- Do not expose the battery to temperatures over 60°C (140°F). Keep it away from fire and other heat sources.
- Do not charge the battery near a heat source, such as a fire or heater.
- Do not leave the battery in direct sunlight.
- Do not pierce the battery with a sharp object, hit it, or step on it.
- Do not use a damaged battery.
- Do not solder a battery.
- The polarity of the battery terminals are fixed and cannot be switched or reversed. Ensure that the batteries are in the correct orientation.
- Do not connect the battery to an electrical power outlet.
- Do not continue recharging the battery if it does not recharge after two successive six hour charging cycles. Replace the battery.
- Do not ship a damaged battery without instructions from Fujfilm Sonosite Technical Support. Refer to **"Getting help"** on page 1-2.
- If the battery leaks or emits an odor, remove it from all possible flammable sources.

Cautions

- Do not immerse the battery in water or allow it to get wet.
- Do not put the battery into a microwave oven or pressurized container.
- If the battery emits an odor or heat, is deformed or discolored, or in any way appears abnormal during use, recharging or storage, immediately remove it and stop using it. If you have any questions about the battery, consult Fujfilm Sonosite or your local representative.
- Use only Fujfilm Sonosite batteries.
- Periodically, check to make sure that the battery charges fully. If the battery fails to charge fully, replace it.
- Do not use or charge the battery with non-Fujfilm Sonosite equipment. Only charge the system battery with the system.

Clinical safety

WARNINGS

- To avoid injury, inspect all fasteners and connections.
- Fujfilm Sonosite does not recommend the use of high-frequency electromedical devices in proximity to its systems. Fujfilm Sonosite equipment has not been validated for use with high-frequency electrosurgical devices or procedures. Use of high-frequency electrosurgical devices in proximity to its systems may lead to abnormal system behavior or shutdown of the system. To avoid the risk of a burn hazard, do not use the transducer with high frequency surgical equipment. Such a hazard may occur in the event of a defect in the high frequency surgical neutral electrode connection.
- The maximum temperature of the transducer scan head may be greater than 41 °C (105.8 °F), but is less than 43 °C (109.4 °F) when in contact with the patient. Special precautions should be considered when using the transducer on children or on other patients who are sensitive to higher temperatures.
- Do not use the system if it exhibits erratic or inconsistent behavior. Discontinuities in the scanning sequence are indicative of a hardware failure that must be corrected before use.
- Some transducer sheaths contain natural rubber latex and talc, which can cause allergic reactions in some individuals. Fujfilm Sonosite recommends identifying your latex- and talc-sensitive patients and being prepared to treat allergic reactions promptly.
- Perform ultrasound procedures prudently. Use the ALARA (as low as reasonably achievable) principle and follow the prudent use information concerning MI and TI.
- Fujfilm Sonosite does not currently recommend a specific brand of acoustic standoff. If an acoustic standoff is used, it must have a minimum attenuation of .3dB/cm/MHz.
- Use market-cleared, sterile transducer sheaths and sterile coupling gel for transrectal, transvaginal, or guided-needle procedures. Do not apply the transducer sheath and coupling gel until you are ready to perform the procedure. After use, remove and discard the single-use sheath, and clean and disinfect the transducer using a Fujfilm Sonosite recommended disinfectant.

WARNINGS

- To avoid injury or reduce the risk of infection to the patient, observe the following:
  - Follow Universal Precautions when inserting and maintaining a medical device for interventional procedures.
  - Appropriate training in interventional procedures as dictated by current relevant medical practices as well as in proper operation of the ultrasound system and transducer is required. During vascular access, the potential exists for serious complications including without limitation the following: pneumothorax, arterial puncture, and guidewire misplacement.
- To avoid applying unsafe voltage levels to the patient while a device is connected to the digital video out port, do not touch the ultrasound system and the patient simultaneously. Check the electrical safety of your system with a trained biomedical engineer.

Hazardous materials

WARNING Products and accessories may contain hazardous materials. When disposing of products and accessories, be environmentally responsible and meet federal and local regulations for disposing hazardous materials.

Electromagnetic compatibility

The ultrasound system has been tested, evaluated, and verified to comply with the electromagnetic compatibility limits for medical devices to IEC 60601-1-2:2014 (Edition 4). The ultrasound system is suitable for use in the professional healthcare facility environment except for near active high frequency surgical equipment or in a RF shielded room where magnetic resonance imaging is performed because both produce high electromagnetic disturbances which could result in performance disruption of the ultrasound system. These limits are designed to provide reasonable protection against harmful interference in a typical medical installation.

WARNING To avoid the risk of increased electromagnetic emissions or decreased immunity, use only accessories and peripherals recommended by Fujfilm Sonosite. Connection of accessories and peripherals not recommended by Fujfilm Sonosite could result in malfunctioning of your ultrasound system or other medical electrical devices in the area. Contact Fujfilm Sonosite or your local representative for a list of accessories and peripherals available from or recommended by Fujfilm Sonosite. See **"Compatible accessories and peripherals"** on page 13-15.

Caution Medical electrical equipment requires special precautions regarding EMC and must be installed and operated according to these instructions. It is possible that high levels of radiated or conducted radio-frequency (RF) electromagnetic interference (EMI) from portable and mobile RF communications equipment or other strong or nearby radio-frequency sources, could result in performance disruption of the ultrasound system. Evidence of disruption may include image degradation or distortion, erratic readings, equipment ceasing to operate, or other incorrect functioning. If this occurs, survey the site to determine the source of disruption, and take the following actions to eliminate the source(s).

- Turn equipment in the vicinity off and on to isolate disruptive equipment.
- Relocate or re-orient interfering equipment.
- Increase distance between interfering equipment (or equipment being interfered with) and your ultrasound system.
- Connect the ultrasound equipment and the interfering equipment (or equipment being interfered with) to different power outlet circuits.
- Manage use of frequencies close to ultrasound system frequencies.
- Remove devices that are highly susceptible to EMI.
- Lower power from internal sources within facility control (such as paging systems).
- Label devices susceptible to EMI.
- Educate clinical staff to recognize potential EMI-related problems.
- Eliminate or reduce EMI with technical solutions (such as shielding).
- Restrict use of personal communicators (cell phones, computers) in areas with devices susceptible to EMI.
- Share relevant EMI information with others, particularly when evaluating new equipment purchases which may generate EMI.
- Purchase medical devices that comply with IEC 60601-1-2 EMC Standards.
- Do not stack other equipment on the ultrasound system or use other equipment in close proximity and adjacent to the ultrasound system. If stacking or using other equipment in close proximity is unavoidable, then you must observe the system to verify normal operation.

Caution The EMC performance of the ultrasound system may be degraded if the product is used in harsh environments where the system is exposed to high humidity, elevated temperatures, high vibration, or high shock for extended durations. If the system shows symptoms of degraded EMC performance, see the precautions (above). If, after taking the listed precautions, the degraded EMC performance persists, the system may need to be serviced to maintain optimum EMC performance.

Wireless transmission

The Sonosite PX ultrasound system contains an internal IEEE 802.11 transmitter that uses the Industrial, Scientific, and Medical (ISM) frequency bands from 2.412 to 2.484 GHz and/or 5.15 to 5.825 GHz. The transmitter supports the 802.11 a/b/g/n/ac wireless communication protocol (five different methods of transmission):

- IEEE 802.11a (5.150 to 5.850GHz) with Orthogonal Frequency Division Multiplexing (OFDM) at 13 dBm +/- 2 dBm @ 54 Mbps
- IEEE 802.11ac (5.150 to 5.850GHz) with Orthogonal Frequency Division Multiplexing (OFDM) at 17 dBm +/- 2 dBm @ MCS 0
- IEEE 802.11b with Direct Sequence Spread Spectrum (DSSS) at 15 dBm +/- 2 dBm @ 11 Mbps
- IEEE 802.11g with Orthogonal Frequency Division Multiplexing (OFDM) at 14 dBm +/- 2 dBm @54 Mbps
- IEEE 802.11n with Orthogonal Frequency Division Multiplexing (OFDM) at 18 dBm +/- 2 dBm @MCS 0

Note This device is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC, the FCC, and Industry Canada.

Electrostatic discharge

WARNING Unless following ESD precautionary procedures, do not connect to or touch (with body or hand-held tools) pins (contacts) of connectors that have the ESD Sensitive Devices label:

Caution Electrostatic discharge (ESD), or static shock, is a naturally occurring phenomenon. ESD is common in conditions of low humidity, which can be caused by heating or air conditioning. ESD is a discharge of the electrical energy from a charged body to a lesser or non-charged body. The degree of discharge can be significant enough to cause damage to a transducer or an ultrasound system. The following precautions can help reduce ESD: anti-static spray on carpets, anti-static spray on linoleum, and anti-static mats.

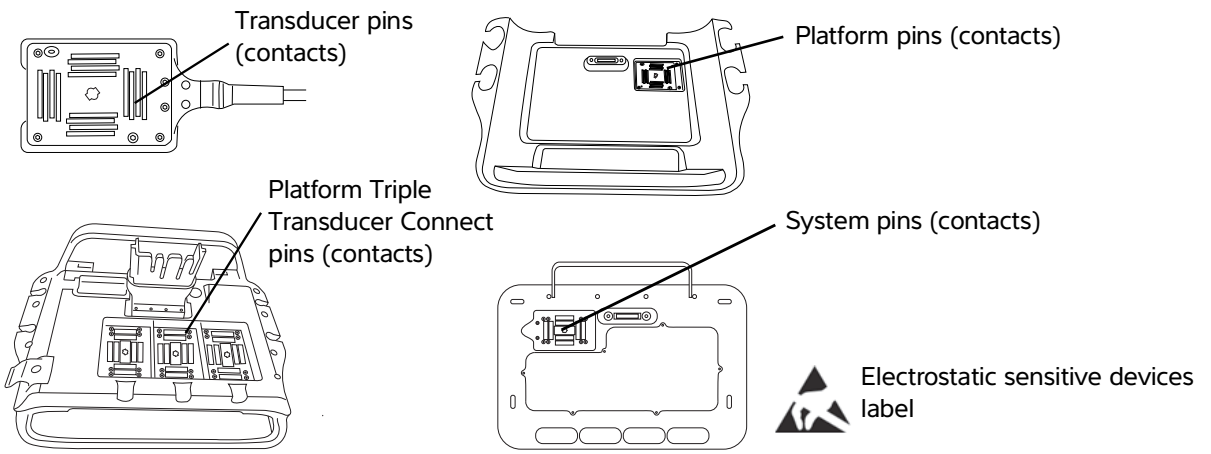


Figure 13-1 Connectors with the electrostatically-sensitive devices label.

ESD precautionary procedures include the following:

- All staff involved must receive training about ESD, including the following at a minimum: an explanation of the ESD warning symbol, ESD precautionary procedures, an introduction to the physics of electrostatic charge, the voltage levels that can occur in normal practice, and the damage that can occur to electronic components if equipment is touched by an individual who is electrostatically charged .
- Prevent the buildup of electrostatic charge. For example, use humidification, conductive floor coverings, non-synthetic clothing, ionizers, and minimizing insulating materials.
- Discharge your body to earth.
- Use a wrist strap to bond yourself to the ultrasound system or to earth.

Separation distance

Recommended separation distances between portable and mobile RF communications equipment and the Sonosite PX ultrasound system

WARNING Portable RF communications equipment (including peripherals, such as antenna cables and external antennas) should be used no closer than 30 cm (12 inches) to any part of the Sonosite PX ultrasound system, including cables specified by the manufacturer. Otherwise, degradation of the performance of this equipment could result.

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

Table 13-1: Separation distance

Rated maximum output power of transmitter (Watts)[a]	Separation distance according to frequency of transmitter (m)		
	150 kHz to 80 MHz $d=1.2\sqrt{P}$	80 MHz to 800 MHz $d=1.2\sqrt{P}$	800 MHz to 2.7 GHz $d=2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

a. 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.

Compatible accessories and peripherals

Fujfilm Sonosite has tested the Sonosite PX ultrasound system with the following accessories and peripherals and has demonstrated compliance to the requirements of IEC 60601-1-2:2014.

You may use these Fujfilm Sonosite accessories and third-party peripherals with the Sonosite PX ultrasound system.

WARNINGS

- Use of the accessories with medical systems other than the Sonosite PX ultrasound system may result in increased emissions or decreased immunity of the medical system.
- Use of accessories other than those specified may result in increased emissions or decreased immunity of the ultrasound system and result in improper operation.

Table 13-2: Compatible accessories and peripherals

Description	Maximum cable length
C5-1 transducer[a]	5.5 ft/1.7 m
IC10-3 transducer[a]	5.7 ft/1.7 m
L12-3 transducer[a]	5.5 ft/1.7 m
L15-4 transducer[a]	7.5 ft /2.3 m
L19-5 transducer[a]	7.5 ft/2.3 m
P5-1 transducer[a]	6.0 ft /1.8 m
CIVCO Needle Guide Starter Kit, C5-1, Infiniti Plus	—
CIVCO Needle Guide Starter Kit, IC10-3	—
CIVCO Needle Guide Starter Kit, L12-3, Infiniti Plus	—
CIVCO Needle Guide Starter Kit, L15-4, Infiniti Plus	—
CIVCO Needle Guide Starter Kit, L19-5, Infiniti Plus	—
CIVCO Needle Guide Starter Kit, L19-5, Accusite	—
Aquasonic gel	—
Batteries (2)	—
Ethernet cable	49.2 ft/15 m
Black & white printer	—
Black & white printer power cord	18 in/0.45 m
Stand	—
Stand AC power cord	10 ft/3.1 m
Stand platform with Triple Transducer Connect	—

Table 13-2: Compatible accessories and peripherals

Description	Maximum cable length
USB flash memory (64 GB)	—
Power supply with DC cord	6.8 ft/2 m
Power supply AC power cord	39 in/1 m
Gel and wipe holders	—
Lockable drawer	—
Storage container	—
Tray	—

a. For transducers, maximum cable length is measured between the strain reliefs. The stated lengths do not include the lengths of cable in the following locations: underneath the strain reliefs, inside the transducer enclosure, or inside the transducer connector.

Manufacturer's declaration

The tables in this section document the intended use environment and EMC compliance levels of the system. For maximum performance, ensure that the system is used in the environments described in these tables.

The system is intended for use in the electromagnetic environment specified below.

Table 13-3: Manufacturer's Declaration – Electromagnetic Emissions per IEC 60601-1-2:2014

Emissions test	Compliance	Electromagnetic environment
RF emissions CISPR 11	Group 1	The Sonosite PX 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 emissions CISPR 11	Class B	The Sonosite PX ultrasound system is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Complies	

The system is intended for use in the electromagnetic environment specified below.

Table 13-4: Manufacturer's Declaration – Electromagnetic Immunity per IEC 60601-1-2:2014

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment
Electrostatic discharge (ESD) IEC 61000-4-2	± 8.0 kV contact, ± 2.0 kV, ± 4.0 kV, ± 8.0 kV ± 15 kV air	± 8.0 kV contact, ± 2.0 kV, ± 4.0 kV, ± 8.0 kV ± 15 kV 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	± 2 kV on the mains ± 1 kV on signal lines	± 2 kV on the mains ± 1 kV on signal lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	± 1 kV line(s) to line(s) ± 2 kV line(s) to earth	± 1 kV line(s) to line(s) ± 2 kV line(s) to earth	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	0% U_T for 0.5 cycle 0% U_T for 1 cycles 70% U_T (30% dip in U_T) for 500 msec <5% U_T (>95% dip in U_T) for 5s	0% U_T for 0.5 cycle 0% U_T for 1 cycles 70% U_T (30% dip in U_T) for 500 msec <5% U_T (>95% dip in U_T) for 5s	Mains power quality should be that of a typical commercial or hospital environment. If the user of the Fujfilm Sonosite ultrasound system requires continued operation during power mains interruptions, it is recommended that the Fujfilm Sonosite ultrasound system be powered from an uninterruptible power supply or a battery.
Power frequency magnetic field IEC 61000-4-8	30 A/m	30 A/m	If image distortion occurs, it may be necessary to position the Fujfilm Sonosite ultrasound system further from sources of power frequency magnetic fields or to install magnetic shielding. The power frequency magnetic field should be measured in the Intended installation location to assure that it is sufficiently low.

Table 13-4: Manufacturer's Declaration – Electromagnetic Immunity per IEC 60601-1-2:2014

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz 6 Vrms in ISM bands	3 Vrms 6 Vrms in ISM bands	Portable and mobile RF communications equipment should be used no closer to any part of the Fujifilm Sonosite ultrasound system including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended Separation Distance $d = 1.2\sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.7 GHz	3 V/m 80 MHz to 2.7 GHz	$d = 1.2\sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ 800 MHz to 2,7 GHz 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). 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]. Interference may occur in the vicinity of equipment marked with the following symbol:  (IEC 60417 No. 417-IEC-5140: "Source of non-ionizing radiation")
Proximity fields from wireless communications equipment IEC 61000-4-3	Per 60601-1-2:2014 Table 9	Per 60601-1-2:2014 Table 9	

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 Fujfilm Sonosite ultrasound system is used exceeds the applicable RF compliance level above, the Fujfilm Sonosite 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 Fujfilm Sonosite ultrasound system.
b. Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Essential performance requirements

Per 60601-2-37, the following have been determined to be essential performance for the Sonosite PX ultrasound system. The Sonosite PX ultrasound system must be free from the following:

- Noise on a waveform or artifacts or distortion in an image or error of a displayed numerical value that cannot be attributed to a physiological effect and that may alter the diagnosis
- Display of incorrect numerical values associated with the diagnosis to be performed
- Display of incorrect safety related indications
- Production of unintended or excessive ultrasound output
- Production of unintended or excessive transducer assembly surface temperature
- Production of unintended or uncontrolled motion of transducer assemblies intended for intracorporeal use.

Results of EMC immunity testing show that the Sonosite PX ultrasound system meets the essential performance requirements in 60601-2-37. If the operator detects unacceptable degradation of basic safety or essential performance, they should stop using the equipment and take suitable precautions as detailed on **page 13-12**.

FCC Caution: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a professional healthcare facility environment. This equipment generates, uses and can radiate harmful radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to other medical or electronic equipment, take suitable precautions as detailed on page 12-13.

Labeling symbols

The following symbols are used on the products, packaging, and containers.

Table 13-5: Standards labeling symbols

Symbol	Title	Standards development organization (SDO)	Reference number	Description
	Manufacturer	ISO 15223-1:2016 Medical devices – symbols to be used with medical device labels, labeling, and information to be supplied – Part 1: General requirements	5.1.1	Indicates the medical device manufacturer, as EU directives 90/385/EEC, 93/42/EEC and 98/79/EC
	Date of manufacture	ISO 7000- Graphical symbols for Use on Equipment	5.1.3	To indicate the date on which a product was manufactured
	Serial Number	ISO 15223-1:2016 Medical devices – symbols to be used with medical device labels, labeling, and information to be supplied – Part 1: General requirements	5.1.7	Indicates the manufacturer´s serial number so that a specific medical device can be identified
	Catalog Number	ISO 15223-1:2016 Medical devices – symbols to be used with medical device labels, labeling, and information to be supplied – Part 1: General requirements	5.1.6	Indicates the manufacturer´s catalogue number so that the medical device can be identified
	Caution	ISO 15223-1:2016 Medical devices – symbols to be used with medical device labels, labeling, and information to be supplied – Part 1: General requirements	5.4.4	Indicates the need for the user to consult the instructions for use for important cautionary information such as warnings and precautions that cannot for a variety of reasons, be presented on the medical device itself

Table 13-5: Standards labeling symbols

Symbol	Title	Standards development organization (SDO)	Reference number	Description
	Fragile handle with care	ISO 15223-1:2016 Medical devices – symbols to be used with medical device labels, labeling, and information to be supplied – Part 1: General requirements	5.3.1	Indicates a medical device that can be broken or damaged if not handled carefully
	Keep dry	ISO 15223-1:2016 Medical devices – symbols to be used with medical device labels, labeling, and information to be supplied – Part 1: General requirements	5.3.4	Indicates a medical device that needs to be protected from moisture
	Temperature limit	ISO 15223-1:2016 Medical devices – symbols to be used with medical device labels, labeling, and information to be supplied – Part 1: General requirements	5.3.7	Indicates the temperature limits to which the medical device can be safely exposed
	Atmospheric pressure limitations	ISO 15223-1:2016 Medical devices – symbols to be used with medical device labels, labeling, and information to be supplied – Part 1: General requirements	5.3.9	Indicates the range of atmospheric pressure to which the medical device can be safely expose
	Humidity limitation	ISO 15223-1:2016 Medical devices – symbols to be used with medical device labels, labeling, and information to be supplied – Part 1: General requirements	5.3.8	Indicates the range of humidity to which the medical device can be safely exposed
	Stacking limit by number	ISO 7000:2004 Graphical symbols for use on equipment	2403	Do not stack over n high, where n represents the number on the label.

Table 13-5: Standards labeling symbols

Symbol	Title	Standards development organization (SDO)	Reference number	Description
	Refer to instruction manual/booklet	IEC 60601-1 Medical electrical equipment Part 1: General requirements for basic safety and essential performance	D.2-10	Follow instructions for use (used in accordance with IEC 60601-1)
	Consult instructions for use	ISO 15223-1:2016 Medical devices – symbols to be used with medical device labels, labeling, and information to be supplied – Part 1: General requirements	5.4.3	Indicates the need for the user to consult the instructions for use
	Non-ionizing electromagnetic radiation	IEC 60601-1-2:2007 Medical electrical equipment — Part 1-2: General requirements for basic safety and essential performance — Collateral standard: Electromagnetic compatibility — Requirements and tests	5.1.1	To indicate generally elevated, potentially hazardous, levels of non-ionizing radiation, or to indicate equipment or systems e.g. in the medical electrical area that include RF transmitters or that intentionally apply RF electromagnetic energy for diagnosis or treatment
	Corrugated recycle	—	—	Shipping box is made of corrugated cardboard and should be recycled accordingly
	21 Part 15	Federal Communications Commission (FCC) Declaration of conformity	—	FCC—Tested to Federal Communications Commission requirements. Device complies with relevant FCC regulations for electronic devices.

Table 13-5: Standards labeling symbols

Symbol	Title	Standards development organization (SDO)	Reference number	Description
	RESY – Recycling Symbol	—	—	Paper recycle
	Recycle: Electronic Equipment	BS EN 50419:2016 Marking of Electrical and Electronic Equipment in accordance with Directive 2012/19/EU for the Waste of Electrical and Electronic Equipment (WEEE) and Directive 2006/66/EC on Batteries and Accumulators and Waste Batteries and Accumulators	Annex IX	Do Not Throw in Trash
	CE Marking	Council Directive 93/42/ EEC	Article 17 Annex XII, Annex VII	Signifies European Technical Conformity
	Conformité Européene Notified Body Reference No.: 2797	Council Directive 93/42/ EEC	Article 17 Annex XII	Indicates European technical conformity and identification of notified body responsible for implementation of the procedures set out in Annexes II, IV, V, and VI
	European community authorized representative	ISO 15223-1 Medical devices - symbols to be used with medical device labels, labelling and information to be supplied	5.1.2	Indicates the Authorized representative in the European Community
	Medical Device	EU MDR	EU MDR Annex I, 23.2 (q)	Indicates the item the label is adhered to is categorized as a medical device per the MDR, Annex 1, 23.2, q.

Table 13-5: Standards labeling symbols

Symbol	Title	Standards development organization (SDO)	Reference number	Description
	Regulatory Compliance Mark (RCM)	AS/NZS3820	—	Indicates C-Tick-Regulatory Compliance Mark for Australia and New Zealand Device complies with relevant Australian and New Zealand regulations for electronic devices.
	Alternating current	ISO 7000 / IEC 60417 Graphical symbols for use on equipment	5032	Indicates on the rating plate, that the equipment is suitable for alternating current only, in order to identify appropriate terminals
	Direct current (DC)	—	—	—
	Batch code, date code, or lot code type of control number	ISO 15223-1 Medical devices - Symbols to be used with medical device labels, labelling and information to be supplied - Part 1: General Requirements	5.1.5	Indicates manufacturer's batch code so that the batch or lot can be identified
	Biological risk	ISO 7010 - Graphical symbols -- Safety colors and safety signs	W009	To warn of biological hazard
	INMETRO Safety Symbols	—	—	Indicates Brazil - Accredited certification body by the National Institute of Metrology Standardization and Industrial Quality (INMETRO)

Table 13-5: Standards labeling symbols

Symbol	Title	Standards development organization (SDO)	Reference number	Description
	Canadian Standard Association Certification Mark	—	—	CSA certification mark signifying that the product complies with the applicable CSA and ANSI/UL requirements and is authorized for use in Canada and the US
	Canadian Standards Association component certification mark	—	—	CSA certification mark signifying that the product complies with the applicable CSA and ANSI/UL requirements and is authorized for use in Canada and the US
	TUV Rhineland of North America	—	—	TUV Rhineland of North America. The "C" and US" indicators signify that the product has been evaluated to the applicable CSA and ANSI/UL standards for use in Canada and the US, respectively.
	Electrostatic sensitive devices	IEC 60417:2002 Graphical Symbols For Use On Equipment	5134	Indicates packages containing electrostatic sensitive devices, or identifies a device or a connector that has not been tested for immunity to electrostatic discharge
	Magnetic resonance environment unsafe	ASTM International (American Society for Testing and Materials)	ASTM F2503	Indicates the system is an item that is known to pose hazards in all MR environments.
GEL	Gel	—	—	—

Table 13-5: Standards labeling symbols

Symbol	Title	Standards development organization (SDO)	Reference number	Description
STERILE R	Sterilized using irradiation	ISO 15223-1 Medical devices – Symbols to be used with medical device labels, labeling and information to be supplied – Part 1: General Requirements	5.2.4	Indicates a medical device that has been sterilized using irradiation
STERILE EO	Sterilized using ethylene oxide	ISO 15223-1 Medical devices – Symbols to be used with medical device labels, labeling and information to be supplied – Part 1: General Requirements	5.2.3	Indicates a medical device that has been sterilized using ethylene oxide
	Caution hot	ISO 7000 / IEC 60417 Graphical symbols for use on equipment	5041	Indicates that the marked item can be hot and should not be touched without taking care
	Caution, static magnetic field hazard	ISO 7000 / IEC 60417 Graphical symbols for use on equipment	6204	Identifies areas with potentially hazardous static magnetic fields and forces in an installation
IPX7	Degree of ingress protection provided by enclosure	IEC 60601-1 Medical electrical equipment Part 1: General requirements for basic safety and essential performance	D.3-2	Protected against the effects of temporary immersion in water. Submersible Protected against the effects of temporary immersion.
IP22	Degree of ingress protection provided by enclosure	IEC 60601-1 Medical electrical equipment Part 1: General requirements for basic safety and essential performance	D.3-2	Protection against solid foreign objects of 12.5 mm diameter or greater, and protection against vertically falling water drops when enclosure is tilted up to 15 degrees.

Table 13-5: Standards labeling symbols

Symbol	Title	Standards development organization (SDO)	Reference number	Description
	—	—	—	Indicates handle with care
	—	—	—	Indicates follow manufacturer's instructions for disinfecting time
	—	—	—	Indicates disinfect transducer
	Type BF applied parts	IEC 60601-1 Medical electrical equipment Part 1: General requirements for basic safety and essential performance	D.1-20	Identifies type BF applied part complying with IEC 60601-1
	Defibrillation-proof type CF applied part	IEC 60601-1 Medical electrical equipment Part 1: General requirements for basic safety and essential performance	D.1-27	Identifies a defibrillation-proof type CF applied part complying with IEC 60601-1
	China Pollution Control (10)	ISO 7000:2014 Graphical symbols for use on equipment	1135	Pollution Control Logo. (Applies to all parts/ products listed in the China RoHS disclosure table. May not appear on the exterior of some parts/products because of space limitations.)

Table 13-5: Standards labeling symbols

Symbol	Title	Standards development organization (SDO)	Reference number	Description
	China Compulsory Certificate mark ("CCC Mark"). A compulsory safety mark for compliance to Chinese national standards for many products sold in the People's Republic of China.	—	—	—
	Potential equalization terminal	IEC 60601-1 Medical Electrical Equipment Part 1: General requirements for basic safety and essential performance	D.1-8	Identifies potential equalization terminal
	Maximum weight load	IEC 60601-1 Medical Electrical Equipment Part 1: General requirements for basic safety and essential performance	7.2.21	Indicates total weight of the equipment, including the safe working load

Specifications

For information on accessories and peripherals, see **"Compatible accessories and peripherals"** on page 13-15.

Dimensions

System

- **Length:** 15.45 in. (392.5 cm)
- **Width:** 13.32 in. (338.4 cm)
- **Height:** 14.60 in. (370.9 cm)
- **Weight:** 17.92 lbs (8.13 kg) with the L15-4 transducer and battery installed

Stand

- **Depth:** 22 in. (55.9 cm)
- **Width:** 20.25 in. (51.4 cm)
- **Height:** 45 in. (114.3 cm) maximum, 33 in. (83.8 cm) minimum
- **Height range:** 9.84 in. (25 cm)
- **Weight:** 40.0 lbs. (18.1 kg)
- **Storage bin capacity:** 11 lbs. (5 kg)
- **Total stand weight with system and peripherals:** 101 lbs. (46 kg) maximum

Display

- **Length:** 13.55 in. (344.16 mm)
- **Height:** 7.62 in. (193.59 mm)
- **Diagonal:** 15.6 in. (396.24 mm)
- **Resolution:** 1920 x 1080 px

Environmental limits

Table 13-6: Operating limits

Limit type	System, batteries, transducers, and stand
Temperature	0–40°C (32–104°F)
Humidity	15–95% R.H.
Atmospheric pressure	700–1060 hPa (0.69–1.05 ATM)

Table 13-7: Shipping and storage limits

Limit type	System, transducers, and stand	System batteries
Temperature	-35–65°C (-31–149°F)	-20–60°C (-4–140°F) for 1 month. -20–45°C (-4–113°F) for 3 months. -20–23°C (-4–73°F) for 1 year. <-20°C (-35°C min) and >60°C (65°C max) limited periods for shipping or transport.
Humidity	5–95% R.H.	15–95% R.H.
Atmospheric pressure	500–1060 hPa (0.5–1.05 ATM)	500–1060 hPa (0.5–1.05 ATM)

Electrical

Portable power supply

Input: 100–240 VAC, 50–60 Hz, 3.4–1.3 A

Output: 26.7 VDC, 8.24 A, 220 W max; Class I, continuous use.

Stand rating

Input: 100–240 VAC, 50–60 Hz, 6.0–2.5 A

Output: 100–240 VAC, 50–60 Hz, 2.5–1.0 A

Note Only connect the printer that comes with the system to the output.

Batteries

Each system battery comprises six lithium-ion cells plus electronics, a temperature sensor, and battery contacts. Run time using both batteries is up to one hour, depending on imaging mode and display brightness.

Imaging modes

- 2D (256 gray shades)
- Color Power Doppler (CPD) (256 colors)
- Color Doppler (Color) (256 colors)
- M Mode
- Continuous wave (CW) Doppler

Additionally, the system includes advanced imaging technologies:

- Tissue Doppler Imaging (TDI)
- Tissue Harmonic Imaging (THI)

Image and video clip storage capacity

The number of images and video clips you can save depends on imaging mode and file format.

Standards

Electromechanical safety standards

Table 13-8: Electromechanical safety standards

Standard	Description
ANSI/AAMI ES60601-1:2005/(R) 2012, and A1:2012	Medical electrical equipment, Part 1: General requirements for basic safety and essential performance (Edition 3.1)
CAN/CSA C22.2 No. 60601-1:2014	Medical electrical equipment - Part 1: General Requirements for Basic Safety and Essential Performance (Edition 3.1)
CSA C22.2 60601-2-37:2008 (+A1:2019)	Medical Electrical Equipment – Part 2-37: Particular requirements for the basic safety and essential performance of ultrasonic medical diagnostic and monitoring equipment (Adopted IEC 60601-2-37:2007, Edition 2.1)
CSA C22.2 60601-1-6:2011 (+A1: 2013)	Medical Electrical Equipment Part 1-6: General requirements for basic safety and essential performance – Collateral Standard: Usability (Adopted IEC 60601-1-6:2013, Edition 3.1)
IEC 60601-1:2012	Medical electrical equipment - Part 1: General Requirements for Basic Safety and Essential Performance (Edition 3.1)
IEC 60601-2-37:2015	Medical Electrical Equipment – Part 2-37: Particular requirements for the basic safety and essential performance of ultrasonic medical diagnostic and monitoring equipment (Edition 2.1)
IEC 60601-1-6:2013	Medical Electrical Equipment Part 1-6: General requirements for basic safety and essential performance – Collateral Standard: Usability (Edition 3.1)

EMC standards classification

Table 13-9: EMC standards classification

Standard	Description
IEC 60601-1-2:2014	Medical Electrical Equipment. General Requirements for Basic Safety and Essential Performance-Collateral Standard. Electromagnetic Compatibility. Requirements and Tests.
CISPR 11:2009	Industrial, Scientific, and Medical (ISM) Radio-Frequency Equipment Electromagnetic Disturbance Characteristics-Limits and Methods of Measurement.

The Classification for the ultrasound system, docking system, accessories, and peripherals when configured together is: Group 1, Class A.

DICOM standard

Digital Imaging and Communications in Medicine (DICOM), Version 3.1, 2007 (NEMA).

The system conforms to the DICOM standard as specified in the Sonosite PX DICOM Conformance Statement, available at **www.sonosite.com**. This statement provides information about the purpose, characteristics, configuration, and specifications of the network connections supported by the system.

Security and privacy standards

The system includes security settings that help you to meet the applicable security requirements listed in the HIPAA standard. Users are ultimately responsible for ensuring the security and protection of all electronic protected health information collected, stored, reviewed, and transmitted on the system.

Table 13-10: Security and privacy standards

Standard	Description
HIPAA:1996	45 CFR Parts 160 and 164; Subparts A, C, and E, Health Insurance Portability and Accountability Act (HIPAA) Privacy and Security Rules
NIST SP 800-53:	Security and Privacy Controls for Federal Information Systems and Organizations

CHAPTER 14

Acoustic Output

This section contains information about the ALARA (as low as reasonably achievable) principle, the output display standard, and acoustic power and intensity tables. The information applies to the ultrasound system, transducer, accessories, and peripherals.

ALARA principle

ALARA is the guiding principle for the use of diagnostic ultrasound. Sonographers and other qualified ultrasound users, using good judgment and insight, determine the exposure that is "as low as reasonably achievable." There are no set rules to determine the correct exposure for every situation. The qualified ultrasound user determines the most appropriate way to keep exposure low and bioeffects to a minimum, while obtaining a diagnostic examination.

A thorough knowledge of the imaging modes, transducer capability, system setup and scanning technique is necessary. The imaging mode determines the nature of the ultrasound beam. A stationary beam results in a more concentrated exposure than a scanned beam, which spreads that exposure over that area. The transducer capability depends upon the frequency, penetration, resolution, and field of view. The default system presets are reset at the start of each new patient. It is the scanning technique of the qualified ultrasound user along with patient variability that determines the system settings throughout the exam.

The variables which affect the way the qualified ultrasound user implements the ALARA principle include patient 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 qualified ultrasound user can control it. The ability to limit the exposure over time supports the ALARA principle.

Applying the ALARA principle

The system imaging mode selected by the qualified ultrasound user is determined by the diagnostic information required. 2D imaging provides anatomical information; CPD imaging provides information about the energy or amplitude strength of the Doppler signal over time at a given anatomical location and is used for detecting the presence of blood flow;

Color imaging provides information about the energy or amplitude strength of the Doppler signal over time at a given anatomical location and is used for detecting the presence, velocity, and direction of blood flow; Tissue Harmonic Imaging uses higher received frequencies to reduce clutter, artifact, and improve resolution on the 2D image. Understanding the nature of the imaging mode used allows the qualified ultrasound user to apply the ALARA principle.

Prudent use of ultrasound means limiting ultrasound to situations in which it is medically useful and limiting patient exposure to the lowest ultrasound output for the shortest time necessary to achieve acceptable diagnostic results. Users can directly control acoustic output as described in the next section. Decisions that support prudent use are based on the type of patient, exam type, patient history, ease or difficulty of obtaining diagnostically useful information, and potential localized heating of the patient due to transducer surface temperature. See **"Transducer surface temperature rise"** on page 14-6. In the event of a device malfunction, there are redundant controls that limit transducer power. This is accomplished by an electrical design that limits both power supply current and voltage to the transducer.

The sonographer uses the system controls to adjust image quality and limit ultrasound output. The system controls are divided into three categories relative to output: controls that directly affect output, controls that indirectly affect output, and receiver controls.

Direct, indirect, and receiver controls

Direct controls The Power control (see **page 6-4**) allows the user to directly control the acoustic output. The sonographer can vary the output level in 10% increments from 100% down to 10%. A direct correlation exists between the power setting and the MI and TI output; reducing the power level causes a reduction in the MI and TI. However, there is not necessarily a linear correlation between the two. Therefore, it is up to the sonographer to adjust the power setting as needed to achieve a desired MI or TI for the current imaging state. It should be understood that while the power setting persists across changes to image settings (e.g. depth, optimization, and THI), the MI and TI are not fixed and will likely change (increase or decrease) as a result of changes to the settings. Therefore, the power settings required to achieve a target MI or TI may be different for different imaging states.

The system does not exceed a spatial peak temporal average intensity (ISPTA) of 720 mW/cm2 for all imaging modes. The mechanical index (MI) and thermal index (TI) may exceed values greater than 1.0 on some transducers in some imaging modes. For either the Ophthalmic or Orbital exam, the acoustic output is limited to the following values: ISPTA does not exceed 50 mW/cm2; TI does not exceed 1.0, and MI does not exceed 0.23. Ultrasound users can monitor the MI and TI values on the right side of the clinical monitor and implement the ALARA principle accordingly. For more information on MI and TI, see Medical Ultrasound Safety, AIUM (a copy is included with each system) and IEC 60601-2-37 Annex "Guidance on the interpretation of TI and MI to be used to inform the operator".

Indirect controls The controls that indirectly affect output are controls affecting imaging mode, freeze, and depth. The imaging mode determines the nature of the ultrasound beam. Freeze stops all ultrasound output but keeps the last image displayed on screen. Freeze can be used by the ultrasound user to limit exposure time while studying an image and maintaining probe position during a scan. Some controls, such as depth, show a rough correspondence with output.

Receiver controls The receiver controls are the gain controls. Receiver controls do not affect output. They should be used, if possible, to improve image quality before using controls that directly or indirectly affect output.

Acoustic artifacts

An acoustic artifact is information, present or absent in an image, that does not properly indicate the structure or flow being imaged. There are helpful artifacts that aid in diagnosis and those that hinder proper interpretation. Examples of artifacts include shadowing, through transmission, aliasing, reverberations, and comet tails.

For more information on detecting and interpreting acoustic artifacts, see the following reference:

Kremkau, Frederick W. *Diagnostic Ultrasound: Principles and Instruments.* 7th ed., W.B. Saunders Company, (Oct. 17, 2005).

Output display

The system meets the output display standard in IEC60601-2-37 for MI and TI (see **"Related guidance documents"** on page 14-5). The system output display consists of two indices: the mechanical index and the thermal index. Both indices are continuously displayed over the range of <0.1 to the maximum output in increments of 0.1.The following table indicates for each transducer and operating mode when either the TI or MI is greater than or equal to a value of 1.0, thus requiring reporting of maximum output values (see **"Acoustic output tables"** on page 14-9).

Table 14-1: TI or MI ≥ 1.0

Transducer	Index[1, 2, 3]	2D/ M Mode	CPD/Color	PW Doppler	2D + PW	2D + PW + Color	CW Doppler
C5-1	MI	Yes	Yes	Yes	—	—	—
	TIC, TIB, or TIS	Yes	Yes	Yes	—	—	—
IC10-3	MI	No	No	No	—	—	—
	TIC, TIB, or TIS	No	No	No	—	—	—
L12-3	MI	Yes	Yes	Yes	Yes	Yes	—
	TIC, TIB, or TIS	Yes	Yes	Yes	Yes	Yes	—
L15-4	MI	Yes	Yes	Yes	Yes	Yes	—
	TIC, TIB, or TIS	No	Yes	Yes	Yes	Yes	—
L19-5	MI	Yes	Yes	No	Yes	Yes	—
	TIC, TIB, or TIS	Yes	Yes	Yes	Yes	Yes	—

Table 14-1: TI or MI ≥ 1.0

Transducer	Index[1, 2, 3]	2D/ M Mode	CPD/Color	PW Doppler	2D + PW	2D + PW + Color	CW Doppler
P5-1	MI	Yes	Yes	Yes	—	—	No
	TIC, TIB, or TIS	Yes	Yes	Yes	—	—	Yes

1. Even if MI is less than 1.0, the system provides a continuous real-time display of MI in all imaging modes, in increments of 0.1.
2. The system meets the output display standard for TI and provides a continuous real-time display of TI in all imaging modes, in increments of 0.1.
3. The TI consists of three user-selectable indices, and only one of these is displayed at any one time. In order to display TI properly and meet the ALARA principle, the user selects an appropriate TI based on the specific exam being performed. FUJIFILM Sonosite provides a copy of AIUM Medical Ultrasound Safety, which contains guidance on determining which TI is appropriate (see "Related guidance documents" on page 14-5).

MI and TI output display accuracy

For each transducer, the accuracy of the displayed MI and TI are provided in the following table. The accuracy values are stated statistically as 95% tolerance interval limits and should be interpreted as follows: with 95% confidence, 95% of the measured MI/TI values are within the specified percentage of the displayed value or 0.1 of the displayed value, whichever is larger.

Table 14-2: MI and TI output display accuracy

Transducer	MI display accuracy	TI display accuracy
C5-1	+19% to -17%	+21% to -21%
IC10-3	+15% to -22%	+19% to -37%
L12-3	+24% to -20%	+33% to -28%
L15-4	+25% to -23%	+37% to -29%
L19-5	+21% to -26%	+38% to -47%
P5-1	+20% to -16%	+21% to -22%

A displayed value of 0.0 for MI or TI means that the calculated estimate for the index is less than 0.05.

Factors that contribute to display uncertainty

The net uncertainty of the displayed indices is derived by combining the quantified uncertainty from three sources: measurement uncertainty, system and transducer variability, and engineering assumptions and approximations made when calculating the display values.

Measurement errors of the acoustic parameters when taking the reference data are the major source of error that contributes to the display uncertainty. The measurement error is described in **"Acoustic measurement precision and uncertainty"** on page 14-53.

The displayed MI and TI values are based on calculations that use a set of acoustic output measurements that were made using a single reference ultrasound system with a single reference transducer that is representative of the population of transducers of that type. The reference system and transducer are chosen from a sample population of systems and transducers taken from early production units, and they are selected based on having an acoustic output that is representative of the nominal expected acoustic output for all transducer-system combinations that might occur. Of course every transducer-system combination has its own unique characteristic acoustic output, and will not match the nominal output on which the display estimates are based. This variability between systems and transducers introduces an error into displayed value. By doing acoustic output sampling testing during production, the amount of error introduced by the variability is bounded. The sampling testing ensures that the acoustic output of transducers and systems being manufactured stays within a specified range of the nominal acoustic output.

Another source of error arises from the assumptions and approximations that are made when deriving the estimates for the display indices. Chief among these assumptions is that the acoustic output, and thus the derived display indices, are linearly correlated with the transmit drive voltage of the transducer. Generally, this assumption is very good, but it is not exact, and thus some error in the display can be attributed to the assumption of voltage linearity.

Related guidance documents

Marketing Clearance of Diagnostic Ultrasound Systems and Transducers, FDA, 2019.

Medical Ultrasound Safety, American Institute of Ultrasound in Medicine (AIUM), 2014. (A copy is included with each system.)

Acoustic Output Measurement Standard for Diagnostic Ultrasound Equipment, NEMA UD2-2004.

IEC 60601-2-37: 2015, "Particular requirements for the basic safety and essential performance of ultrasonic diagnostic and monitoring equipment".

Transducer surface temperature rise

The tables in this section list the measured surface temperature rise from ambient (23°C ± 3°C) of transducers used on the ultrasound system. The temperatures were measured in accordance with IEC 60601-2-37 with controls and settings positioned to give maximum temperatures.

Table 14-3: Maximum transducer surface temperature rise, external use (°C)

Test	C5-1	L12-3	L15-4	L19-5	P5-1
Still air	12.8 (≤27)	12.3 (≤27)	12.0 (≤27)	11.4 (≤27)	15.2 (≤27)
Simulated use	8.9 (≤10)	8.5 (<10)	8.6 (<10)	8.2 (<10)	8.6 (<10)

Table 14-4: Maximum transducer surface temperature rise, non-external use (°C)

Test	IC10-3
Still air	8.3 (≤27)
Simulated use	4.7 (≤6)

Acoustic output measurement

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

The acoustic output for this ultrasound system has been measured and calculated in accordance with IEC 60601-2-37: 2015, Medical electrical equipment -- Part 2-37: Particular requirements for the safety and essential performance of ultrasonic diagnostic and monitoring equipment and IEC 62359: 2017, Ultrasonics - Field characterization - Test methods for the determination of thermal and mechanical indices related to medial diagnostic ultrasonic fields.

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, type of tissue, and the frequency of the ultrasound passing through the tissue. The intensity value in the tissue, *In Situ,* has been estimated by using the following formula:

In Situ= Water [$e^{-(0.23alf)}$] where:

where:

In Situ = *In Situ* intensity value

Water = Water intensity value

e = 2.7183

a = attenuation factor (dB/cm MHz)

Attenuation factor (a) for various tissue types are given below:

brain = 0.53

heart = 0.66

kidney = 0.79

liver = 0.43

muscle = 0.55

l = skinline to measurement depth in cm

f = center frequency of the transducer/system/mode combination in MHz

Since the ultrasonic path during the exam 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 purposes; therefore, the *In Situ* value commonly reported uses the formula:

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

Since this value is not the true *In Situ* intensity, the term "derated" is used to qualify it.

The maximum derated and the maximum water values do not always occur at the same operating conditions; therefore, the reported maximum water and derated values may not be related by the *In Situ* (derated) formula. For example: a multi-zone array transducer that has maximum water value intensities in its deepest zone, but also has the smallest derating factor in that zone. The same transducer may have its largest derated intensity in one of its shallowest focal zones.

Tissue models and equipment survey

Tissue models are necessary to estimate attenuation and acoustic exposure levels *In Situ* from measurements of acoustic output made in water. Currently, available models may be limited in their accuracy because of varying tissue paths during diagnostic ultrasound exposures and uncertainties in the acoustic properties of soft tissues. No single tissue model is adequate for predicting exposures in all situations from measurements made in water, and continued improvement and verification of these models is necessary for making exposure assessments for specific exam types.

A homogeneous tissue model with attenuation coefficient of 0.3 dB/cm MHz throughout the beam path is commonly used when estimating exposure levels. The model is conservative in that it overestimates the *In Situ* acoustic exposure when the path between the transducer and site of interest is composed entirely of soft tissue. When the path contains significant amounts of fluid, as in many first and second-trimester pregnancies scanned transabdominally, this model may underestimate the *In Situ* acoustic exposure. The amount of underestimation depends upon each specific situation.

Fixed-path tissue models, in which soft tissue thickness is held constant, sometimes are used to estimate *In Situ* acoustic exposures when the beam path is longer than 3 cm and consists largely of fluid. When this model is used to estimate maximum exposure to the fetus during transabdominal scans, a value of 1 dB/cm MHz may be used during all trimesters.

Existing tissue models that are based on linear propagation may underestimate acoustic exposures when significant saturation due to non-linear distortion of beams in water is present during the output measurement.

The maximum acoustic output levels of diagnostic ultrasound devices extend over a broad range of values:

- A survey of 1990-equipment models yielded MI values between 0.1 and 1.0 at their highest output settings. Maximum MI values of approximately 2.0 are known to occur for currently available equipment. Maximum MI values are similar for real-time 2D and M Mode imaging.
- Computed estimates of upper limits to temperature elevations during transabdominal scans were obtained in a survey of 1988 and 1990 pulsed Doppler equipment. The vast majority of models yielded upper limits less than 1° and 4°C (1.8° and 7.2°F) for exposures of first-trimester fetal tissue and second-trimester fetal bone, respectively. The largest values obtained were approximately 1.5°C (2.7°F) for first-trimester fetal tissue and 7°C (12.6°F) for second-trimester fetal bone. Estimated maximum temperature elevations given here are for a "fixed path" tissue model and are for devices having ISPTA values greater than 500 mW/cm2. The temperature elevations for fetal bone and tissue were computed based on calculation procedures given in Sections 4.3.2.1-4.3.2.6 in "Bioeffects and Safety of Diagnostic Ultrasound" (AIUM, 1993).

Acoustic output tables

The tables in this section indicate the acoustic output for the system and transducer combinations with a TI or MI equal to or greater than one, and in all cases for the Ophthalmic and Orbital exam types. These tables are organized by transducer model and imaging mode. For a definition of terms used in the tables, see **"Terminology in acoustic output tables"** on page 14-53.

Table 14-6: Transducer model: C5-1 Operating mode: 2D

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.56	1.25		1.25		(b)
Index component value			1.25	1.25	1.25	1.25	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	2.34					
	P (mW)		290.3		290.3		#
	P_{1x1} (mW)		98.5		98.5		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	3.8					
	$z_{pii,\alpha}$ (cm)	3.8					
	f_{awf} (MHz)	2.23	2.66		2.66		#
Other information	*prr* (Hz)	2778					
	srr (Hz)	21.7					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	309.2					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	15.7					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	27.4					
	p_r at z_{pii} (MPa)	3.03					
Operating controls	Exam type	MSK	Gyn		Gyn		
	Optimization	Gen	Pen		Pen		
	Depth (cm)	8.7	8.3		8.3		
	MB/THI	Off/on	On/off		On/off		
	AQ zoom	—	Medium/middle		Medium/middle		
	Needle profiling	Off	—		—		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–7: Transducer model: C5–1 Operating mode: 2D + M Mode

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.56	1.26		1.92		(b)
Index component value			1.20	1.26	1.00	1.92	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	2.28					
	P (mW)		269.8		166.1		#
	P_{1x1} (mW)		95.4		98.8		
	z_s (cm)			3.6			
	z_b (cm)					3.6	
	z_{MI} (cm)	3.2					
	$z_{pii,\alpha}$ (cm)	3.2					
	f_{awf} (MHz)	2.12	2.65		2.13		#
Other information	prr (Hz)	2369					
	srr (Hz)	15.4					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	258.8					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	14.1					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	23.6					
	p_r at z_{pii} (MPa)	2.70					
Operating controls	Exam type	Abdomen	Abdomen		OB		
	Optimization	Gen	Pen		Gen		
	Depth (cm)	7.7	20.7		8.7		
	MB/THI	Off/on	Off/off		Off/on		
	AQ zoom	Off	Medium/middle		Small/middle		
	Needle profiling	—	—		—		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14-8: Transducer model: C5-1 Operating mode: Color/CPD

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.55	1.67		1.67		(b)
Index component value			1.67	1.67	1.67	1.67	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	2.30					
	P (mW)		187.8		187.8		#
	P_{1x1} (mW)		125.3		125.3		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	4.6					
	$z_{pii,\alpha}$ (cm)	4.6					
	f_{awf} (MHz)	2.21	2.75		2.75		#
Other information	*prr* (Hz)	1175					
	srr (Hz)	9.1					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	276.6					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	9.6					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	16.5					
	p_r at z_{pii} (MPa)	3.09					
Operating controls	Exam type	MSK	Gyn		Gyn		
	Mode	Color	Color		Color		
	2D optimization/depth (cm)	Gen/11.2	Pen/8.7		Pen/8.7		
	THI	On	Off		Off		
	Color optimization/PRF (Hz)	Low/219	Low/868		Low/868		
	Color box position/size	Top/default	Default/ narrow-short		Default/ narrow-short		
	AQ zoom	—	On		On		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–9: Transducer model: C5–1 Operating mode: PW Doppler

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.35	2.29		4.52		(b)
Index component value			1.09	2.29	1.09	4.52	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	1.99					
	P (mW)		375.5		375.5		#
	P_{1x1} (mW)		103.1		103.1		
	z_s (cm)			3.6			
	z_b (cm)					3.6	
	z_{MI} (cm)	3.4					
	$z_{pii,\alpha}$ (cm)	3.4					
	f_{awf} (MHz)	2.19	2.23		2.23		#
Other information	prr (Hz)	1008					
	srr (Hz)	—					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	254.3					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	341.2					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	582.9					
	p_r at z_{pii} (MPa)	2.48					
Operating controls	Exam type	Abdomen	Abdomen		Abdomen		
	Gate size (mm)	1	4		4		
	Gate position (cm)	Zone 3 (3.8)	Zone 9 (14.1)		Zone 9 (14.1)		
	PRF (Hz)	1008	3906		3906		
	TDI	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14-10: Transducer model: IC10-3 Operating mode: 2D

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.73	0.28		0.28		(b)
Index component value			0.28	0.28	0.28	0.28	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	1.66					
	P (mW)		14.5		14.5		#
	P_{1x1} (mW)		11.2		11.2		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	2.2					
	$z_{pii,\alpha}$ (cm)	2.2					
	f_{awf} (MHz)	5.14	5.28		5.28		#
Other information	*prr* (Hz)	2400					
	srr (Hz)	50.0					
	n_{pps}	2					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	134.7					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	8.8					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	16.4					
	p_r at z_{pii} (MPa)	2.40					
Operating controls	Exam type	GYN	GYN		GYN		
	Optimization	Gen	Gen		Gen		
	Depth (cm)	5.2	4.1		4.1		
	MB/THI	On/off	On/off		On/off		
	AQ zoom	Small/middle	Medium/middle		Medium/middle		
	Needle profiling	—	—		—		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–11: Transducer model: IC10–3 Operating mode: 2D + M Mode

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.73	0.23		0.25		(b)
Index component value			0.23	0.22	0.23	0.25	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	1.66					
	P (mW)		12.3		12.3		#
	P_{1x1} (mW)		9.3		9.3		
	z_s (cm)			1.0			
	z_b (cm)					2.2	
	z_{MI} (cm)	2.2					
	$z_{pii,\alpha}$ (cm)	2.2					
	f_{awf} (MHz)	5.14	5.14		5.14		#
Other information	prr (Hz)	6286					
	srr (Hz)	57.1					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	134.7					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	3.2					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	6.0					
	p_r at z_{pii} (MPa)	2.40					
Operating controls	Exam type	GYN	GYN		GYN		
	Optimization	Gen	Gen		Gen		
	Depth (cm)	5.2	5.2		5.2		
	MB/THI	Off/off	Off/off		Off/off		
	AQ zoom	Off	Medium/middle		Medium/middle		
	Needle profiling	—	—		—		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–12: Transducer model: IC10–3 Operating mode: Color/CPD

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.76	0.30		0.30		(b)
Index component value			0.30	0.30	0.30	0.30	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	1.61					
	P (mW)		20.1		20.1		#
	P_{1x1} (mW)		15.3		15.3		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	1.7					
	$z_{pii,\alpha}$ (cm)	1.7					
	f_{awf} (MHz)	4.46	4.05		4.05		#
Other information	*prr* (Hz)	1915					
	srr (Hz)	18.4					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	117.3					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	1.3					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	2.2					
	p_r at z_{pii} (MPa)	2.04					
Operating controls	Exam type	OB	OB		OB		
	Mode	Color	Color		Color		
	2D optimization/depth (cm)	Gen/4.1	Gen/3.0		Gen/3.0		
	THI	On	Off		Off		
	Color optimization/PRF (Hz)	Low/324	Low/648		Low/648		
	Color box position/size	Top/default	Default/default		Default/default		
	AQ zoom	Off	Off		Off		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–13: Transducer model: IC10–3 Operating mode: PW Doppler

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.72	0.30		0.93		(b)
Index component value			0.30	0.21	0.25	0.93	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	1.51					
	P (mW)		14.3		12.1		#
	P_{1x1} (mW)		14.3		12.1		
	z_s (cm)			1.1			
	z_b (cm)					1.5	
	z_{MI} (cm)	1.6					
	$z_{pii,\alpha}$ (cm)	1.6					
	f_{awf} (MHz)	4.37	4.37		4.37		#
Other information	prr (Hz)	1008					
	srr (Hz)	—					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	122.1					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	143.7					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	293.3					
	p_r at z_{pii} (MPa)	1.82					
Operating controls	Exam type	OB	OB		OB		
	Gate size (mm)	1	2		2		
	Gate position (cm)	Zone 2 (2.0)	Zone 4 (3.5)		Zone 2 (2.0)		
	PRF (Hz)	1008	3906		6250		
	TDI	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–14: Transducer model: L12-3 Operating mode: 2D

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.59	0.83		0.83		(b)
Index component value			0.83	0.83	0.83	0.83	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	3.77					
	P (mW)		112.6		112.6		#
	P_{1x1} (mW)		31.6		31.6		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	1.8					
	$z_{pii,\alpha}$ (cm)	1.8					
	f_{awf} (MHz)	5.66	5.49		5.49		#
Other information	*prr* (Hz)	7465					
	srr (Hz)	19.4					
	n_{pps}	3					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	516.2					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	47.5					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	77.0					
	p_r at z_{pii} (MPa)	5.31					
Operating controls	Exam type	Venous	Venous		Venous		
	Optimization	Gen	Gen		Gen		
	Depth (cm)	3.4	7.6		7.6		
	MB/THI	On/off	On/off		On/off		
	AQ zoom	—	—		—		
	Needle profiling	Off	Off		Off		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–15: Transducer model: L12–3 Operating mode: 2D + M Mode

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.59	0.87		0.99		(b)
Index component value			0.87	0.83	0.84	0.99	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	3.77					
	P (mW)		104.5		95.1		#
	P_{1x1} (mW)		33.2		31.1		
	z_s (cm)			1.05			
	z_b (cm)					1.2	
	z_{MI} (cm)	1.8					
	$z_{pii,\alpha}$ (cm)	1.8					
	f_{awf} (MHz)	5.66	5.49		5.51		#
Other information	prr (Hz)	10000					
	srr (Hz)	50.0					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	516.2					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	63.6					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	103.1					
	p_r at z_{pii} (MPa)	5.31					
Operating controls	Exam type	Venous	Venous		Superficial		
	Optimization	Gen	Gen		Gen		
	Depth (cm)	4.7	7.6		5.5		
	MB/THI	Off/off	Off/off		Off/off		
	AQ zoom	—	—		—		
	Needle profiling	—	—		—		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–16: Transducer model: L12-3 Operating mode: Color/CPD

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.59	1.51		1.51		(b)
Index component value			1.51	1.51	1.51	1.51	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	3.77					
	P (mW)		92.5		92.5		#
	P_{1x1} (mW)		54.3		54.3		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	1.8					
	$z_{pii,\alpha}$ (cm)	1.8					
	f_{awf} (MHz)	5.66	5.80		5.80		#
Other information	*prr* (Hz)	3784					
	srr (Hz)	19.6					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	516.2					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	23.9					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	38.8					
	p_r at z_{pii} (MPa)	5.31					
Operating controls	Exam type	Arterial	Breast		Breast		
	Mode	Color	Color		Color		
	2D optimization/depth (cm)	Gen/4.7	Res/2.9		Res/2.9		
	THI	Off	Off		Off		
	Color optimization/PRF (Hz)	High/12500	Low/1096		Low/1096		
	Color box position/size	Top/default	Bottom/default		Bottom/default		
	AQ zoom	—	—		—		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–17: Transducer model: L12–3 Operating mode: PW Doppler

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.06	1.40		2.79		(b)
Index component value			1.40	1.24	1.40	2.79	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	2.33					
	P (mW)		77.8		77.8		#
	P_{1x1} (mW)		60.8		60.8		
	z_s (cm)			1.1			
	z_b (cm)					1.35	
	z_{MI} (cm)	1.35					
	$z_{pii,\alpha}$ (cm)	1.35					
	f_{awf} (MHz)	4.82	4.82		4.82		#
Other information	*prr* (Hz)	1563					
	srr (Hz)	—					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	201.7					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	391.2					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	622.0					
	p_r at z_{pii} (MPa)	2.74					
Operating controls	Exam type	Venous	Venous		Venous		
	Gate size (mm)	1	1		1		
	Gate position (cm)	Zone 11 (7.0)	Zone 11 (7.0)		Zone 11 (7.0)		
	PRF (Hz)	1562	1562		1562		
	TDI	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14-18: Transducer model: L12-3 Operating mode: 2D + PW Doppler

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.66	1.53		2.97		(b)
Index component value			1.53	1.40	1.53	2.97	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	4.07					
	P (mW)		90.0		90.0		#
	P_{1x1} (mW)		65.0		65.0		
	z_s (cm)			1.05			
	z_b (cm)					1.05	
	z_{MI} (cm)	1.4					
	$z_{pii,\alpha}$ (cm)	1.4					
	f_{awf} (MHz)	6.05	4.82		4.82		#
Other information	prr (Hz)	7812					
	srr (Hz)	40.7					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	675.4					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	27.8					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	47.5					
	p_r at z_{pii} (MPa)	5.49					
Operating controls	Exam type	Arterial	Venous		Venous		
	Optimization/depth (cm)	Gen/3.4	Res/9.0		Res/9.0		
	THI	On	On		On		
	Gate size (mm)	1	1		1		
	Gate position (cm)	Zone 1 (0.6)	Zone 11 (7.0)		Zone 11 (7.0)		
	PRF (Hz)	2604	3906		3906		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–19: Transducer model: L12–3 Operating mode: 2D + PW Doppler + Color

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.61	1.54		2.75		(b)
Index component value			1.54	1.42	1.54	2.75	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	3.98					
	P (mW)		108.4		108.4		#
	P_{1x1} (mW)		67.0		67.0		
	z_s (cm)			1.05			
	z_b (cm)					1.05	
	z_{MI} (cm)	1.4					
	$z_{pii,\alpha}$ (cm)	1.4					
	f_{awf} (MHz)	6.06	4.80		4.80		#
Other information	prr (Hz)	2116					
	srr (Hz)	16.3					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	652.6					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	7.2					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	12.4					
	p_r at z_{pii} (MPa)	5.34					
Operating controls	Exam type	Arterial	Venous		Venous		
	2D optimization/depth (cm)	Gen/4.0	Res/9.0		Res/9.0		
	THI	On	On		On		
	Color optimization/PRF (Hz)	5208	2604		2604		
	Gate size (mm)	1	1		1		
	Gate position (cm)	Zone 1 (0.6)	Zone 11 (7.0)		Zone 11 (7.0)		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14-20: Transducer model: L12-3 Ophthalmic Operating mode: 2D

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.17	0.04		0.04		(b)
Index component value			0.04	0.04	0.04	0.04	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	0.48					
	P (mW)		3.1		3.1		#
	P_{1x1} (mW)		0.9		0.9		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	1.7					
	$z_{pii,\alpha}$ (cm)	1.7					
	f_{awf} (MHz)	8.53	8.53		8.53		#
Other information	*prr* (Hz)	6778					
	srr (Hz)	11.8					
	n_{pps}	3					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	7.9					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	3.0					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	8.3					
	p_r at z_{pii} (MPa)	1.28					
Operating controls	Exam type	Ophthalmic	Ophthalmic		Ophthalmic		
	Optimization	Res	Res		Res		
	Depth (cm)	9.0	9.0		9.0		
	MB/THI	On/off	On/off		On/off		
	AQ zoom	—	—		—		
	Needle profiling	—	—		—		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–21: Transducer model: L12–3 Ophthalmic Operating mode: 2D + M Mode

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.16	0.03		0.03		(b)
Index component value			0.03	0.02	0.03	0.02	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	0.47					
	P (mW)		1.90		1.90		#
	P_{1x1} (mW)		0.60		0.60		
	z_s (cm)			1.2			
	z_b (cm)					1.45	
	z_{MI} (cm)	3.5					
	$z_{pii,\alpha}$ (cm)	3.5					
	f_{awf} (MHz)	8.87	8.78		8.78		#
Other information	prr (Hz)	6800					
	srr (Hz)	33.3					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	10.8					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	1.6					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	4.3					
	p_r at z_{pii} (MPa)	1.37					
Operating controls	Exam type	Ophthalmic	Ophthalmic		Ophthalmic		
	Optimization	Res	Res		Res		
	Depth (cm)	7.6	9.0		9.0		
	MB/THI	Off/off	Off/off		Off/off		
	AQ zoom	—	—		—		
	Needle profiling	—	—		—		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14-22: Transducer model: L12-3 Ophthalmic Operating mode: Color/CPD

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.18	0.05		0.05		(b)
Index component value			0.05	0.05	0.05	0.05	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	0.53					
	P (mW)		4.2		4.2		#
	P_{1x1} (mW)		2.0		2.0		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	0.55					
	$z_{pii,\alpha}$ (cm)	0.55					
	f_{awf} (MHz)	8.63	4.84		4.84		#
Other information	*prr* (Hz)	3274					
	srr (Hz)	17.0					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	9.5					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	0.1					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	0.4					
	p_r at z_{pii} (MPa)	0.60					
Operating controls	Exam type	Ophthalmic	Ophthalmic		Ophthalmic		
	Mode	Color	Color		Color		
	2D optimization/depth (cm)	Res/1.8	Res/9.0		Res/9.0		
	THI	Off	Off		Off		
	Color optimization/PRF (Hz)	Low/287	Med/2358		Med/2358		
	Color box position/size	Default/default	Bottom/default		Bottom/default		
	AQ zoom	—	—		—		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14-23: Transducer model: L12-3 Ophthalmic Operating mode: PW Doppler

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.15	0.10		0.21		(b)
Index component value			0.10	0.09	0.10	0.21	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	0.32					
	P (mW)		5.4		5.4		#
	P_{1x1} (mW)		4.2		4.2		
	z_s (cm)			1.05			
	z_b (cm)					1.05	
	z_{MI} (cm)	0.9					
	$z_{pii,\alpha}$ (cm)	0.9					
	f_{awf} (MHz)	4.81	4.80		4.80		#
Other information	prr (Hz)	1563					
	srr (Hz)	—					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	3.6					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	6.6					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	9.0					
	p_r at z_{pii} (MPa)	0.37					
Operating controls	Exam type	Ophthalmic	Ophthalmic		Ophthalmic		
	Gate size (mm)	1	3		3		
	Gate position (cm)	Zone 3 (1.3)	Zone 11 (7.0)		Zone 11 (7.0)		
	PRF (Hz)	1562	7812		7812		
	TDI	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14-24: Transducer model: L15-4 Operating mode: 2D

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.44	0.60		0.60		(b)
Index component value			0.60	0.60	0.60	0.60	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	3.40					
	P (mW)		72.8		72.8		#
	P_{1x1} (mW)		15.0		15.0		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	1.0					
	$z_{pii,\alpha}$ (cm)	1.0					
	f_{awf} (MHz)	5.58	8.60		8.60		#
Other information	*prr* (Hz)	4611					
	srr (Hz)	10.5					
	n_{pps}	3					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	247.0					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	22.1					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	32.7					
	p_r at z_{pii} (MPa)	3.90					
Operating controls	Exam type	Venous	Superficial		Superficial		
	Optimization	Gen	Gen		Gen		
	Depth (cm)	6.0	6.0		6.0		
	MB/THI	On/on	Off/off		Off/off		
	AQ zoom	—	—		—		
	Needle profiling	Off	Off		Off		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–25: Transducer model: L15–4 Operating mode: 2D + M Mode

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.44	0.70		0.75		(b)
Index component value			0.70	0.64	0.69	0.75	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	3.40					
	P (mW)		67.5		73.8		#
	P_{1x1} (mW)		17.6		19.3		
	z_s (cm)			1.0			
	z_b (cm)					0.95	
	z_{MI} (cm)	1.0					
	$z_{pii,\alpha}$ (cm)	1.0					
	f_{awf} (MHz)	5.58	8.59		7.74		#
Other information	prr (Hz)	3931					
	srr (Hz)	13.8					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	247.0					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	18.8					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	27.8					
	p_r at z_{pii} (MPa)	3.90					
Operating controls	Exam type	MSK	Superficial		MSK		
	Optimization	Gen	Gen		Gen		
	Depth (cm)	6.0	6.0		6.0		
	MB/THI	Off/on	Off/off		Off/off		
	AQ zoom	—	—		—		
	Needle profiling	—	—		—		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14-26: Transducer model: L15-4 Operating mode: Color/CPD

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.44	1.04		1.04		(b)
Index component value			1.04	1.04	1.04	1.04	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	3.40					
	P (mW)		55.8		55.8		#
	P_{1x1} (mW)		36.4		36.4		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	1.0					
	$z_{pii,\alpha}$ (cm)	1.0					
	f_{awf} (MHz)	5.58	5.87		5.87		#
Other information	*prr* (Hz)	2387					
	srr (Hz)	13.9					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	247.0					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	11.3					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	16.7					
	p_r at z_{pii} (MPa)	3.90					
Operating controls	Exam type	Venous	Breast		Breast		
	Mode	CVD	CVD		CVD		
	2D optimization/depth (cm)	Gen/6.0	Res/6.0		Res/6.0		
	THI	On	Off		Off		
	Color optimization/PRF (Hz)	High/4808	Low/1096		Low/1096		
	Color box position/size	Default/default	Default/ narrow-short		Default/ narrow-short		
	AQ zoom	—	—		—		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–27: Transducer model: L15–4 Operating mode: PW Doppler

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.86	0.92		2.01		(b)
Index component value			0.92	0.74	0.92	2.01	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	1.98					
	P (mW)		43.7		43.7		#
	P_{1x1} (mW)		36.4		36.4		
	z_s (cm)			1.1			
	z_b (cm)					1.15	
	z_{MI} (cm)	0.9					
	$z_{pii,\alpha}$ (cm)	0.9					
	f_{awf} (MHz)	5.33	5.31		5.31		#
Other information	prr (Hz)	1563					
	srr (Hz)	—					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	181.8					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	342.0					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	468.7					
	p_r at z_{pii} (MPa)	2.27					
Operating controls	Exam type	Venous	Venous		Venous		
	Gate size (mm)	1	1		1		
	Gate position (cm)	Zone 3 (1.1)	Zone 11 (4.7)		Zone 11 (4.7)		
	PRF (Hz)	1562	2604		2604		
	TDI	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–28: Transducer model: L15–4 Operating mode: 2D + PW Doppler

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.44	0.95		1.95		(b)
Index component value			0.95	0.79	0.95	1.95	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	4.20					
	P (mW)		56.2		56.2		#
	P_{1x1} (mW)		35.7		35.7		
	z_s (cm)			1.1			
	z_b (cm)					1.15	
	z_{MI} (cm)	0.4					
	$z_{pii,\alpha}$ (cm)	0.4					
	f_{awf} (MHz)	8.48	5.31		5.31		#
Other information	prr (Hz)	4688					
	srr (Hz)	21.4					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	640.1					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	5.2					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	9.9					
	p_r at z_{pii} (MPa)	4.75					
Operating controls	Exam type	Venous	Venous		Venous		
	Optimization/depth (cm)	Res/1.7	Gen/6.0		Gen/6.0		
	THI	On	On		On		
	Gate size (mm)	1	1		1		
	Gate position (cm)	Zone 0 (0.4)	Zone 11 (4.7)		Zone 11 (4.7)		
	PRF (Hz)	1562	1953		1953		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–29: Transducer model: L15–4 Operating mode: 2D + PW Doppler + Color

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.37	1.05		1.91		(b)
Index component value			1.05	0.91	1.05	1.91	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	4.05					
	P (mW)		65.1		68.2		#
	P_{1x1} (mW)		41.3		41.2		
	z_s (cm)			1.0			
	z_b (cm)					1.15	
	z_{MI} (cm)	1.2					
	$z_{pii,\alpha}$ (cm)	1.2					
	f_{awf} (MHz)	8.76	5.31		5.30		#
Other information	prr (Hz)	1724					
	srr (Hz)	11.7					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	443.2					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	2.0					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	3.6					
	p_r at z_{pii} (MPa)	5.52					
Operating controls	Exam type	Venous	Venous		Venous		
	2D optimization/depth (cm)	Gen/2.5	Res/5.3		Gen/6.0		
	THI	On	On		On		
	Color optimization/PRF (Hz)	NA/1953	NA/1953		NA/1953		
	Gate size (mm)	1	1		1		
	Gate position (cm)	Zone 0 (0.4)	Zone 10 (4.3)		Zone 11 (4.7)		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–30: Transducer model: L19–5 Operating mode: 2D

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.52	1.01		1.01		(b)
Index component value			1.01	1.01	1.01	1.01	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	3.87					
	P (mW)		41.3		41.3		#
	P_{1x1} (mW)		23.1		23.1		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	0.7					
	$z_{pii,\alpha}$ (cm)	0.7					
	f_{awf} (MHz)	6.49	9.20		9.20		#
Other information	*prr* (Hz)	2538					
	srr (Hz)	12.8					
	n_{pps}	3					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	411.9					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	47.4					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	63.9					
	p_r at z_{pii} (MPa)	4.49					
Operating controls	Exam type	Superficial	MSK		MSK		
	Optimization	Gen	Gen		Gen		
	Depth (cm)	4.5	5.2		5.2		
	MB/THI	On/on	On/off		On/off		
	AQ zoom	—	—		—		
	Needle profiling	On	Off		Off		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–31: Transducer model: L19–5 Operating mode: 2D + M Mode

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.52	1.01		1.05		(b)
Index component value			1.01	0.95	1.01	1.05	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	4.17					
	P (mW)		38.2		38.2		#
	P_{1x1} (mW)		22.6		22.6		
	z_s (cm)			0.8			
	z_b (cm)					0.8	
	z_{MI} (cm)	0.8					
	$z_{pii,\alpha}$ (cm)	0.8					
	f_{awf} (MHz)	7.56	9.26		9.26		#
Other information	prr (Hz)	3813					
	srr (Hz)	26.7					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	467.0					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	11.7					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	17.3					
	p_r at z_{pii} (MPa)	5.14					
Operating controls	Exam type	Superficial	MSK		MSK		
	Optimization	Gen	Gen		Gen		
	Depth (cm)	2.5	4.5		4.5		
	MB/THI	Off/on	Off/off		Off/off		
	AQ zoom	—	—		—		
	Needle profiling	—	—		—		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–32: Transducer model: L19–5 Operating mode: Color/CPD

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.52	1.46		1.46		(b)
Index component value			1.46	1.46	1.46	1.46	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	4.17					
	P (mW)		52.2		52.2		#
	P_{1x1} (mW)		43.1		43.1		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	0.8					
	$z_{pii,\alpha}$ (cm)	0.8					
	f_{awf} (MHz)	7.56	6.79		6.79		#
Other information	*prr* (Hz)	3140					
	srr (Hz)	24.3					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	467.0					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	9.5					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	14.1					
	p_r at z_{pii} (MPa)	5.14					
Operating controls	Exam type	Venous	Superficial		Superficial		
	Mode	Color	Color		Color		
	2D optimization/depth (cm)	Res/2.9	Gen/4.8		Gen/4.8		
	THI	On	Off		Off		
	Color optimization/PRF (Hz)	Med/1866	Low/1667		Low/1667		
	Color box position/size	Default/wide	Default/default		Default/default		
	AQ zoom	—	—		—		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–33: Transducer model: L19-5 Operating mode: PW Doppler

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.00	1.16		2.29		(b)
Index component value			1.16	0.85	1.16	2.29	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	2.46					
	P (mW)		40.7		40.7		#
	P_{1x1} (mW)		40.7		40.7		
	z_s (cm)			0.75			
	z_b (cm)					0.75	
	z_{MI} (cm)	0.5					
	$z_{pii,\alpha}$ (cm)	0.5					
	f_{awf} (MHz)	6.02	6.02		6.02		#
Other information	prr (Hz)	1563					
	srr (Hz)	—					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	236.7					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	467.3					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	576.1					
	p_r at z_{pii} (MPa)	2.73					
Operating controls	Exam type	Nerve	Nerve		Nerve		
	Gate size (mm)	1	1		1		
	Gate position (cm)	Zone 3 (0.9)	Zone 12 (4.4)		Zone 12 (4.4)		
	PRF (Hz)	1562	3906		3906		
	TDI	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–34: Transducer model: L19–5 Operating mode: 2D + PW Doppler

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.52	1.17		2.07		(b)
Index component value			1.17	0.90	1.17	2.07	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	4.73					
	P (mW)		41.2		41.2		#
	P_{1x1} (mW)		38.2		38.2		
	z_s (cm)			0.75			
	z_b (cm)					0.75	
	z_{MI} (cm)	0.85					
	$z_{pii,\alpha}$ (cm)	0.85					
	f_{awf} (MHz)	9.76	6.06		6.06		#
Other information	*prr* (Hz)	4688					
	srr (Hz)	24.4					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	762.3					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	16.2					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	27.4					
	p_r at z_{pii} (MPa)	6.27					
Operating controls	Exam type	Venous	Venous		Venous		
	Optimization/depth (cm)	Gen/2.2	Gen/5.2		Gen/5.2		
	THI	On	On		On		
	Gate size (mm)	1	1		1		
	Gate position (cm)	Zone 1 (0.4)	Zone 12 (4.4)		Zone 12 (4.4)		
	PRF (Hz)	1562	6250		6250		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–35: Transducer model: L19–5 Operating mode: 2D + PW Doppler + Color

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.52	1.18		1.87		(b)
Index component value			1.18	0.99	1.14	1.87	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	4.73					
	P (mW)		46.3		43.4		#
	P_{1x1} (mW)		38.5		37.9		
	z_s (cm)			0.75			
	z_b (cm)					0.75	
	z_{MI} (cm)	0.85					
	$z_{pii,\alpha}$ (cm)	0.85					
	f_{awf} (MHz)	9.76	6.06		6.04		#
Other information	*prr* (Hz)	3210					
	srr (Hz)	24.9					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	762.3					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	11.1					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	18.7					
	p_r at z_{pii} (MPa)	6.27					
Operating controls	Exam type	Venous	Venous		Venous		
	2D optimization/depth (cm)	Gen/2.2	Res/5.2		Gen/5.2		
	THI	On	On		On		
	Color optimization/PRF (Hz)	NA/2604	NA/1562		NA/2604		
	Gate size (mm)	1	1		1		
	Gate position (cm)	Zone 1 (0.4)	Zone 12 (4.4)		Zone 12 (4.4)		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14-36: Transducer model: L19-5 Ophthalmic Operating mode: 2D

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.17	0.02		0.02		(b)
Index component value			0.022	0.022	0.022	0.022	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	0.59					
	P (mW)		0.67		0.67		#
	P_{1x1} (mW)		0.37		0.37		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	1.45					
	$z_{pii,\alpha}$ (cm)	1.45					
	f_{awf} (MHz)	12.58	12.34		12.34		#
Other information	*prr* (Hz)	5726					
	srr (Hz)	14.9					
	n_{pps}	3					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	18.0					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	0.6					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	1.4					
	p_r at z_{pii} (MPa)	1.09					
Operating controls	Exam type	Ophthalmic	Ophthalmic		Ophthalmic		
	Optimization	Res	Res		Res		
	Depth (cm)	4.1	6.0		6.0		
	MB/THI	On/off	On/off		On/off		
	AQ zoom	—	—		—		
	Needle profiling	—	—		—		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–37: Transducer model: L19–5 Ophthalmic Operating mode: 2D + M Mode

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.16	0.02		0.02		(b)
Index component value			0.020	0.018	0.020	0.020	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	0.57					
	P (mW)		0.56		0.56		#
	P_{1x1} (mW)		0.33		0.33		
	z_s (cm)			0.75			
	z_b (cm)					0.9	
	z_{MI} (cm)	0.9					
	$z_{pii,\alpha}$ (cm)	0.9					
	f_{awf} (MHz)	12.45	12.41		12.41		#
Other information	prr (Hz)	3813					
	srr (Hz)	26.7					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	15.9					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	0.2					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	0.5					
	p_r at z_{pii} (MPa)	0.83					
Operating controls	Exam type	Ophthalmic	Ophthalmic		Ophthalmic		
	Optimization	Res	Res		Res		
	Depth (cm)	1.4	4.1		4.1		
	MB/THI	Off/off	Off/off		Off/off		
	AQ zoom	—	—		—		
	Needle profiling	—	—		—		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–38: Transducer model: L19–5 Ophthalmic Operating mode: Color/CPD

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.17	0.04		0.04		(b)
Index component value			0.036	0.036	0.036	0.036	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	0.42					
	P (mW)		1.47		1.47		#
	P_{1x1} (mW)		1.08		1.08		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	0.7					
	$z_{pii,\alpha}$ (cm)	0.7					
	f_{awf} (MHz)	6.13	6.13		6.13		#
Other information	*prr* (Hz)	9063					
	srr (Hz)	24.8					
	n_{pps}	12					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	5.2					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	2.9					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	3.7					
	p_r at z_{pii} (MPa)	0.50					
Operating controls	Exam type	Ophthalmic	Ophthalmic		Ophthalmic		
	Mode	Color	Color		Color		
	2D optimization/depth (cm)	Res/2.9	Res/4.8		Res/4.8		
	THI	Off	Off		Off		
	Color optimization/PRF (Hz)	Medium/1645	Medium/2976		Medium/2976		
	Color box position/size	Default/default	Bottom/default		Bottom/default		
	AQ zoom	—	—		—		
	Variable sector	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–39: Transducer model: L19-5 Ophthalmic Operating mode: PW Doppler

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.15	0.10		0.19		(b)
Index component value			0.100	0.083	0.100	0.190	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	0.38					
	P (mW)		3.71		3.71		#
	P_{1x1} (mW)		3.50		3.50		
	z_s (cm)			0.6			
	z_b (cm)					0.6	
	z_{MI} (cm)	0.65					
	$z_{pii,\alpha}$ (cm)	0.65					
	f_{awf} (MHz)	6.01	6.01		6.01		#
Other information	prr (Hz)	1563					
	srr (Hz)	—					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	5.2					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	21.0					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	28.0					
	p_r at z_{pii} (MPa)	0.44					
Operating controls	Exam type	Ophthalmic	Ophthalmic		Ophthalmic		
	Gate size (mm)	2	2		2		
	Gate position (cm)	Zone 5 (1.4)	Zone 13 (4.7)		Zone 13 (4.7)		
	PRF (Hz)	1562	10417		10417		
	TDI	—	—		—		

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14-40: Transducer model: P5-1 Operating mode: 2D

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.52	1.55		1.55		3.33
Index component value			1.55	1.55	1.55	1.55	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	2.18					
	P (mW)		174.3		174.3		147.8
	P_{1x1} (mW)		157.9		157.9		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	1.0					
	$z_{pii,\alpha}$ (cm)	1.0					
	f_{awf} (MHz)	2.06	2.06		2.06		2.08
Other information	*prr* (Hz)	3100					
	srr (Hz)	100.0					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	167.3					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	109.1					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	118.7					
	p_r at z_{pii} (MPa)	1.94					
Operating controls	Exam type	Cardiac	Cardiac		Cardiac		OB
	Optimization	Gen	Gen		Gen		Gen
	Depth (cm)	5.0	7.0		7.0		7.0
	MB/THI	Off/on	Off/on		Off/on		Off/on
	AQ zoom	Off	Medium/middle		Medium/middle		Small/ middle
	Needle profiling	—	—		—		—
	Variable sector	Minimum	Off		Off		—

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–41: Transducer model: P5–1 Operating mode: 2D + M Mode

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.52	1.55		2.20		3.39
Index component value			1.55	1.50	1.44	2.20	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	2.18					
	P (mW)		171.3		164.4		146.7
	P_{1x1} (mW)		156.9		142.6		
	z_s (cm)			1.8			
	z_b (cm)					3.8	
	z_{MI} (cm)	1.0					
	$z_{pii,\alpha}$ (cm)	1.0					
	f_{awf} (MHz)	2.06	2.07		2.11		2.09
Other information	prr (Hz)	3556					
	srr (Hz)	44.4					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	167.3					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	54.6					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	59.4					
	p_r at z_{pii} (MPa)	1.94					
Operating controls	Exam type	Cardiac	Cardiac		Abdomen		Abdomen
	Optimization	Gen	Gen		Gen		Gen
	Depth (cm)	5.0	7.0		11.0		7.0
	MB/THI	Off/on	Off/on		Off/on		Off/on
	AQ zoom	Off	Medium/middle		Small/middle		Small/ middle
	Needle profiling	—	—		—		—
	Variable sector	Off	Off		—		—

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14-42: Transducer model: P5-1 Operating mode: Color/CPD

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.49	1.59		1.59		3.32
Index component value			1.59	1.59	1.59	1.59	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	2.18					
	P (mW)		182.8		182.8		182.8
	P_{1x1} (mW)		158.0		158.0		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	3.0					
	$z_{pii,\alpha}$ (cm)	3.0					
	f_{awf} (MHz)	2.13	2.10		2.10		2.10
Other information	*prr* (Hz)	1652					
	srr (Hz)	19.0					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	168.4					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	10.4					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	12.1					
	p_r at z_{pii} (MPa)	2.60					
Operating controls	Exam type	OB	Abdomen		Abdomen		Abdomen
	Mode	Color	Color		Color		Color
	2D optimization/depth (cm)	Pen/5.0	Gen/11.0		Gen/11.0		Gen/11.0
	THI	Off	Off		Off		Off
	Color optimization/PRF (Hz)	Low/273	High/1894		High/1894		High/1894
	Color box position/size	Default/narrow-short	Default/narrow		Default/narrow		Default/narrow
	AQ zoom	Off	On		On		On
	Variable sector	—	—		—		—

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–43: Transducer model: P5–1 Operating mode: PW Doppler

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		1.52	1.54		4.20		3.50
Index component value			1.13	1.54	1.11	4.20	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	2.32					
	P (mW)		218.9		214.5		234.4
	P_{1x1} (mW)		114.0		111.7		
	z_s (cm)			2.4			
	z_b (cm)					3.4	
	z_{MI} (cm)	3.6					
	$z_{pii,\alpha}$ (cm)	3.6					
	f_{awf} (MHz)	233	2.09		2.09		2.08
Other information	prr (Hz)	1008					
	srr (Hz)	—					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	285.8					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	379.0					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	689.4					
	p_r at z_{pii} (MPa)	3.00					
Operating controls	Exam type	Cardiac	Cardiac		Abdomen		Abdomen
	Gate size (mm)	1	5		5		2
	Gate position (cm)	Zone 3 (4.6)	Zone 11 (22.0)		Zone 8 (14.0)		Zone 12 (25.4)
	PRF (Hz)	1008	1953		2604		2604
	TDI	On	Off		—		—

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14-44: Transducer model: P5-1 Operating mode: CW Doppler

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		(a)	1.14		3.87		2.62
Index component value			1.14	0.89	1.02	3.87	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	#					
	P (mW)		120.1		106.7		120.1
	P_{1x1} (mW)		120.1		106.7		
	z_s (cm)			1.8			
	z_b (cm)					2.8	
	z_{MI} (cm)	#					
	$z_{pii,\alpha}$ (cm)	#					
	f_{awf} (MHz)	#	2.00		2.00		2.00
Other information	*prr* (Hz)	#					
	srr (Hz)	#					
	n_{pps}	#					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	#					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	#					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	#					
	p_r at z_{pii} (MPa)	#					
Operating controls	Exam type		Cardiac		Cardiac		Cardiac
	Gate position (cm)		Zone 12 (25.4)		Zone 4 (6.1)		Zone 12 (25.4)

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14-45: Transducer model: P5-1 Orbital Operating mode: 2D

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.15	0.02		0.02		0.04
Index component value			0.021	0.021	0.021	0.021	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	0.26					
	P (mW)		2.69		2.69		2.69
	P_{1x1} (mW)		1.74		1.74		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	1.6					
	$z_{pii,\alpha}$ (cm)	1.6					
	f_{awf} (MHz)	2.92	2.56		2.56		2.56
Other information	prr (Hz)	11273					
	srr (Hz)	87.4					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	3.1					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	0.6					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	0.7					
	p_r at z_{pii} (MPa)	0.30					
Operating controls	Exam type	Orbital	Orbital		Orbital		Orbital
	Optimization	Gen	Pen		Pen		Pen
	Depth (cm)	5.0	5.0		5.0		5.0
	MB/THI	Off/off	Off/off		Off/off		Off/off
	AQ zoom	—	—		—		—
	Needle profiling	—	—		—		—
	Variable sector	—	—		—		—

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14–46: Transducer model: P5–1 Orbital Operating mode: 2D + M Mode

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.15	0.02		0.02		0.03
Index component value			0.019	0.019	0.019	0.021	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	0.26					
	P (mW)		2.12		2.12		2.12
	P_{1x1} (mW)		1.40		1.40		
	z_s (cm)			1.4			
	z_b (cm)					1.4	
	z_{MI} (cm)	1.6					
	$z_{pii,\alpha}$ (cm)	1.6					
	f_{awf} (MHz)	2.92	2.92		2.92		2.92
Other information	*prr* (Hz)	10720					
	srr (Hz)	80.0					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	3.1					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	0.6					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	0.7					
	p_r at z_{pii} (MPa)	0.30					
Operating controls	Exam type	Orbital	Orbital		Orbital		Orbital
	Optimization	Gen	Gen		Gen		Gen
	Depth (cm)	5.0	5.0		5.0		5.0
	MB/THI	Off/off	Off/off		Off/off		Off/off
	AQ zoom	—	—		—		—
	Needle profiling	—	—		—		—
	Variable sector	—	—		—		—

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14-47: Transducer model: P5-1 Orbital Operating mode: Color/CPD

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.17	0.09		0.09		0.18
Index component value			0.088	0.088	0.088	0.088	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	0.25					
	P (mW)		9.81		9.81		9.81
	P_{1x1} (mW)		8.55		8.55		
	z_s (cm)			—			
	z_b (cm)					—	
	z_{MI} (cm)	3.6					
	$z_{pii,\alpha}$ (cm)	3.6					
	f_{awf} (MHz)	2.11	2.11		2.11		2.11
Other information	*prr* (Hz)	2071					
	srr (Hz)	7.3					
	n_{pps}	14					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	2.0					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	2.8					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	4.2					
	p_r at z_{pii} (MPa)	0.37					
Operating controls	Exam type	Orbital	Orbital		Orbital		Orbital
	Mode	Color	Color		Color		Color
	2D optimization/depth (cm)	Gen/ 31.0	Gen/5.0		Gen/5.0		Gen/5.0
	THI	Off	Off		Off		Off
	Color optimization/PRF (Hz)	Low/ 710	Low/1016		Low/1016		Low/1016
	Color box position/size	Default/ default	Top/wide-short		Top/wide-short		Top/ wide-short
	AQ zoom	—	—		—		—
	Variable sector	—	—		—		—

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Table 14-48: Transducer model: P5-1 Orbital Operating mode: PW Doppler

Index label		MI	TIS		TIB		TIC
			At surface	Below surface	At surface	Below surface	At surface
Maximum index value		0.17	0.16		0.40		0.32
Index component value			0.11	0.16	0.11	0.40	
Acoustic parameters	$p_{r,\alpha}$ at z_{MI} (MPa)	0.25					
	P (mW)		21.7		21.7		21.7
	P_{1x1} (mW)		11.3		11.3		
	z_s (cm)			2.2			
	z_b (cm)					3.6	
	z_{MI} (cm)	3.4					
	$z_{pii,\alpha}$ (cm)	3.4					
	f_{awf} (MHz)	2.10	2.09		2.09		2.09
Other information	*prr* (Hz)	3906					
	srr (Hz)	—					
	n_{pps}	1					
	$I_{pa,\alpha}$ at $z_{pii,\alpha}$ (W/cm^2)	2.0					
	$I_{spta,\alpha}$ at $z_{pii,\alpha}$ or $z_{sii,\alpha}$ (mW/cm^2)	29.0					
	I_{spta} at z_{pii} or z_{sii} (mW/cm^2)	48.2					
	p_r at z_{pii} (MPa)	0.31					
Operating controls	Exam type	Orbital	Orbital		Orbital		Orbital
	Gate size (mm)	3	5		5		5
	Gate position (cm)	Zone 3 (4.6)	Zone 10 (18.9)		Zone 10 (18.9)		Zone 10 (18.9)
	PRF (Hz)	3906	3125		3125		3125
	TDI	—	—		—		—

(a) This index is not required for this operating mode; value is <1.
(b) This transducer is not intended for transcranial or neonatal cephalic uses.
No data are reported for this operating condition since the global maximum index value is not reported for the reason listed. (Reference global maximum index value line.)
— Not applicable for this transducer/mode.

Acoustic measurement precision and uncertainty

All table entries have been obtained at the same operating conditions that give rise to the maximum index value in the first row of the table. Measurement uncertainty for power, pressure, intensity, and other quantities that are used to derive the values in the acoustic output table are shown in the table below.

Table 14-49: Acoustic measurement uncertainty

Parameter	Uncertainty (95% confidence)		
	C5-1, IC10-3, P5-1	L12-3, L15-4	L19-5
p_r	+11.2 to -9.3%	+12.5 to -12.3%	+13.4 to -13.1%
$p_{r.3}$	+11.2 to -9.4%	+12.5 to -12.3%	+13.5 to -13.2%
P	±11.7%	±11.7%	±16.2%
f_{awf}	±1.0%	±1.0%	±1.0%
Pii	+19.4 to -14.1%	+21.8 to -21.3%	+24.1 to -23.2%
Pii.3	+19.5 to -14.2%	+21.9 to -21.4%	+24.2 to -23.3%

Terminology in acoustic output tables

Table 14-50: Acoustic output terminology

Term	Definition
α	Attenuation coefficient used for derating. Equal to 0.3 dB/cm/MHz^2.
f_{awf}	Acoustic working frequency.
$I_{pa,\alpha}$	Attenuated pulse-average intensity.
I_{spta}	Spatial-peak temporal-average intensity.
$I_{spta,\alpha}$	Attenuated spatial-peak temporal-average intensity.
MI	Mechanical index.
P	Output power.
P_{1x1}	Bounded-square output power.
$p_{r,\alpha}$	Attenuated peak-rarefactional acoustic pressure.
p_r	Peak-rarefactional acoustic pressure.
pii	Pulse-intensity integral.

Table 14–50: Acoustic output terminology

Term	Definition
pii,α	Attenuated pulse-intensity integral.
n_{pps}	Number of pulses per ultrasonic scan line.
prr	Pulse repetition rate.
srr	Scan repetition rate.
TI	Thermal index.
TIB	Bone thermal index.
TIC	Cranial-bone thermal index.
TIS	Soft-tissue thermal index.
z_b	Depth for TIB.
z_{MI}	Depth for mechanical index.
z_{pii}	Depth for peak pulse-intensity integral.
$z_{pii,\alpha}$	Depth for peak attenuated pulse-intensity integral.
z_{sii}	Depth for peak sum of pulse-intensity integrals.
$z_{sii,\alpha}$	Depth for peak sum of attenuated pulse-intensity integrals.
z_s	Depth for TIS.

CHAPTER 15

IT Network

Functions

This device can be connected to an IT network to perform the following functions:

- Storing the examination data (static images, clips) acquired by this device in a Picture Archiving and Communication System (PACS) by DICOM communication.
- Querying examination orders from the Modality Worklist (MWL) server by DICOM communication and starting them.
- Setting the time of this device by interrogating the network time service.
- Communicating procedure status via the Modality Performed Procedure Step (MPPS) service.
- Requesting transfer of responsibility for image ownership to another system via the Storage Commitment service.

Data backup

- Perform data backups regularly as part of your organization's disaster recovery plan. Doing so will help ensure proper system operation and data integrity. Fujfilm Sonosite recommends that you allow only the authorized system administrator to back up the ePHI, audit log and system configurable data.
- Keep data backups on modern types of media to ensure data is not lost due to technology obsolescence.

Network for connecting the device

To ensure security and privacy, use an IT network that is isolated from the external environment by a firewall.

Specifications for the connection

Hardware specification

- 802.11 a/b/g/n/ac
- Ethernet 10/100/1000 BASE-T using RJ45 port with patch cable

Security and privacy

- The port for DICOM communication (specified by the user in the system settings; typically port 104, 2762, or 11112) is used for outgoing communication to the network.
- Anti-virus software is not installed on this device.
- This device has a single configurable listening port for the purposes of DICOM Echo and Storage Commitment.
- The security and privacy-related configurable controls in Sonosite PX are:
  - User roles and responsibilities
  - Automatic user log off
  - User authorization and authentication
  - Data backup and recovery
  - Data encryption (at rest and in transit)
- System and department administrators should follow the suggested technical and physical safeguards listed below, as well as the detailed HIPAA guidelines to ensure HIPAA compliance:
  - **Room Access Control:** Local procedures must be put in place to limit physical access to medical equipment, to prevent accidental, casual, or deliberate contact by unauthorized individuals.
  - **System Access Controls:** Access the system only through unique user accounts. Login credentials must not be disclosed.
  - **Audit Controls:** Each user action associated with patient data will be tracked through ePHI audit logs, which are accessible to and should be routinely audited by the administrator.
  - **De-identification:** Use a de-identification option before exporting patient data to removable media used for system troubleshooting or repair.
  - **Removable media handling:** Removable media that contains images or other medical information must be stored in a secure area that is not accessible by unauthorized individuals.
  - **Transmission Security:** Clinical data transmitted over the network may not be encrypted. Add only trusted devices to the network. (We highly recommend the use of encrypted DICOM. If secure DICOM is not supported, then network security controls shall be implemented to protect integrity and confidentiality of data).
  - **Data Integrity:** Cryptographic methods should be used at all times to ensure the integrity of personal data. When possible, perform integrity checks to identify unauthorized changes in personal data. In case there is suspicion of improperly altered or destroyed clinical data, notify Fujfilm Sonosite service.

- **Data Encryption:** Data at rest should be encrypted at the disk level as well as the database level with a valid FIPS 140-2 compliant encryption method. Encryption keys should be kept secured and maintained only by system administrators.
- **System Hardening:** The application and database hosting server(s) should be hardened according to the NIST 800-123 server security controls.

- Software Updates: Only Fujfilm Sonosite authorized updates and/or patches should be applied to the medical device.

Data flow

DICOM

MWL Server ----------> Sonosite PX ----------> PACS
Study order (DICOM MWL) Study data (DICOM Storage)

Please refer to the Sonosite PX *DICOM Conformance Statement* for details.

Caution

1. Connection of equipment to an IT network that includes other systems could result in previously unidentified risks to patients, operators or third parties. Before connecting the equipment to an uncontrolled IT Network, make sure that all potential risks resulting from such connections were identified and evaluated, and suitable countermeasures were put in place. IEC 80001-1:2010 provides guidance for addressing these risks.
2. When a setting of the IT network to which this device is connected has been changed, check that the change does not affect this device and take measures if necessary. Changes to the IT network include:
   - Changes in network configuration (IP address, router etc.)
   - Connection of additional items
   - Disconnection of items
   - Update of equipment
   - Upgrade of equipment

   Any changes to the IT network could introduce new risks requiring additional evaluation to be performed as per item 1 above.

Whitelisting

Whitelisting prevents unauthorized use of the ultrasound system.

- The system only allows execution of software that is configured in the whitelist.
- The system blocks attempts to change, overwrite or delete all files that are included in the whitelist.
- The whitelist is not configurable by the user. Whitelist configuration on the system is part of the Fujifilm Sonosite software installation process.
- The system only allows a whitelist change when the change is initiated by a digitally signed software component, such as a Fujifilm Sonosite update.
- The system logs any attempt to change or delete whitelist files.
- The system logs any attempt to change the whitelist configuration.
- The system logs any attempt to load or execute unauthorized software files.

System logs should be routinely audited by the administrator.

IT network failure recovery measures

Connection to an IT network may become, at times, unreliable, and this may lead to failure to perform the functions described in **"Functions"** on page 15-1. As a result, the following hazardous situations may occur:

Network failure	Impact on equipment	Hazard	Sonosite PX countermeasures
IT network becomes unstable	Unable to transmit exam data to a PACS	Delay of diagnosis	Sonosite PX has internal memory, and exam data is stored in it. After the IT network has returned to stable, the system automatically re-initiates the transfer of data.
	Delay of transmission to a PACS		
	Incorrect data transmitted to a PACS	Misdiagnosis	Integrity of the data is ensured by the TCP/IP and DICOM Protocols used by Sonosite PX.
	Unable to get order data from an MWL server	Delay of exam	On Sonosite PX, the user can initiate/create a new study.
	Delay of getting order from an MWL server		
	Incorrect data from a MWL server	Incorrect exam	Sonosite PX uses the TCP/IP and DICOM Protocols. Integrity of the data is ensured by them.
	Unable to get the time from a time server.	Incorrect exam data	Sonosite PX has the capability of entering data and time manually.
	Incorrect time data		Sonosite PX always indicates the date and the time on the main screen.

Network failure	Impact on equipment	Hazard	Sonosite PX countermeasures
Firewall has broken down	Attack via network	Manipulation of exam data	Sonosite PX closes unnecessary network ports.
	Infection by computer virus	Leak of exam data	Sonosite PX prevents a user from loading software and executing it.

Glossary

Terms

For ultrasound terms not included in this glossary, refer to *Recommended Ultrasound Terminology, Third Edition,* published in 2011 by the American Institute of Ultrasound in Medicine (AIUM).

ACEP	American College of Emergency Physicians
as low as reasonably achievable (ALARA)	The guiding principle of ultrasound use, which states that you should keep patient exposure to ultrasound energy as low as reasonably achievable for diagnostic results.
curved array transducer	Identified by the letter C (curved or curvilinear) and a number (60). The number corresponds to the radius of curvature of the array expressed in millimeters. The transducer elements are electrically configured to control the characteristics and direction of the acoustic beam. For example, C60xp.
depth	Refers to the depth of the display. A constant speed of sound of 1538.5 meters/second is assumed in the calculation of echo position in the image.
D-line	Refers to the focus position of the ultrasound beam during Doppler imaging.
in situ	In the natural or original position.
linear array transducer	Identified by the letter L (linear) and a number (38). The number corresponds to the length of the array expressed in millimeters. The transducer elements are electrically configured to control the characteristics and direction of the acoustic beam. For example, L38xp.
mechanical index (MI)	An indication of the likelihood of mechanical bioeffects occurring: the higher the MI, the greater the likelihood of mechanical bioeffects. See **Chapter 14, "Acoustic Output,"** for a more complete description of MI.
MI/TI	Refer to *mechanical index (MI)* and *thermal index (TI).*
M-line	Refers to the focus position of the ultrasound beam during M Mode imaging.
phased array transducer	A transducer designed primarily for cardiac scanning. Forms a sector image by electronically steering the beam direction and focus. For example, P21xp.
skinline	A depth on the display that corresponds to the skin/transducer interface.

SonoMB technology	A subset of the 2D imaging mode in which the 2D image is enhanced by looking at a target from multiple angles and then merging or averaging the scanned data together to improve overall image quality and, in parallel, reducing noise and artifacts.
Tissue Doppler Imaging (TDI)	A pulsed wave Doppler technique used to detect myocardial motion.
thermal index (TI)	The ratio of total acoustic power to the acoustic power required to raise tissue temperature by 1°C under defined assumptions. See **Chapter 14, "Acoustic Output,"** for a more complete description of TI.
TIB (bone thermal index)	A thermal index for applications in which the ultrasound beam passes through soft tissue and a focal region is in the immediate vicinity of bone.
TIC (cranial bone thermal index)	A thermal index for applications in which the ultrasound beam passes through bone near the beam entrance into the body.
TIS (soft tissue thermal index)	A thermal index related to soft tissues.
Tissue Harmonic Imaging (THI)	Transmits at one frequency and receives at a higher harmonic frequency to reduce noise and clutter and improve resolution.
transducer	A device that transforms one form of energy into another form of energy. Ultrasound transducers contain piezoelectric elements, which when excited electrically, emit acoustic energy. When the acoustic energy is transmitted into the body, it travels until it encounters an interface, or change in tissue properties. At the interface, an echo is formed that returns to the transducer, where this acoustic energy is transformed into electrical energy, processed, and displayed as anatomical information.
variance	Displays a variation in Color Doppler flow imaging within a given sample. Variance is mapped to the color green and is used to detect turbulence.

Abbreviations

Table A-1: Abbreviations in the user interface

Abbreviation	Definition
A	"A" Wave Peak Velocity
A PG	"A" Wave Peak Pressure Gradient
A2Cd	Apical 2 Chamber diastolic
A2Cs	Apical 2 Chamber systolic
A4Cd	Apical 4 Chamber diastolic

Table A-1: Abbreviations in the user interface

Abbreviation	Definition
A4Cs	Apical 4 Chamber systolic
AAA	Abdominal Aortic Aneurysm
AAo or Asc Ao	Ascending Aorta
Abd	Abdomen
abs	Absolute value
AC	Abdominal Circumference
ACA	Anterior Cerebral Artery
ACoA	Anterior Communicating Artery
ACS	Aortic Valve Cusp Separation
Adur	"A" wave duration
AFI	Amniotic Fluid Index
AI	Aortic Insufficiency
AI PHT	Aortic Insufficiency Pressure Half Time
AL	Atlas Loop
Ann D	Annulus Diameter
ANT F	Anterior Far
ANT N	Anterior Near
Ao	Aorta
AoD	Aortic Root Diameter
Apical	Apical View
APTD	Anteroposterior Trunk Diameter
Art	Artery
AS	Aortic Stenosis
AT	Acceleration (Deceleration) Time
ATFL	Anterior Talofibular Ligament
AUA	Average Ultrasound Age Calculated by averaging the individual ultrasound ages for the fetal biometry measurements performed during the exam. The measurements used to determine the AUA are based on the selected OB calculation authors.

Table A-1: Abbreviations in the user interface

Abbreviation	Definition
AV	Aortic Valve
AV Area	Aortic Valve Area
AVA	Aortic Valve Area
BA	Basilar Artery
Bifur	Bifurcation
BP	Blood Pressure
BPD	Biparietal Diameter
BPM	Beats per Minute
BPP	Biophysical Profile
Bre	Breast
BSA	Body Surface Area
CBD	Common Bile Duct
CCA	Common Carotid Artery
CI	Cardiac Index
CIA	Common Iliac Artery
Cine	Cine buffer or loop. The cine buffer stores a sequence of images recorded over a certain time frame.
CM	Cisterna Magna
CMFN	CM From Nipple
CO	Cardiac Output
CPD	Color Power Doppler
Crd	Cardiac
CRL	Crown Rump Length
CVD	Color Velocity Doppler
CW	Continuous Wave Doppler
CxLen	Cervix Length
D or Diam	Diameter
D Apical	Distance Apical
DCCA	Distal Common Carotid Artery

Table A-1: Abbreviations in the user interface

Abbreviation	Definition
DECA	Distal External Carotid Artery
Decel	Deceleration time
DICA	Distal Internal Carotid Artery
Dist	Distal
dP/dt	Delta Pressure/Delta Time
E	"E" Wave Peak Velocity
E PG	"E" Wave Peak Pressure Gradient
E:A	E:A Ratio
E/e'	E velocity = Mitral Valve E velocity divided by the annular e' velocity
ECA	External Carotid Artery
ECICA	Extracranial Internal Carotid Artery
ECVA	Extracranial Vertebral Artery
EDA	End Diastolic Area
EDD	Estimated Date of Delivery
EDD by AUA	Estimated Date of Delivery by Average Ultrasound Age The estimated date of delivery calculated from the measurements performed during the exam.
EDD by LMP	Estimated Date of Delivery by Last Menstrual Period The due date calculated from the user-entered LMP.
EDV	End Diastolic Velocity
EF	Ejection Fraction
EF:SLOPE	E-F Slope
EFW	Estimated Fetal Weight Calculated from the measurements performed during the exam. The measurements used to determine EFW are defined by the currently selected EFW calculation author.
EIA	External Iliac Artery
Endo	Endocardial
Epi	Epicardial
EPSS	"E" Point Septal Separation

Table A-1: Abbreviations in the user interface

Abbreviation	Definition
ESA	End Systolic Area
ESI	Epidural Steroid Injection
Estab. DD	Established Due Date A user-entered due date based on previous exam data or other available information. The LMP is derived from the Established Due Date and is listed in the patient report as LMPd.
ET	Elapsed Time
FAC	Fractional Area Change
FH	Femoral Head
FHR	Fetal Heart Rate
FL	Femur Length
FM	Foramen Magnum (same as SO)
Foll	Follicle
FS	Fractional Shortening
FTA	Fetal Trunk Area
GA	Gestational Age
GA by LMP	Gestational Age by Last Menstrual Period The fetal age calculated using the date of the Last Menstrual Period (LMP).
GA by LMPd	Gestational Age by derived Last Menstrual Period The fetal age calculated using the Last Menstrual Period (LMPd) derived from the Estab. DD.
Gate	Depth of Doppler Gate
GB	Gallbladder
Gest	Gestational
GS	Gestational Sac
GSV	Great Saphenous Vein
Gyn	Gynecology
H	Height
HC	Head Circumference
HL	Humerus Length

Table A-1: Abbreviations in the user interface

Abbreviation	Definition
HR	Heart Rate
IAS	Interatrial Septum
ICA	Internal Carotid Artery
IIA	Internal Iliac Artery
IJV	Internal Jugular Vein
IMT	Intima Media Thickness
IOD	Inner Ocular Distance
IVC	Inferior Vena Cava
IVCT	Isovolumic Contraction Time
IVRT	Isovolumic Relaxation Time
IVS	Interventricular Septum
IVSd	Interventricular Septum Diastolic
IVSFT	Interventricular Septum Fractional Thickening
IVSs	Interventricular Septum Systolic
L	Length
LA	Left Atrium
LA/Ao	Left Atrium/Aorta Ratio
LAT F	Lateral Far
LAT N	Lateral Near
Lat V	Lateral Ventricle
LCL	Lateral Collateral Ligament
LMP	Last Menstrual Period
LMP	Last Menstrual Period The first day of the last menstrual period. Used to calculate gestational age and EDD.
LSV	Long Saphenous Vein
Lt	Left
LMPd	derived Last Menstrual Period Calculated from the user-entered Estab. DD.

Table A-1: Abbreviations in the user interface

Abbreviation	Definition
LV	Left Ventricular
LV Area	Left Ventricular Area
LV mass	Left Ventricular mass
LV Volume	Left Ventricular Volume
LVd	Left Ventricular diastolic
LVD	Left Ventricular Dimension
LVDd	Left Ventricular Dimension Diastolic
LVDFS	Left Ventricular Dimension Fractional Shortening
LVDs	Left Ventricular Dimension Systolic
LVEDV	Left Ventricular End Diastolic Volume
LVESV	Left Ventricular End Systolic Volume
LVET	Left Ventricular Ejection Time
LVO	Left Ventricular Opacification
LVOT	Left Ventricular Outflow Tract
LVOT Area	Left Ventricular Outflow Tract Area
LVOT D	Left Ventricular Outflow Tract Diameter
LVOT VTI	Left Ventricular Outflow Tract Velocity Time Integral
LVPW	Left Ventricular Posterior Wall
LVPWd	Left Ventricular Posterior Wall Diastolic
LVPWFT	Left Ventricular Posterior Wall Fractional Thickening
LVPWs	Left Ventricular Posterior Wall Systolic
LVs	Left Ventricular systolic
MB	SonoMB technology
MCA	Middle Cerebral Artery
MCCA	Mid Common Carotid Artery
MCL	Medial Collateral Ligament
MECA	Mid External Carotid Artery
MI	Mechanical Index

Table A–1: Abbreviations in the user interface

Abbreviation	Definition
MICA	Mid Internal Carotid Artery
Mid	Middle
MM	M Mode
MR PISA	Mitral Regurgitation Proximal Iso Velocity Surface Area
MR/VTI	Mitral Regurgitation/Velocity Time Integral
Msk	Musculoskeletal
MV	Mitral Valve
MV Area or MVA	Mitral Valve Area
MV Regurgitant Fraction	Mitral Valve Regurgitant Fraction
MV Regurgitant Volume	Mitral Valve Regurgitant Volume
MV/VTI	Mitral Valve/Velocity Time Integral
MV ERO	Mitral Valve Effective Regurgitant Orifice
MV PISA Area	Mitral Valve Proximal Iso Velocity Surface Area
MV Rate	Mitral Valve Rate
Neo	Neonatal
Nrv	Nerve
NST	Non-Stress Test
NT	Nuchal Translucency
OA	Ophthalmic Artery
OB	Obstetrical
OFD	Occipital Frontal Diameter
ONSD	Optic Nerve Sheath Diameter
OOD	Outer Occular Distance
Oph	Ophthalmic
Orb	Orbital
PAL	Phase Alternating Line
PCAp	Posterior Cerebral Artery Peak
PCCA	Proximal Common Carotid Artery

Table A-1: Abbreviations in the user interface

Abbreviation	Definition
PCoA or PComm	Posterior Communicating Artery
PECA	Proximal External Carotid Artery
PG Max	Maximum Pressure Gradient
PG Mean	Mean Pressure Gradient
PGr	Pressure Gradient
PHT	Pressure Half Time
PI	Pulsatility Index
PICA	Proximal Internal Carotid Artery
PISA	Proximal Isovelocity Surface Area
Plaq	Plaque
POST F	Posterior Far
POST N	Posterior Near
Post-V	Pre-void
Pre-V	Post-void
PRF	Pulse Repetition Frequency
Prox	Proximal
PSIS	Posterior Superior Iliac Spine
PSV	Peak Systolic Velocity
PV	Pulmonic Valve
P. Vein	Pulmonary Vein
PW	Pulsed Wave Doppler
QL	Quadratus Lumborum
Qp/Qs	Pulmonary blood flow divided by systemic blood flow
RA	Right Atrial
RAP	Right Atrial Pressure
RCA	Right Coronary Artery
RI	Resistive Index
RIMP	Right Ventricular Index of Myocardial Performance

Table A-1: Abbreviations in the user interface

Abbreviation	Definition
Rt	Right
RV	Right Ventricular
RVD	Right Ventricular Dimension
RVDd	Right Ventricular Dimension Diastolic
RVDs	Right Ventricular Dimension Systolic
RVOT D	Right Ventricular Outflow Tract Diameter
RVOT VTI	Right Ventricular Outflow Tract Velocity Time Integral
RVSP	Right Ventricular Systolic Pressure
RVW	Right Ventricular Free Wall
RVWd	Right Ventricular Free Wall Diastolic
RVWs	Right Ventricular Free Wall Systolic
S´	Tricuspid Lateral Annular Systolic Velocity (TDI measurement)
S/D	Systolic/Diastolic Ratio
SI	Stroke Index
Siphon	Siphon (internal carotid artery)
SM	Submandibular
SmP	Small Parts
SO	Suboccipital
Sup	Superficial
SV	Stroke Volume
TAM	Time Average Mean
TAP	Time Average Peak
TAPSE	Tricuspid Annular Plane Systolic Excursion: M Mode distance measurement of systolic excursion of the right ventricle
TAV	Time Average Velocity
TCD	Trans-cerebellum Diameter (OB measurement) Transcranial Doppler (exam type)
TDI	Tissue Doppler Imaging
THI	Tissue Harmonic Imaging

Table A-1: Abbreviations in the user interface

Abbreviation	Definition
TI	Thermal Index
TICA	Terminal Internal Carotid Artery
TL	Tibia Length
TO	Transorbital
Trans	Transverse
TRMax	Tricuspid Regurgitation (peak velocity)
TT	Transtemporal
TTD	Transverse Trunk Diameter
TV	Tricuspid Valve
TVA	Tricuspid Valve Area
UA	Ultrasound Age Calculated on the mean measurements taken for a particular fetal biometry.
Umb A	Umbilical Artery
VA	Vertebral Artery
VArty	Vertebral Artery
Vas	Vascular
Ven	Venous
VF	Volume Flow
VMax	Peak Velocity
VMean	Mean Velocity
Vol	Volume
VTI	Velocity Time Integral
W	Width
YS	Yolk Sac

Index

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