



EPIQ 7 Ultrasound System

User Manual

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PHILIPS

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This Medical Device meets the provisions of the transposition of the Medical Device Directive 93/42/EEC within the country of origin of the Notified Body concerned with the device.

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WARNING

United States federal law restricts this device to sale by or on the order of a physician.

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6,780,155; 6,824,517; 7,037,264; 7,043,062; 7,131,947; 7,439,656; 7,484,412; 7,544,164; 7,593,554; 7,637,869; 7,645,237; 7,648,461; 7,656,418; 7,704,208; 7,758,508; 7,771,354; 7,859,170; 8,030,824; 8,038,618; 8,096,947; 8,137,272; 8,161,817; 8,169,125; 8,177,718; 8,257,260; Re43,048; Re36,564.

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1 Read This First

This manual is intended to assist you with the safe and effective operation of your Philips product. Before attempting to operate the product, read this manual and strictly observe all warnings and cautions. Pay special attention to the information in the “[Safety](#)” section.

The user information for your Philips product describes the most extensive configuration of the product, with the maximum number of options and accessories. Some functions described may be unavailable on your product's configuration.

Intended Audience

Before you use your user information, you need to be familiar with ultrasound techniques. Sonography training and clinical procedures are not included here.

This document is intended for sonographers, physicians, and biomedical engineers who operate and maintain your Philips product.

Intended Use

This product is intended to be installed, used, and operated only in accordance with the safety procedures and operating instructions given in the product user information, and only for the purposes for which it was designed. For indications for use, see “[Indications for Use and Supporting Transducers](#)” on page 176. However, nothing stated in the user information reduces your responsibility for sound clinical judgment and best clinical procedure.

Installation, use, and operation of this product is subject to the law in the jurisdictions in which the product is used. Install, use, and operate the product *only* in such ways that do not conflict with applicable laws or regulations, which have the force of law.

Use of the product for purposes other than those intended and expressly stated by Philips, as well as incorrect use or operation, may relieve Philips or its agents from all or some responsibility for resultant noncompliance, damage, or injury.

**WARNING**

System users are responsible for image quality and diagnosis. Inspect the data that is being used for the analysis and diagnosis and ensure that the data is sufficient both spatially and temporally for the measurement approach being used.

Warnings

Before using the system, read these warnings and the “[Safety](#)” section.

**WARNING**

Do not remove the protective covers on the system; hazardous voltages are present inside. Cabinet panels must be in place while the system is in use. All internal adjustments and replacements must be made by a qualified Philips Ultrasound field service engineer.

**WARNING**

To avoid electrical shock, use only supplied power cords and connect only to properly grounded wall (wall/mains) outlets.

**WARNING**

Do not operate this system in the presence of flammable gases or anesthetics. Explosion can result. The system is *not* compliant in AP/APG environments as defined by IEC 60601-1.

**WARNING**

Medical equipment must be installed and put into service according to the special electromagnetic compatibility (EMC) guidelines provided in the “[Safety](#)” section.

**WARNING**

The use of portable and mobile radio-frequency (RF) communications equipment can affect the operation of medical equipment.

Warning Symbols

The system may use the following warning symbols. For additional symbols used on the system, see the “[Safety](#)” section.

Warning Symbols

Symbol	Description
	Identifies a safety note.
	Dangerous voltages: Appears adjacent to high-voltage terminals, indicating the presence of voltages greater than 1,000 Vac (600 Vac in the United States).
	Identifies ESD (electrostatic-discharge) sensitivity of a connector that is not tested as specified in IEC 60601-1-2. Do not touch exposed connector pins. Touching exposed pins can cause electrostatic discharge, which can damage the product.
	Indicates that the user should see the instructions for use for safety information.

User Information Components

The user information provided with your product includes the following components:

- *User Information CD*: Includes all of the user information, except the *Operating Notes*. The instructions for using the CD are included with the CD.
- *Operating Notes*: Contains information that clarifies certain product responses that might be misunderstood or cause user difficulty.
- *User Manual*: Provided with the product and included on the CD. The *User Manual* introduces you to features and concepts, helps you set up your system, and includes important safety information. This manual also includes procedures for basic operation. For detailed operating instructions, see the Help.
- *Quick Guide*: Provided with the product and included on the CD. The *Quick Guide* helps you perform an ultrasound exam step-by-step.

- *Help:* Available on the system in some languages and included on the CD, the *Help* contains comprehensive instructions for using the system. The *Help* also provides reference information and descriptions of all controls and display elements. To display the *Help*, touch  on the touch screen.
- *Acoustic Output Tables:* Included on the CD, it contains information about acoustic output and patient-applied part temperatures.
- *Medical Ultrasound Safety:* Included on the CD, it contains information on bioeffects and biophysics, prudent use, and implementing ALARA (as low as reasonably achievable).
- *Shared Roles for System and Data Security:* Included on the CD, it contains guidelines to help you understand how the security of your Philips product could be compromised and information on Philips' efforts to help you prevent security breaches.
- *Media Compatibility:* Included on the CD, it contains current information on media that are compatible with your system.

Product Conventions

Your Philips product uses certain conventions throughout the interface to make it easy for you to learn and use:

- Three unlabeled buttons near the trackball are used with the trackball. The two buttons on either side of the trackball are called the "left and right trackball buttons," and they operate somewhat similarly to PC mouse buttons. The button above the trackball is called the "middle trackball button," and it is used to update the imaging display, complete measurements, and other operations as specified in procedures. The trackball arbitration icon, at the bottom of the display, indicates the current functions of the trackball buttons.
- Tabs along the top of the monitor display let you choose additional sets of setup options. Tabs along the top of the touch screen let you choose additional pages of controls.
- To type text into a text field, click in the field and use the keyboard.
- To display a list, click the down arrow . To scroll through a list, click the arrows at either end of the scroll bar or drag the scroll box up or down.
- Controls on the control panel include buttons, knobs, slide controls, and a trackball. Press a button to activate or deactivate its function. Turn a knob to change the selected setting. Press a knob-button to activate its function, or turn it to change the selected setting. Move a slide control to change its setting. Roll the trackball in the direction that you want to move an object.

- Controls on the touch screen include buttons, knob labels, and sliders. To use a touch screen button, simply touch it. To use a touch screen knob label, touch the label and adjust the corresponding knob, located directly below it on the control panel. If two knob labels are available for the knob, you must first touch the knob label that you want to adjust. To use a slider, swipe the slider button, or touch a location on the slider, to move the slider button.
- Many tabs on the touch screen contain two pages of controls. To display the second page, place your finger on the touch screen and swipe to the left. To return to the first page, place your finger on the touch screen and swipe to the right.
- Some areas of the display include chevrons   . Clicking  displays or hides additional information, options, or fields.

User Information Conventions

The user information for your product uses the following typographical conventions to assist you in finding and understanding information:

- All procedures are numbered, and all subprocedures are lettered. You must complete steps in the sequence they are presented to ensure success.
- Bulleted lists indicate general information about a particular function or procedure. They do not imply a sequential procedure.
- Control names and menu items or titles are spelled as they are on the system, and they appear in bold text. Exceptions are the trackball, the buttons adjacent to it, and the TGC slide controls, all of which are unlabeled.
- Symbols appear as they appear on the system.
- The *pointer* is the cursor used to select elements on the display. Use the **Pointer** control to display the pointer.
- *Point* means to position the tip of the pointer or cursor on an item on the display.
- *Click* means to move the pointer or cursor to an object and press one of the unlabeled trackball buttons located on either side of the trackball.
- *Select* means to move the pointer to an object and press one of the unlabeled trackball buttons located on either side of the trackball to "highlight" the object (such as an item in a list), or in the case of a check box or "radio button," to fill the object. *Deselect* means clicking the item to remove the highlight or fill.
- *Double-click* means to quickly click twice to select an object or text.

- *Drag* means to place the pointer over an object and then press and hold the left or right trackball button while moving the trackball. Use this method to move an object on the display.
- *Touch* means to press a button on the touch screen, located above the control panel.
- *Swipe* means to touch the touch screen with the tip of your finger and move your finger in a quick motion either to the left or to the right. This action displays an additional touch screen, if one is available.
- *Highlight* means to change the color of a display selection (such as an item in a list) or overlay it with a colored bar, usually by clicking.
- The left side of the system is to your left as you stand in front of the system, facing the system. The front of the system is nearest to you as you operate it.
- Transducers and pencil probes both are referred to as transducers, unless the distinction is important to the meaning of the text.

Information that is essential for the safe and effective use of your product appears throughout your user information as follows:



WARNING

Warnings highlight information vital to the safety of you, the operator, and the patient.



CAUTION

Cautions highlight ways that you could damage the product and consequently void your warranty or service contract or ways that you could lose patient or system data.

NOTE

Notes bring your attention to important information that will help you operate the product more effectively.

Upgrades and Updates

Philips is committed to innovation and continued improvement. Upgrades may be announced that consist of hardware or software improvements. Updated user information will accompany those upgrades.

Customer Comments

If you have questions about the user information, or you discover an error in the user information, in the USA, please call Philips at 800-722-9377; outside the USA, please call your local customer service representative.

Supplies and Accessories

To order ECG trunk cables, lead sets, and electrodes; transducer covers; bite guards; biopsy guides; and other supplies and accessories, contact CIVCO Medical Solutions:

CIVCO Medical Solutions

102 First Street South, Kalona, IA 52247-9589

Telephone: 800-445-6741 (USA and Canada), +1 319-248-6757 (International)

Fax: 877-329-2482 (USA and Canada), +1 319-248-6660 (International)

E-mail: info@civco.com

Internet: www.civco.com

To order the items listed in the following table, see the referenced section and then contact your Philips representative.

System Accessories

Item	Additional Information
Cables	See “ Approved Cables for Electromagnetic Compliance ” on page 72.
DVD recorder	See “ Approved Accessories for Electromagnetic Compliance ” on page 73

Item	Additional Information
Foot switch	Contact your Philips representative.
Printers	See “ External Printers ” on page 102.
Removable media	See “ Media Compatibility ” on page 143.
Transducers	See “ Clinical Applications and Transducers ” on page 174.

Customer Service

Customer service representatives are available worldwide to answer questions and to provide maintenance and service. Please contact your local Philips representative for assistance. You can also contact the following office for referral to a customer service representative, or visit the Philips Healthcare “Contact Us” website:

www.healthcare.philips.com/main/about/officelocator/index.wpd

Philips Ultrasound Headquarters

22100 Bothell-Everett Highway, Bothell, WA 98021-8431, USA

800-722-9377

Recycling, Reuse, and Disposal

Philips is concerned with helping protect the natural environment and helping ensure continued safe and effective use of this system through proper support, maintenance, and training. Philips designs and manufactures equipment in compliance with relevant guidelines for environmental protection. As long as the equipment is properly operated and maintained, it presents no risk to the environment. However, the equipment may contain materials that could be harmful to the environment if disposed of incorrectly. Use of such materials is essential for the implementation of certain functions and for meeting certain statutory and other requirements.

The European Union Directive on Waste Electrical and Electronic Equipment (WEEE) requires producers of electrical and electronic equipment to provide reuse and treatment information for each product. This information is provided in a Philips Healthcare Recycling Passport. Such recycling passports for Philips Ultrasound systems are available on this website:

www.healthcare.philips.com/main/about/sustainability/recycling/ultrasound.wpd

Recycling, reuse, and disposal information in this document is directed mainly at the entity with legal authority over the equipment. Operators are usually uninvolved in disposal, except in the case of certain batteries.

Passing Your System to Another User

If you pass this system to another user who will use the system for its intended purpose, then pass it on in its complete state. Particularly, ensure that all the product-support documentation, including all instructions for use, are passed on to the new user. Make the new user aware of the support services that Philips Healthcare provides for installing, commissioning, and maintaining the system, and for comprehensive operator training. Existing users must remember that passing on medical electrical equipment to new users may present serious technical, medical, privacy, and legal risks. The original user may remain liable, even if the equipment is given away.

Philips strongly advises you to seek advice from your local Philips representative before agreeing to pass on any equipment.

After you pass the system to a new user, you might still receive important safety-related information, such as bulletins and field change orders. In many jurisdictions the original owner has a clear duty to communicate such safety-related information to new users. If you are unable or unprepared to do this, inform Philips Healthcare about the new user, so that Philips Healthcare can provide the new user with safety-related information.

Final Disposal of Your System



Final disposal is when you dispose of the system in such a way that it can no longer be used for its intended purposes.

**WARNING**

Do not dispose of this system (or any parts of it) with industrial or domestic waste. The system may contain materials such as lead, tungsten, or oil, or other hazardous substances that can cause serious environmental pollution. The system also contains privacy-sensitive information, which should be properly removed (scrubbed). Philips advises you to contact your Philips service organization before disposing of this system.

Philips Healthcare gives support for the following:

- Recovery of useful parts
- Recycling of useful materials by competent disposal companies
- Safe and effective disposal of equipment

For advice and information, contact your Philips service organization, or see the following website:

www.healthcare.philips.com/us/about/sustainability/recycling

Perchlorate Material

In this system, perchlorate material is present in lithium coin cells or batteries. Special handling may apply to those items. For more information, see this website:

www.dtsc.ca.gov/hazardouswaste/perchlorate

Discarding Batteries

Batteries should be discarded if there are visual signs of damage. Batteries should be discarded in an environmentally safe manner. Properly dispose of batteries according to local regulations.

**WARNING**

Do not disassemble, puncture, or incinerate batteries. Be careful not to short the battery terminals because this could result in a fire hazard.

**CAUTION**

Use caution when handling, using, and testing the batteries. Do not short circuit, crush, drop, mutilate, puncture, apply reverse polarity, expose to high temperatures, or disassemble. Misuse or abuse could cause physical injury.

NOTE

Wash skin with large amounts of water in the event of electrolyte leakage to prevent skin irritation and inflammation.

Read This First

Recycling, Reuse, and Disposal

2 Safety

Please read this information before using your ultrasound system. It applies to the ultrasound system, transducers, recording devices, and any optional equipment. This section covers general safety information only. Safety information that applies only to a specific task is included in the procedure for that task.

This device is intended for use by, or by the order of, and under the supervision of a licensed physician qualified to direct the use of the device.



WARNING

Warnings highlight information vital to the safety of you, the operator, and the patient.



CAUTION

Cautions highlight ways that you could damage the product and consequently void your warranty or service contract or ways that you could lose patient or system data.

Basic Safety



WARNING

Do not use the system for any application until you have read, understood, and know all the safety information, safety procedures, and emergency procedures contained in this "Safety" section. Operating the system without a proper awareness of safe use could lead to fatal or other serious personal injury.

**WARNING**

Do not use this system for any application until you are sure that the system's periodic maintenance is current. If *any* part of the system is known or suspected to be defective or incorrectly adjusted, *do not use* the system until it is repaired. Operating the system with defective or incorrectly adjusted components could expose you and the patient to safety hazards.

**WARNING**

Do not use the system for any application until you are adequately and properly trained on its safe and effective operation. If you are unsure of your ability to operate the system safely and effectively, do not use it. Operation of the system without proper and adequate training could lead to fatal or other serious personal injury.

**WARNING**

Do not operate the system with patients unless you have an adequate understanding of its capabilities and functions. Using the system without such understanding may compromise the system's effectiveness and the safety of the patient, you, and others.

**WARNING**

Never attempt to remove, modify, override, or frustrate any safety device on the system. Interfering with safety devices could lead to fatal or other serious personal injury.

**WARNING**

Use the system only for its intended purposes. Do not use the system with any product that Philips does not recognize as compatible with the system. Operation of the product for unintended purposes, or with incompatible products, could lead to fatal or other serious injury.

**WARNING**

Stop use immediately if the system or the transducer appear to be malfunctioning. Contact your Philips representative immediately.

Electrical Safety

This equipment has been verified by a recognized third-party testing agency as a Class I device with Type BF and Type CF isolated patient-applied parts. (The safety standards met by this system are included in the “[Specifications](#)” section.) For maximum safety, observe these warnings and cautions:



WARNING

Shock hazards may exist if this system, including all externally mounted recording and monitoring devices, is not properly grounded. Protection against electrical shock is provided by grounding the chassis with a three-wire cable and plug. The system must be plugged into a grounded outlet. The grounding wire must not be removed or defeated.



WARNING

To avoid the risk of electrical shock, never connect the system power cord to a power strip or an extension cord. When using the power cord, always connect it directly to a grounded wall outlet.



WARNING

Use only Type CF transducers for invasive procedures. Type B transducers are insufficiently electrically isolated for invasive use.



WARNING

Do not remove the protective covers on the system; hazardous voltages are present inside. Cabinet panels must be in place while the system is in use. All internal adjustments and replacements must be made by a qualified Philips Ultrasound field service engineer.



WARNING

Do not operate this system in the presence of flammable gases or anesthetics. Explosion can result. The system is *not* compliant in AP/APG environments as defined by IEC 60601-1.

**WARNING**

To avoid risk of electrical shock hazards, always inspect the transducer before use: Check the face, housing, and cable before use. Do not use if the face is cracked, chipped, or torn; the housing is damaged; or the cable is abraded.

**WARNING**

To avoid risk of electrical shock hazards, always turn off the system and disconnect it from the wall outlet before cleaning the system.

**WARNING**

All patient-contact devices, such as transducers, pencil probes, and ECG leads not specifically indicated as defibrillation-proof, must be removed from patient contact before application of a high-voltage defibrillation pulse. See “[Defibrillators](#)” on page 33.

**WARNING**

During transesophageal echocardiographic (TEE) procedures, either remove the TEE transducer from the patient or disconnect the TEE transducer from the system immediately following image acquisition.

**WARNING**

Ultrasound equipment in normal operation, as with other medical electronic diagnostic equipment, uses high-frequency electrical signals that can interfere with pacemaker operation. Though the possibility of interference is slight, be alert to this potential hazard and stop system operation immediately if you note interference with a pacemaker.

**WARNING**

When using additional peripheral equipment powered from an electrical source other than the ultrasound system, the combination is considered to be a medical system. It is your responsibility to comply with IEC 60601-1 and test the system to those requirements. If you have questions, contact your Philips representative.

**WARNING**

Do not use nonmedical peripherals, such as report printers, within 1.5 m (5 ft) of a patient, unless the nonmedical peripherals receive power from an isolated power outlet on the Philips ultrasound system, or from an isolation transformer that meets medical safety standards, as defined by standard IEC 60601-1.

**WARNING**

The system and patient-applied parts meet the standard IEC 60601-1. Applied voltages exceeding the standard, although unlikely, may result in electrical shock to the patient or operator.

**WARNING**

Connection of optional devices not supplied by Philips Ultrasound could result in electrical shock. When such optional devices are connected to your ultrasound system, ensure that the total system earth leakage current does not exceed 500 µA.

**WARNING**

To avoid risk of electrical shock, do not use any transducer that has been immersed beyond the specified cleaning or disinfection level.

**WARNING**

To avoid risks of electrical shock and fire hazards, inspect the system power cord and plug regularly. Ensure that they are not damaged in any way.

**WARNING**

Do not drape the power cord over any of the cable hooks or the handle on the system cart. Damage to the cord or power receptacle unit can occur if the cart is raised.

**WARNING**

Operating the system with physio input signals that are below the specified minimum levels may cause inaccurate results. See the “[Specifications](#)” section.

**WARNING**

Electrosurgical units (ESUs) and other devices intentionally introduce radio frequency electromagnetic fields or currents into patients. Because imaging ultrasound frequencies are coincidentally in the radio frequency range, ultrasound transducer circuits are susceptible to radio frequency interference. While an ESU is in use, severe noise interferes with the black-and-white image and completely obliterates the color image. Concurrent failures in an ESU or other device and in the outer layer of the TEE transducer shaft can cause electrosurgical currents to return along the transducer conductors. This could burn the patient, and the ultrasound system and the transducer could also be damaged. Be aware that a disposable transducer cover provides no protective electrical insulation at ESU frequencies.

**WARNING**

To avoid risk of a burn hazard, do not use transducers with high-frequency surgical equipment. A burn hazard may result from a defect in the high-frequency surgical neutral electrode connection.

**WARNING**

Using cables, transducers, and accessories other than those specified for use with the system may result in increased emissions from, or decreased immunity of, the system.

**CAUTION**

Although your system has been manufactured in compliance with existing EMI/EMC requirements, use of this system in the presence of an electromagnetic field can cause momentary degradation of the ultrasound image. When interference is present or intermittent, use caution when continuing to use the system. If interference occurs often, review the environment in which the system is being used, to identify possible sources of radiated emissions. These emissions could be from other electrical devices used within the same room or an adjacent room. Communication devices such as cellular phones and pagers can cause these emissions. The existence of radio, TV, or microwave transmission equipment located nearby can cause emissions. In cases where EMI is causing disturbances, it may be necessary to relocate your system.

**CAUTION**

For information on electromagnetic emissions and immunity as it applies to the system, see “[Electromagnetic Compatibility](#)” on page 68. Ensure that the operating environment of your system meets the conditions specified in the referenced information. Operating the system in an environment that does not meet those conditions may degrade system performance.

Defibrillators

Observe the following warnings when a defibrillation is required while using the ultrasound system.

**WARNING**

Before defibrillation, always remove all patient-applied parts from the patient.

**WARNING**

Before defibrillation, always disconnect invasive transducers that remain in contact with the patient from the system.

**WARNING**

A disposable transducer cover provides no protective electrical insulation against defibrillation.

**WARNING**

A small hole in the outer layer of the transducer opens a conductive path to grounded metal parts of the transducer. The secondary arcing that could occur during defibrillation could cause patient burns. The risk of burns is reduced, but not eliminated, by using an ungrounded defibrillator.

Use defibrillators that do not have grounded patient circuits. To determine whether a defibrillator patient circuit is grounded, see the defibrillator service guide, or consult a biomedical engineer.

Fire Safety



WARNING

On electrical or chemical fires, use only extinguishers that are specifically labeled for those purposes. Using water or other liquids on an electrical fire can lead to fatal or other serious personal injury. Before attempting to fight a fire, if it is safe to do so, attempt to isolate the product from electrical and other supplies, to reduce the risk of electrical shock.

Use of electrical products in an environment for which they were not designed can lead to fire or explosion. Fire regulations for the type of medical area being used should be fully applied, observed, and enforced. Fire extinguishers should be available for both electrical and nonelectrical fires.

Mechanical Safety

A list of precautions related to mechanical safety follows; observe these precautions when using the system:



WARNING

Be aware of the wheels on the system cart, especially when moving the system. The system could cause injury to you or others if it rolls over feet or into shins. Use caution when going up or down ramps.



WARNING

When attempting to overcome an obstacle, do not push the system from either side with excessive force, which could cause the system to tip over.

**WARNING**

Position external hardcopy devices away from the system. Ensure that they are secure. Do not stack them on the system.

**WARNING**

When positioning the monitor, move it carefully to avoid pinching hands or extremities against other objects, such as a bed rail.

**WARNING**

Never park the system on an incline.

**WARNING**

The brakes are intended as a convenience. To increase cart security, use wheel chocks when the system is parked.

**WARNING**

If system operation is abnormal after you move or transport the system, contact Philips Ultrasound Customer Service immediately. System components are installed securely and can withstand considerable shock, but excessive shock can cause a system failure.

**WARNING**

To avoid injury, Philips recommends against lifting the system cart.

**WARNING**

If you park the system on a floor that is tilted 10 degrees or more and set the brakes, one of the braked casters might not be touching the floor, which can cause the system to move.

**WARNING**

Before moving the system, ensure that the keyboard is retracted, the control panel is centered, and the monitor is locked. When extended, the keyboard might be damaged if it hits another object, and the video monitor could swing out during transport, causing injury or equipment damage.

**CAUTION**

Ensure that the cables for all patient-applied parts are secure before moving the system. Use the cable management system to ensure that transducer cables are protected from damage.

**CAUTION**

Do not roll the system over transducer cables or power cables.

Equipment Protection

Follow these precautions to protect your system:

**CAUTION**

Excessive bending or twisting of cables on patient-applied parts may cause failure or intermittent operation of the system. Do not roll the system over cables, which may damage them.

**CAUTION**

Improper cleaning or sterilization of a patient-applied part may cause permanent damage. For cleaning and disinfection instructions, see the “[Transducer Care](#)” section.

**CAUTION**

Do not submerge the transducer connector in solution. The cables and transducer bodies are liquid-tight, but the connectors are not.

**CAUTION**

Do not use solvents, such as thinner or acetone, or abrasive cleaners on the system, transducers, or any hardcopy device.

**CAUTION**

For optimal performance, connect your ultrasound system to a circuit dedicated solely for the system. Do not connect life-support devices to the same circuit as the ultrasound system.

**CAUTION**

If systems, transducers, and peripherals have been in an environment below 10°C (50°F), allow them to reach room temperature before connecting or turning them on. Philips recommends allowing 24 hours for complete normalization. Otherwise, condensation inside the devices could cause damage. If the device was only briefly exposed to temperatures below 10°C (50°F), then the time required for the device to return to room temperature could be significantly less than 24 hours.

**CAUTION**

To avoid damaging the flat-panel display in the monitor, do not store the system where the ambient temperature exceeds 65°C (149°F).

Product Compatibility

Do not use your system in combination with other products or components, unless Philips expressly recognizes those other products or components as compatible. For information about such products and components, contact your Philips representative.

Changes and additions to the system should be made only by Philips or by third parties expressly authorized by Philips to do so. Such changes and additions must comply with all applicable laws and regulations that have the force of law within the jurisdictions concerned, and best engineering practices.

**WARNING**

System changes and additions that are made without the appropriate training or by using unapproved spare parts may void the Philips warranty. As with all complex technical products, maintenance by unqualified persons or using unapproved spare parts carries serious risks of system damage and personal injury.

Symbols

The International Electrotechnical Commission (IEC) has established a set of symbols for medical electronic equipment that classify a connection or warn of potential hazards. Of those symbols, the following may be used on your Philips product and its accessories and packaging.

USA federal law restricts this device to sale by or on the order of a physician.

Rx only

Isolated patient connection (Type BF applied part).



Defibrillation-proof patient connection (Type BF applied part).



Non-isolated patient connection (Type B applied part).



Isolated patient connection for applied part intended for intraoperative use, including direct cardiac application and contact with major vessels (Type CF applied part).



Defibrillation-proof patient connection (Type CF applied part).



Identifies ESD (electrostatic-discharge) sensitivity of a connector that is not tested as specified in IEC 60601-1-2. Do not touch exposed connector pins. Touching exposed pins can cause electrostatic discharge, which can damage the product.



Identifies an On/Off control.



On a two-position power switch, represents On (|) and Off (○).



Identifies a safety note.



Indicates that the user should see the instructions for use for safety information.



Identifies equipotential ground.



Identifies earth ground.



Identifies protective earth ground.



Nonionizing electromagnetic radiation. Indicates that interference may occur in the vicinity of equipment marked with this symbol.



Indicates conformance with European Council Directive 93/42/EEC.



The radio component contained in this device is compliant to Council Directive 1999/5/EC (Radio Equipment and Telecommunications Terminal Equipment Directive).



Class 2 radio equipment identifier per Directive 1999/5/EC. European Union member states may apply restrictions on putting this device into service or placing it on the market. This device is intended to be connected to the Publicly Available Interfaces for use throughout the European Economic Area.

IPX1

Indicates that the device is protected against the effects of vertically falling water. This degree of protection can apply to transducers.

IPX4

Indicates that the device is protected against the effects of splashing liquids. This degree of protection can apply to foot-operated devices.

IPX7

Indicates that the device is protected against the effects of immersion. This degree of protection can apply to transducers and foot-operated devices.

IPX8

Indicates that the device is protected against the effects of immersion for up to 60 minutes. This degree of protection can apply to foot-operated devices or transducers.



Indicates the need for separate collection for electrical and electronic equipment in compliance with the Waste Electrical and Electronic Equipment (WEEE) Directive. When accompanied by or , components of the device may contain lead or mercury, respectively, which must be recycled or disposed of in accordance with local, state, or federal laws. The backlight lamps in an LCD system monitor contain mercury.



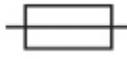
Do not throw away. Dispose of in accordance with local, state, or federal laws.



Do not reuse.



Use-by date.

GMDN	Global Medical Device Nomenclature Code.
GTIN	Global Trade Item Number
MOD	Model name for the device
	Indicates a possible crushing hazard to hands.
	Warns that the system should not be used stacked with other equipment. If the system is used stacked with or adjacent to other equipment, verify normal operation before use.
	Indicates the temperature range (noncondensing) for transport and storage. (Does not apply to media.)
	Indicates the atmospheric pressure range for transport and storage.
	Indicates the relative humidity range (noncondensing) for transport and storage.
	Indicates that a connector receives alternating current.
	Identifies fuse boxes or their locations. For continued protection from fire and shock, replace fuses only with fuses of the same type and rating.
	Identifies the date of manufacture.

Identifies the legal manufacturer.



This side up: Points toward the side of the shipping crate that should be kept facing up.



Indicates that the device should be kept dry.



Indicates that the device is fragile; handle with care.



Do not use if damaged.



Warns of system over-balance due to external force. (Do not push on the monitor or the transducer holders to move the system.)



Keep away from sunlight.



Non-sterile.



Sterilized using ethylene oxide.



Catalog number.



Batch code.





Serial number.



Universal part number.

The following symbols may also be used on the system and its accessories and packaging:



Indicates a hazard to patients with pacemakers. Do not place field generator within 200 mm (8 in) of a patient with a pacemaker.



Connection for a pencil probe



Connection for a pencil probe



Connection for a transducer



Connection for ECG and physio leads



Connection for ECG and physio leads



Print remote output



Input port for audio left/right, VHS/S-VHS, microphone, CD, or DVD

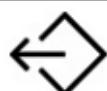




Output port for audio left/right, VHS/S-VHS, video patient monitor, black-and-white printer, or interlaced RGB output port



Input port



VGA or parallel output port



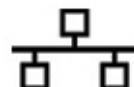
DVI video output receptacle



USB input/output port



FireWire (IEEE 1394) input/output port



Ethernet connection



RS-232 serial port



System microphone

AUX POWER
ISOLATE OUTPUT

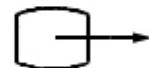
Isolated auxiliary power provided for connection of Philips-approved remote accessories.



Foot switch



SVGA or DVI-I connection.



Video Connection



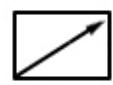
S-Video connection



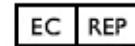
B/W Composite video output connection



Color composite video output connection



Video print trigger connection



EU Authorized Representative



Russian approval (GOST)



Chinese Environmentally Friendly Use Period symbol.



CSA (CSA International) classification symbol.



Indicates a possible pinch hazard when positioning the monitor.

The following symbols may be used inside the system:



Dangerous voltages: Appears adjacent to high-voltage terminals, indicating the presence of voltages greater than 1,000 Vac (600 Vac in the United States).



Identifies equipotential ground.

Biological Safety

This section contains information about biological safety and a discussion of the prudent use of the system.

A list of precautions related to biological safety follows; observe these precautions when using the system. For more information refer to *Medical Ultrasound Safety* on your *User Information* CD.



WARNING

Do not use the system if an error message on the video display indicates that a hazardous condition exists. Note the error code, turn off power to the system, and call your customer service representative.



WARNING

Do not use a system that exhibits erratic or inconsistent image updating. Discontinuities in the scanning sequence indicate a hardware failure that must be corrected before use.

**WARNING**

Perform ultrasound procedures prudently. Use the ALARA (as low as reasonably achievable) principle.

**WARNING**

Use only acoustic standoffs that have been approved by Philips Ultrasound. For information on ordering approved accessories, see "[Supplies and Accessories](#)" on page 21.

**WARNING**

Verify the alignment of the biopsy guide before use. See the "[Biopsy Guides](#)" section.

**WARNING**

Verify the condition of the biopsy needle before use. Do not use a bent biopsy needle.

**WARNING**

Transducer covers may contain natural rubber latex. Those covers may cause allergic reactions in some individuals. See "[FDA Medical Alert on Latex](#)" on page 49.

**WARNING**

The M2203A bite guard strap contains natural rubber latex, which may cause allergic reactions. See "[FDA Medical Alert on Latex](#)" on page 49.

**WARNING**

In contrast studies using a high-MI acoustic field, capillary rupture, due to microbubble expansion within a capillary in an acoustic field, can cause extravasation. References: (1) Skyba, D.M., Price, R.J., Linka, A.Z., Skalak, T.C., Kaul, S. "Direct *in vivo* visualization of intravascular destruction of microbubbles by ultrasound and its local effects on tissue." *Circulation*, 1998; 98:290-293. (2) van Der Wouw, P.A., Brauns, A.C., Bailey, S.E., Powers, J.E., Wilde, A.A. "Premature ventricular contractions during triggered imaging with ultrasound contrast." *Journal of the American Society of Echocardiography*, 2000;13(4):288-94.

**WARNING**

Preventricular contractions can be caused by the oscillations of microbubbles when a high-MI acoustic field is triggered in the heart at the end of systole. In a very sick patient with certain risk factors, theoretically, this could lead to ventricular fibrillation. Reference: van Der Wouw, P.A., Brauns, A.C., Bailey, S.E., Powers, J.E., Wilde, A.A. "Premature ventricular contractions during triggered imaging with ultrasound contrast." *Journal of the American Society of Echocardiography*, 2000;13(4):288-94.

**WARNING**

If a sterile transducer cover becomes compromised during an intraoperative application involving a patient with transmissible spongiform encephalopathy, such as Creutzfeldt-Jakob disease, follow the guidelines of the U.S. Centers for Disease Control and this document from the World Health Organization: WHO/CDS/ APH/2000/3, WHO Infection Control Guidelines for Transmissible Spongiform Encephalopathies. The transducers for your system cannot be decontaminated using a heat process.

**WARNING**

If the system becomes contaminated internally with bodily fluids carrying pathogens, you must immediately notify your Philips service representative. Components inside the system cannot be disinfected. In that case, the system must be disposed of as biohazardous material in accordance with local or federal laws.

**WARNING**

The backlight lamps in the system displays may contain mercury and must be recycled or disposed of according to local, state, or federal laws.

**WARNING**

Select the correct application when starting an exam, and remain in that application throughout the exam. Some applications are for parts of the body that require lower limits for acoustic output.

FDA Medical Alert on Latex

March 29, 1991, Allergic Reactions to Latex-Containing Medical Devices

Because of reports of severe allergic reactions to medical devices containing latex (natural rubber), the FDA is advising health care professionals to identify their latex sensitive patients and be prepared to treat allergic reactions promptly. Patient reactions to latex have ranged from contact urticaria to systemic anaphylaxis. Latex is a component of many medical devices, including surgical and examination gloves, catheters, intubation tubes, anesthesia masks, and dental dams.

Reports to the FDA of allergic reactions to latex-containing medical devices have increased lately. One brand of latex cuffed enema tips was recently recalled after several patients died as a result of anaphylactoid reactions during barium enema procedures. More reports of latex sensitivity have also been found in the medical literature. Repeated exposure to latex both in medical devices and in other consumer products may be part of the reason that the prevalence of latex sensitivity appears to be increasing. For example, it has been reported that 6% to 7% of surgical personnel and 18% to 40% of spina bifida patients are latex sensitive.

Proteins in the latex itself appear to be the primary source of the allergic reactions. Although it is not now known how much protein is likely to cause severe reactions, the FDA is working with manufacturers of latex-containing medical devices to make protein levels in their products as low as possible.

FDA's recommendations to health professionals in regard to this problem are as follows:

- When taking general histories of patients, include questions about latex sensitivity. For surgical and radiology patients, spina bifida patients and health care workers, this recommendation is especially important. Questions about itching, rash or wheezing after wearing latex gloves or inflating a toy balloon may be useful. Patients with positive histories should have their charts flagged.
- If latex sensitivity is suspected, consider using devices made with alternative materials, such as plastic. For example, a health professional could wear a non-latex glove over the latex glove if the patient is sensitive. If both the health professional and the patient are sensitive, a latex middle glove could be used. (Latex gloves labeled "Hypoallergenic" may not always prevent adverse reactions.)
- Whenever latex-containing medical devices are used, especially when the latex comes in contact with mucous membranes, be alert to the possibility of an allergic reaction.

- If an allergic reaction does occur and latex is suspected, advise the patient of a possible latex sensitivity and consider an immunologic evaluation.
- Advise the patient to tell health professionals and emergency personnel about any known latex sensitivity before undergoing medical procedures. Consider advising patients with severe latex sensitivity to wear a medical identification bracelet.

The FDA is asking health professionals to report incidents of adverse reactions to latex or other materials used in medical devices. (See the October 1990 FDA Drug Bulletin.) To report an incident, contact the FDA Problem Reporting Program, MedWatch, at 1-800-332-1088, or on the Internet:

www.fda.gov/Safety/MedWatch/

For a single copy of a reference list on latex sensitivity, write to: LATEX, FDA, HFZ-220, Rockville, MD 20857.

NOTE

The ultrasound system and transducers described in this document do not contain natural rubber latex that contacts humans. Natural rubber latex is not used on any Philips ultrasound transducer. It also is not used on Philips ECG cables for the products described in this document.

ALARA Education Program

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

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

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

There are a number of variables which affect the way in which the output display indices can be used to implement the ALARA principle. These variables include index values, 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 it is controlled by the user. The ability to limit the index values over time supports the ALARA principle.

Applying ALARA

The system imaging mode used depends upon the information needed. 2D and M-mode imaging provide anatomical information, while Doppler, Color Power Angio (CPA), and Color imaging provide information about blood flow. A scanned mode, like 2D or Color, disperses or scatters the ultrasonic energy over an area, while an unscanned mode, like M-mode or Doppler, concentrates ultrasonic energy. Understanding the nature of the imaging mode being used allows the sonographer to apply the ALARA principle with informed judgment. Additionally, the transducer frequency, system setup values, scanning techniques, and operator experience allow the sonographer to meet the definition of the ALARA principle.

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

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

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

Acoustic Output Limits

This ultrasound system maintains acoustic output below the appropriate limits for each application, as listed here. The significant difference in magnitude emphasizes the need to select the correct application and remain in that application, so the correct application limits are in use for the appropriate application.

Limits for Non-Ophthalmic Applications

- $I_{spta,3} \leq 720 \text{ mW/cm}^2$
- MI ≤ 1.9
- TI ≤ 6.0

Limits for Ophthalmic Applications

- $I_{spta,3} \leq 50 \text{ mW/cm}^2$
- MI ≤ 0.23
- TI ≤ 1.0

Direct Controls

Application selection and the output-power control directly affect acoustic intensity. There are different ranges of allowable intensity or output based on your selection. Selecting the correct range of acoustic intensity for the application is one of the first things that occurs in any exam. For example, peripheral vascular intensity levels are not recommended for fetal exams. Some systems automatically select the proper range for a particular application, while others require manual selection. Ultimately, the user has the responsibility for proper clinical use. The ultrasound system provides both automatic (default) settings and manual (user-selectable) settings.

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

Indirect Controls

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

The choice of imaging mode determines the nature of the ultrasound beam. 2D is a scanning mode; Doppler is a stationary or unscanned mode. A stationary ultrasound beam concentrates energy in a single location. A moving or scanned ultrasound beam disperses the energy over an area and the beam is concentrated on the same area for a fraction of the time as that of an unscanned mode.

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

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

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

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

Receiver Controls

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

An Example of Applying the ALARA Principle

An ultrasound scan of a patient's liver begins with selecting the appropriate transducer frequency. After selecting the transducer and the application, which are based on patient anatomy, adjustments to output power should be made to ensure that the lowest possible setting is used to acquire an image. After the image is acquired, adjusting the focus of the transducer, and then increasing the receiver gain to produce a uniform representation of the tissue follows. If an adequate image can be obtained with the increase in gain, then a decrease in output should be made. Only after making these adjustments should you increase output to the next level.

Having acquired the 2D display of the liver, Color can be used to localize blood flow. As with the 2D image display, gain and image processing controls must be optimized before increasing output.

Having localized the blood flow, use the Doppler controls to position the sample volume over the vessel. Before increasing output, adjust velocity range or scale and Doppler gain to obtain an optimal Doppler trace. Only if maximum Doppler gain does not create an acceptable image do you increase output.

In summary: Select the correct transducer frequency and application for the job; start with a low output level; and optimize the image by using focus, receiver gain, and other imaging controls. If the image is not diagnostically useful at this point, then increase output.

Additional Considerations

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

Output Display

The system output display comprises two basic indices: a mechanical index and a thermal index.

The mechanical index is continuously displayed over the range of 0.0 to 1.9, in increments of 0.1 for all applications except contrast, where the minimum increment is 0.01.

The thermal index further consists of the following indices: soft tissue (TIS), bone (TIB), and cranial bone (TIC). Only one of these is displayed at any time. Each transducer application has a default selection that is appropriate for that combination. The TIB, TIS, or TIC is continuously displayed over the range of 0.0 to maximum output, based on the transducer and application, in increments of 0.1. For the location of the output display, see “[Imaging Display](#)” on page 135.

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

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

- Appropriate index for the application: TIS is used for imaging soft tissue, TIB for a focus at or near bone, and TIC for imaging through bone near the surface, as in a cranial exam.
- Mitigating factors that might create artificially high or low thermal index readings: location of fluid or bone, or blood flow. For example, is there a highly attenuating tissue path so that the actual potential for local zone heating is less than the thermal index displays?
- Scanned modes versus unscanned modes of operation affect the thermal index. For scanned modes, heating tends to be near the surface; for unscanned modes, the potential for heating tends to be deeper in the focal zone.
- Always limit ultrasound exposure time. Do not rush the exam. Ensure that the indices are kept to a minimum and that exposure time is limited without compromising diagnostic sensitivity.

Mechanical Index (MI) Display

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

Thermal Index (TI) Displays

The TI informs the user about the conditions that exist that might lead to an increase in temperature at the surface of the body, within the body tissue, or at the point of focus of the ultrasound beam on bone. That is, the TI informs the user of the potential for temperature rise in body tissue. It is an estimate of temperature increase in body tissue with specific properties. The actual amount of any temperature rise is influenced by factors such as tissue type, vascularity, mode of operation, and others. The TI should be used as a guide for implementing the ALARA principle.

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

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

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

You can choose to display TIS, TIC, or TIB. (For details on changing the TI display, see the system *Help*.) On systems with transcranial applications, TIC is displayed when you select a transcranial preset.

Mechanical and Thermal Indices Display Precision and Accuracy

The MI and TI precision is 0.1 unit on the system.

The MI and TI display accuracy estimates for the system are given in *Acoustic Output Tables*, on your user information CD. Those accuracy estimates are based on the variability range of transducers and systems, inherent acoustic output modeling errors, and measurement variability, as discussed in this section.

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

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

- The measured water tank values are derated using a conservative, industry standard, attenuation coefficient of 0.3 dB/cm-MHz.
- Conservative values for tissue characteristics were selected for use in the TI models. Conservative values for tissue or bone absorption rates, blood perfusion rates, blood heat capacity, and tissue thermal conductivity were selected.
- Steady State temperature rise is assumed in the industry standard TI models, and the assumption is made that the ultrasound transducer is held steady in one position long enough for steady state to be reached.

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

The conservative assumptions of the output estimation algorithms of linear propagation, at all depths, through a 0.3 dB/cm-MHz attenuative medium is not considered in the accuracy estimate for the display. Neither linear propagation, nor uniform attenuation at the 0.3 dB/cm-MHz rate, occur in water tank measurements or in most tissue paths in the body. In the body, different tissues and organs have dissimilar attenuation characteristics. In water, there is almost no attenuation. In the body, and in particular, in water tank measurements, nonlinear propagation and saturation losses occur as pulser voltages increase.

Therefore, the display accuracy estimates are based on the variability range of transducers and systems, inherent acoustic output modeling errors, and measurement variability. Display accuracy estimates are not based on errors in, or caused by measuring according to, the AIUM measurement standards, or the effects of nonlinear loss on the measured values.

Control Effects

Controls Affecting the Indices

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

Power

The output power control affects the system acoustic output. Two real-time output values are on the display: TI and MI. They change as the system responds to power-control adjustments.

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

2D Controls

- **Sector Width:** Narrowing the sector angle may increase frame rate. This action will increase the TI. Pulser voltage may be automatically adjusted down with software controls to keep the TI below the system maximums. A decrease in pulser voltage will decrease MI.
- **Zoom:** Increasing the zoom magnification by pressing **Zoom** may increase frame rate. This action will increase the TI. The number of focal zones may also increase automatically to improve resolution. This action may change the MI, because the peak MI can occur at a different depth.
- **Number of Focal Zones:** More focal zones may change both the TI and MI by changing frame rate or focal depth automatically. Lower frame rates decrease the TI. MI displayed will correspond to the zone with the largest MI value.
- **Focus:** Changing the focal depth will change MI. Generally, higher MI values will occur when the focal depth is near the natural focus of the transducer.

Color and Power Controls

- **Flow Opt:** Increasing the color sensitivity with the **Flow Opt** control may increase the TI. More time is spent scanning the color image. Color pulses are the dominant pulse type in this mode.

- **Color Sector Width:** Narrower color sector width will increase color frame rate and the TI will increase. The system may automatically decrease pulser voltage to stay below the system maximum. A decrease in pulser voltage will decrease the MI. If PW Doppler is also enabled, then PW Doppler will remain the dominant mode and the TI change will be small.
- **Color Sector Depth:** Deeper color sector depth may automatically decrease color frame rate or select a new color focal zone or color pulse length. The TI will change due to the combination of these effects. Generally, the TI will decrease with increased color sector depth. MI will correspond to the MI of the dominant pulse type which is a color pulse. However, if PW Doppler is also enabled then PW Doppler will remain the dominant mode and the TI change will be small.
- **Scale:** Using the scale control to increase the color velocity range may increase the TI. The system may automatically adjust pulser voltage to stay below the system maximums. A decrease in pulser voltage will also decrease MI.
- **Sector Width:** A narrower 2D sector width in Color imaging will increase color frame rate. The TI will increase. MI will change little, if at all. If PW Doppler is also enabled, then PW Doppler will remain the dominant mode and the TI change will be small.

M-Mode and Doppler Controls

- **Simultaneous and Update Methods:** Use of combination modes affects both the TI and MI through the combination of pulse types. During simultaneous mode, the TI is additive. During Duplex, the TI will display the dominant pulse type. The displayed MI will be from the mode with the largest MI value.
- **Sample Volume Depth:** When Doppler sample volume depth is decreased, the Doppler pulse repetition frequency (PRF) may automatically increase. An increase in PRF will increase the TI. The system may also automatically decrease the pulser voltage to remain below the system maximum. A decrease in pulser voltage will decrease MI.

Other Control Effects

- **Imaging Mode Controls:** When a new imaging mode is selected, both the TI and MI may change to default settings. Each mode has a corresponding pulse repetition frequency and maximum intensity point. In combined or simultaneous modes, the TI is the sum of the contribution from the modes enabled, and the displayed MI is the largest of the MI values associated with each mode and focal zone enabled. The system will return to the previously selected state if a mode is turned off and then reselected.

- **Transducer:** Each transducer type has unique specifications for contact area, beam shape, and center frequency. Defaults are initialized when you select a transducer. Factory defaults vary with transducer, application, and selected mode. Defaults have been chosen below the FDA limits for intended use.
- **2D Depth:** An increase in 2D depth will automatically decrease the 2D frame rate. This will decrease the TI. The system may also automatically choose a deeper 2D focal depth. A change of focal depth may change the MI. The MI displayed is that of the zone with the largest MI value.
- **Application:** Acoustic output defaults are set when you select an application. Factory defaults vary with transducer, application, and mode. Defaults have been chosen below the FDA limits for intended use.

Related Guidance Documents

For more information about ultrasonic bioeffects and related topics, see the following:

- "Bioeffects and Safety of Diagnostic Ultrasound." AIUM Report, January 28, 1993.
- "American Institute of Ultrasound in Medicine Bioeffects Consensus Report." *Journal of Ultrasound in Medicine*, Vol. 27, Issue 4, April 2008.
- Acoustic Output Measurement Standard for Diagnostic Ultrasound Equipment. (AIUM, NEMA, 2004)
- Second Edition of the AIUM Medical Ultrasound Safety brochure, 2009. (A copy of this document is provided with each system.)
- Information for Manufacturers Seeking Marketing Clearance of Diagnostic Ultrasound Systems and Transducers. FDA, September 2008.
- Standard for Real-Time Display of Thermal and Mechanical Acoustic Output Indices on Diagnostic Ultrasound Equipment. (AIUM, NEMA, 2004)
- WFUMB. "Symposium on Safety of Ultrasound in Medicine: Conclusions and Recommendations on Thermal and Non-Thermal Mechanisms for Biological Effects of Ultrasound." *Ultrasound in Medicine and Biology*, 1998; Vol. 24, Supplement 1.

Acoustic Output and Measurement

Since the initial use of diagnostic ultrasound, the possible human bioeffects from ultrasound exposure have been studied by various scientific and medical institutions. In October 1987, the American Institute of Ultrasound in Medicine (AIUM) ratified a report prepared by its Bioeffects Committee ("Bioeffects Considerations for the Safety of Diagnostic Ultrasound." *Journal of*

Ultrasound in Medicine, Vol. 7, No. 9 Supplement, September 1988), sometimes referred to as the Stowe Report, which reviewed available data on possible effects of ultrasound exposure. Another report, "Bioeffects and Safety of Diagnostic Ultrasound," dated January 28, 1993, provides more-current information.

The acoustic output for this system has been measured and calculated in accordance with the "Acoustic Output Measurement Standard for Diagnostic Ultrasound Equipment" (Revision 3, AIUM, NEMA, 2004), the "Standard for Real-Time Display of Thermal and Mechanical Acoustic Output Indices on Diagnostic Ultrasound Equipment" (Revision 2, AIUM, NEMA, 2004), and the September 2008 FDA document "Information for Manufacturers Seeking Marketing Clearance of Diagnostic Ultrasound Systems and Transducers."

In Situ, Derated, and Water Value Intensities

All intensity parameters are measured in water. Since water absorbs very little acoustic energy, these water measurements represent a worst case value. Biological tissue does absorb acoustic energy. The true value of the intensity at any point depends on the amount and type of tissue and the frequency of the ultrasound that passes through the tissue. The intensity value in the tissue, *In Situ*, has been estimated by using the following formula:

$$\text{In Situ} = \text{Water} [e^{-0.23alf}]$$

Where:

Variable	Value
<i>In Situ</i>	<i>In Situ</i> intensity value
Water	Water value intensity
e	2.7183
a	Attenuation factor
Tissue	a(dB/cm-MHz)
Amniotic Fluid	0.006
Brain	0.53
Heart	0.66
Kidney	0.79
Liver	0.43
Muscle	0.55
I	Skin line to measurement depth (cm)
f	Center frequency of the transducer/system/mode combination (MHz)

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

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

Since this value is not the true *in situ* intensity, the term “derated” is used.

Mathematical derating of water based measurements using the 0.3 dB/cm-MHz coefficient, may yield lower acoustic exposure values than would be measured in a homogenous 0.3 dB/cm-MHz tissue. This is true because nonlinearly propagating acoustic energy waveforms experience more distortion, saturation, and absorption in water than in tissue, where attenuation present all along the tissue path will dampen the buildup of nonlinear effects.

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 may have its largest derated intensity in one of its shallowest focal zones.

Conclusions Regarding 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. Presently, available models may be limited in their accuracy because of varying tissue paths during diagnostic ultrasound exposures and uncertainties in acoustical 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 applications.

A homogeneous tissue model with an 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 the site of interest is composed entirely of soft tissue, because the attenuation coefficient of soft tissue is generally higher than 0.3 dB/cm-MHz. 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* acoustical exposure. The amount of underestimation

depends on each specific situation. For example, when the beam path is longer than 3 cm and the propagation medium is predominantly fluid (conditions that may exist during transabdominal OB scans), a more accurate value for the derating term is 0.1 dB/cm-MHz.

Fixed-path tissue models, in which soft tissue thickness is held constant, sometimes are used to estimate *in situ* acoustical 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/MHz may be used during all trimesters.

The maximum acoustic output levels of diagnostic ultrasound devices extend over a broad range of values:

- A survey of 1990-equipment models yielded mechanical index (MI) values between 0.1 and 1 at their highest output settings. Maximum MI values of approximately 2 are known to occur for currently available equipment. Maximum MI values are similar for real-time 2D, M-mode, PW Doppler, and Color flow imaging.
- Computed estimates of upper limits to temperature elevations during transabdominal scans were obtained in a survey of 1988 and 1990 PW Doppler equipment. The vast majority of models yielded upper limits less than 1°C and 4°C for exposures of first-trimester fetal tissue and second-trimester fetal bone, respectively. The largest values obtained were approximately 1.5°C for first-trimester fetal tissue and 7°C for second-trimester fetal bone. Estimated maximum temperature elevations given here are for a "fixed-path" tissue model and are for devices having I_{spta} (derated) 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 through 4.3.2.6 in "Bioeffects and Safety of Diagnostic Ultrasound" (AIUM Report, January 28, 1993).

Acoustic Output Tables

Acoustic output tables are in *Acoustic Output Tables*, on your *User Information CD*.

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 column of the tables. Measurement precision and uncertainty for power, pressure, intensity, and center frequency are listed in the following tables.

NOTE

Per Section 6.4 of the Output Display Standard, measurement precision on the following quantities is determined by making repeated measurements and stating the standard deviation as a percentage.

Acoustic Measurement Precision

Quantity	Precision (Percentage Standard Deviation)
Pr is the underated peak rarefactional pressure measured in megapascals (MPa).	Pr: 5.4%
Wo is the ultrasonic power in milliwatts (mW).	6.2%
f _c is the center frequency in megahertz (MHz) (NEMA UD-2 definition).	<1%
PII.3 is the derated spatial-peak pulse intensity integral in joules per square centimeter (J/cm ²).	PII.3: 3.2%

Acoustic Measurement Uncertainty

Quantity	Measurement Uncertainty (Percentage, 95% Confidence Value)
Pr is the underated peak rarefactional pressure measured in megapascals (MPa).	Pr: $\pm 11.3\%$
Wo is the ultrasonic power in milliwatts (mW).	$\pm 10\%$
f _c is the center frequency in megahertz (MHz) (NEMA UD-2 definition).	$\pm 4.7\%$
PII.3 is the derated spatial-peak pulse intensity integral in joules per square centimeter (J/cm ²).	PII.3: +18% to -23%

Operator Safety

The following issues and situations can affect operator safety when you are using an ultrasound system.

Repetitive Strain Injury

Repetitive ultrasound scanning has been associated with carpal tunnel syndrome (CTS) and related musculoskeletal problems. Some investigators have looked at a large population of sonographers with different types of equipment. An article, with feedback from a smaller geographical area, makes the following recommendations:

- Maintain your joints in optimum positions with a balanced posture while scanning.
- Allow frequent breaks to give soft tissue a chance to recuperate from awkward positions and repetitive movement.
- Avoid gripping the transducer with excessive force.

Repetitive Strain References

Pike, I., et al. "Prevalence of Musculoskeletal Disorders and Related Work and Personal Factors Among Diagnostic Medical Sonographers." *Journal of Diagnostic Medical Sonographers*, Vol. 13, No. 5: 219-227, September 1997.

Necas, M. "Musculoskeletal Symptomatology and Repetitive Strain Injuries in Diagnostic Medical Sonographer." *Journal of Diagnostic Medical Sonographers*, 266-227, November/December 1996.

Foot Switch Warning



WARNING

The foot switch is not intended for use in wet locations, such as emergency rooms and operating theaters.

Philips Transducers

Use only transducers that are approved by Philips for use with your Philips ultrasound system. See “[Clinical Applications and Transducers](#)” on page 174 for a list of the transducers that are compatible with your ultrasound system.

In the United States, the FDA 510(k) regulatory clearance for use of the product is applicable only when Philips-manufactured transducers are connected to the system.

Glutaraldehyde Exposure

The United States Occupational Safety and Health Administration (OSHA) has issued a regulation covering levels of acceptable glutaraldehyde exposure in the working environment. Philips does not sell glutaraldehyde-based disinfectants with its products, but this type of disinfectant is recommended for the disinfection of transducers used in TEE, intraoperative, endocavity, and biopsy procedures.

To reduce the presence of glutaraldehyde fumes in the air, be sure to use a covered or ventilated soaking basin. Such systems are commercially available. The most-current information about disinfection products and Philips transducers can be found on the Philips Transducer Care website:

www.healthcare.philips.com/us_en/products/ultrasound/Transducers/transducer_care/index.wpd

Infection Control

Issues related to infection control affect the operator and the patient. Follow the infection-control procedures established in your facility for the protection of both the staff and the patient.

Handling Contaminated Transducers

The primary area of concern is the handling of transducers that have contacted infected patients. Always wear gloves when you handle transducers used in TEE, endocavity, intraoperative, and biopsy procedures that have not been previously disinfected.

For information on cleaning and disinfecting transducers, see the “[Transducer Care](#)” section.

Removing Blood and Infectious Material from the System



CAUTION

Do not wipe the transducer housing joint, strain relief, or cable with isopropyl alcohol. Isopropyl alcohol can damage these parts of the transducer. This damage is not covered by the warranty or your service contract.

Use a gauze pad moistened with soap and water to remove blood on the system and the transducer connectors and cables. Then dry the equipment with a soft cloth to prevent corrosion. You can use a 70% solution of isopropyl alcohol on the system and only on certain parts of some transducers. Additional cleaning agents are available for transducers. For more information, see the “[Transducer Care](#)” section.

For more information about removing blood and other infectious material from the system, see “[Disinfecting System Surfaces](#)” on page 290.

ECG Cables and Lead Sets

For information on cleaning ECG cables and lead sets, see “[Cleaning the System and ECG Equipment](#)” on page 287.

Disposable Drape

If you believe contamination of the system might occur during an exam, Philips recommends that you take universal precautions and cover the system with a disposable drape. Consult your facility's rules regarding equipment use in the presence of infectious disease.



CAUTION

Position the disposable drape so that it does not block the vents on the system, the monitors, or the peripherals.

Electromagnetic Compatibility

Electromagnetic compatibility (EMC) is defined as the ability of a product, a device, or a system to function satisfactorily in the presence of the electromagnetic phenomena that exists in the location of the product, the device, or the system being used; and, in addition, to not introduce intolerable electromagnetic disturbances to anything in that same environment.

Electromagnetic immunity is the ability of a product, a device, or a system to function satisfactorily in the presence of electromagnetic interference (EMI).

Electromagnetic emissions is the ability of a product, a device, or a system to introduce intolerable electromagnetic disturbances into the use environment.

Your system has been manufactured in compliance with existing electromagnetic compatibility requirements. Use of this system in the presence of an electromagnetic field can cause momentary degradation of the tracking ability. If this occurs often, review the environment in which the system is being used to identify possible sources of radiated emissions. These emissions could be from other electrical devices used within the same room or an adjacent room, or from portable and mobile RF communications equipment such as cellular phones and pagers, or from the existence of radio, TV, or microwave transmission equipment located nearby. In cases where electromagnetic interference (EMI) is causing disturbances, it may be necessary to relocate your system.

The system complies with International Standard CISPR 11 for radiated and conducted electromagnetic disturbances. Compliance with this standard allows the system to be used 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.



WARNING

Using cables, transducers, or accessories other than those specified for use with the system may result in increased emissions or decreased immunity of the system.



CAUTION

Medical equipment has special precautions regarding EMC and must be installed and put into service according to the EMC information provided in the system's accompanying documents.

This section includes information on electromagnetic emissions and immunity as it applies to the system. Ensure that the operating environment of your system meets the conditions specified in the referenced information. Operating the system in an environment that does not meet these conditions may degrade system performance.

The information and warnings contained in this and other sections should be observed when installing and using the system to ensure its EMC.

NOTE

See the other electrical-safety warnings and cautions in this section.

If the system is operated within the electromagnetic environment described in [“Electromagnetic Immunity” on page 74](#), the system will remain safe and will provide the following essential performance:

- Imaging
- Doppler audio and spectral display
- Measurements
- Acoustic output
- ECG triggering
- Recording and playback on a VCR or DVD recorder
- Printing using system printers
- Patient information
- Date and time information

Radio-Frequency Emissions

The following information applies to the system and any radio-frequency device included in or with the system. For information on related labeling, see [“Symbols” on page 38](#).

FCC and Industry Canada Radio Compliance: This device complies with Part 15 of the FCC Rules and RSS-210 of Industry Canada. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation. Any changes or modifications to this equipment not expressly approved by Philips may cause harmful radio frequency interference and void your authority to operate this equipment.

The radio component in this device is the LG-Ericsson USB-1040.

The wireless technology radio device used in this product is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. This product is intended to be connected to the Publicly Available Interfaces and used throughout the European Economic Area.

ECG Signal



WARNING

Operation of your system with ECG signals below 0.25 mV may cause inaccurate results.

The amplitude of the electrocardiogram (ECG) signal is critical for reliable frame triggering. Frame triggering should be used only when a clean, noise-free ECG waveform is observed on the ECG display. The ECG signal should be at least 0.25 mV to ensure reliable triggering when the system is used in the presence of the electromagnetic phenomena described in this section and elsewhere in your system user information.

Electrostatic Discharge Precautions

Electrostatic discharge (ESD), commonly referred to as a static shock, is a naturally occurring phenomenon that results in the flow of an electrical charge from a higher charged object or person to a lower charged object or person. ESD is most prevalent during conditions of low humidity, which can be caused by heating or air-conditioning. During low humidity conditions, electrical charges naturally build up on individuals and objects and can create static discharges.

The following cautions can help to reduce ESD effect:



CAUTION

Do not touch transducer connector pins or the system's transducer receptacle.



CAUTION

Handle the transducer by the metal connector shell.

**CAUTION**

Make contact with a metal surface of the system before connecting a transducer to the system.

**CAUTION**

The following precautions can help to reduce ESD: anti-static spray on carpets; anti-static spray on linoleum; anti-static mats; or a ground wire connection between the system and the patient table or bed.

**CAUTION**

On connectors labeled with the ESD sensitivity symbol , do not touch the connector pins, and always observe the preceding ESD precautions when handling or connecting transducers.

NOTE

Electrostatic discharges (ESDs) may cause the ECG heart rate display to increase by 10% to 15% for a few seconds after the discharge. However, the ECG heart rate display will return to normal within 4 seconds.

Electromagnetic Emissions

The system is intended for use in the electromagnetic environment specified in the table. The customer or the user of the system should ensure that it is used in such an environment.

Electromagnetic Emissions: Environment Guidance

Emissions Test	Compliance	Electromagnetic Environment Guidance
Radiated emissions, CISPR 11	Class B However, the use of intracardiac echocardiography (ICE) or transesophageal echocardiographic (TEE) probes results in Class A Radiated Emissions and should be used only in a hospital environment.	The 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.
Conducted emissions, CISPR 11	Group 1 Class B	
Harmonic emissions, IEC 61000-3-2	Class B	
Voltage fluctuations/flicker emissions, IEC 61000-3-3	Complies	The 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.

Approved Cables for Electromagnetic Compliance

Cables connected to the system may affect its emissions. Use only the cable types and lengths listed here.



WARNING

Using cables, transducers, and accessories other than those specified for use with the system may result in increased emissions from, or decreased immunity of, the system.

Approved Cables

Cable	Type	Length	Philips Part Number
Adult and pediatric ECG three-lead patient trunk cable (for AAMI and IEC leadsets)	—	2.7 m (9 ft) with leadset	
Adult ECG leadset (AAMI)	—	—	453561490131/M1671A

Cable	Type	Length	Philips Part Number
Adult ECG leadset (IEC)	–	–	453561490141/M1672A
Pediatric ECG leadset (AAMI)	–	–	453561490101/M1624A
Pediatric ECG leadset (IEC)	–	–	453561490121/M1669A
S-video	S-video cable	Any	–
LAN	Twisted pair	Any	–
USB	Shielded	Any	–

Approved Transducers for Electromagnetic Compliance

The imaging transducers used with the system may affect its emissions. The transducers listed in “[Clinical Applications and Transducers](#)” on page 174, when used with the system, have been tested to comply with the Group 1, Class B emissions, as required by International Standard CISPR 11. Use only those transducers.



WARNING

Using cables, transducers, and accessories other than those specified for use with the system may result in increased emissions from, or decreased immunity of, the system.

NOTE

The use of an Intracardiac Echocardiography (ICE) Probe or an Transesophageal Echocardiogram (TEE) probe results in Class A Radiated Emissions and should be used in a hospitable environment only.

Approved Accessories for Electromagnetic Compliance

Accessories used with the system may affect its emissions. The accessories listed here, when used with the system, have been tested to comply with the Group 1, Class B emissions as required by International Standard CISPR 11. Use only the accessories listed here.

When connecting other accessories to the system, such as a remote video monitor or computer, it is the user's responsibility to ensure the electromagnetic compatibility of the system. Use only CISPR 11 or CISPR 22, Class B-compliant devices, unless otherwise noted.

**WARNING**

Using cables, transducers, and accessories other than those specified for use with the system may result in increased emissions from, or decreased immunity of, the system.

**CAUTION**

Use only Class-B USB storage devices with the system. Some plastic-cased unshielded USB devices may cause RF emissions that exceed Class-B limits. See the device's documentation to determine whether it is Class-B compliant.

Approved Accessories

Accessory	Manufacturer	Model Number
Ultrasonic imaging transducer	Philips	Use only the transducers listed in "Clinical Applications and Transducers" on page 174
DVD recorder	Sony	DVO-1000MD
Black-and-white printer	Sony	UP-D897MD
Color printer	Sony	UP-D25MD

Electromagnetic Immunity

The system is intended for use in the electromagnetic environment specified here. The customer or the user of the system should ensure that it is used in such an environment.

NOTE

The guidelines specified here may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

NOTE

U_T is the AC power voltage before application of the test level.

NOTE

At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

Electromagnetic Immunity: Environment Guidance

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment Guidance
Electrostatic discharge (ESD), IEC 61000-4-2	± 6 kV contact, ± 8 kV air	Same as IEC 60601 test level	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 for power supply lines, ± 1 kV for input/output lines	Same as IEC 60601 test level	Mains power quality should be that of a typical commercial or hospital environment.
Surge, IEC 61000-4-5	± 1 kV differential mode, ± 2 kV common mode	Same as IEC 60601 test level	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	Drop out <40 msec	Same as IEC 60601 test level	Mains power quality should be that of a typical commercial or hospital environment. If you require continued operation during power mains interruptions, Philips recommends that the system be powered from an uninterruptible power supply or a battery.

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment Guidance
Power frequency (50/60 Hz) magnetic field, IEC 61000-4-8	3 A/m	Same as IEC 60601 test level	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Conducted RF, IEC 61000-4-6	3 VRMS 150 kHz to 80 MHz	3 mVRMS	For recommended separation distances, see “Recommended Separation Distance” on page 79 .
Radiated RF, IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	For recommended separation distances, see “Recommended Separation Distance” on page 79 .



CAUTION

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

Although most remote devices comply with their applicable standards for immunity, those device requirements may not be as stringent as those required for medical equipment. It is the responsibility of the installer and the user of this remote customer-supplied equipment to ensure that it functions properly in the electromagnetic environment where the system is installed. Philips suggests that the installer or the user of such a system consult with experts in the field of electromagnetic compatibility and safety for guidance to ensure the safe and effective use of the created system.

Electromagnetic Interference

Electromagnetic interference may appear in many ways on the system and depends on the mode the equipment is operating in, the imaging control settings, the type of transducer being used, the type of electromagnetic phenomena, and the intensity level of the phenomena.



CAUTION

When interference is present or intermittent, use caution when continuing to use the system.

NOTE

Electromagnetic phenomena are not always present and may be transitory in nature. It may be extremely difficult to identify the source of the interference.

NOTE

The following table describes a few typical interferences seen in imaging systems. It is impossible to describe all manifestations of interference, because it depends on many parameters of the transmitting device, such as the type of modulation used by the signal carrier, the source type, and the transmitted level. It is also possible for the interference to degrade the imaging system's performance and not be visible in the image. If the diagnostic results are suspicious, other means should be used to confirm the diagnosis.

Typical Interference on Ultrasonic Imaging Systems

Imaging Mode	ESD ¹	RF ²	Power Line ³
2D or 3D	Change of operating mode, system settings, or system reset. Brief flashes in the displayed or recorded image.	For sector imaging transducers, white radial bands or flashes in the center lines of the image. For linear imaging transducers, white vertical bands, sometimes more pronounced on the sides of the image.	White dots, dashes, or diagonal lines near the center of the image.
Color	Change of operating mode, system settings, or system reset. Brief flashes in the displayed or recorded image.	Color flashes, radial or vertical bands, increase in background noise, or changes in image color.	Color flashes, dots, dashes, or changes in the color noise level.
Doppler	Change of operating mode, system settings, or system reset. Brief flashes in the displayed or recorded image.	Horizontal lines in the spectral display or tones, abnormal noise in the audio, or both.	Vertical lines in the spectral display, "popping" noise in the audio, or both.
M-mode	Change of operating mode, system settings, or system reset. Brief flashes in the displayed or recorded image.	Increase in the image background noise or white M-mode lines.	White dots, dashes, diagonal lines, or increase in image background noise.

1. Electrostatic discharge (ESD) caused by discharging of electric charge buildup on insulated surfaces or persons.
2. Radio frequency (RF) energy from RF transmitting equipment such as portable phones, handheld radios, wireless devices, commercial radio and TV stations, and so on.
3. Conducted interference on power lines or connected cables caused by other equipment, such as switching power supplies, electrical controls, and natural phenomena such as lightning.

Recommended Separation Distance

The following table provides recommended separation distances, which are guidelines on the distances that any RF transmitting equipment should be kept away from the ultrasound system to reduce the risk of interference with the system. Portable and mobile RF communications equipment should be used no closer to any part of the system, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, should be less than the compliance level in each frequency range as noted in the table. Interference may occur in the vicinity of equipment marked with the following symbol: .

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 system is used exceeds the applicable RF compliance level in the table, the system should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the system.

NOTE

For transmitters rated at a maximum output power not listed in the following table, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE

At 80 MHz and 800 MHz, the higher frequency range applies.

NOTE

The recommended separation distance guidelines in the following table may not apply to all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

The information provided here, in conjunction with “[Electromagnetic Interference](#)” on page 77, provides guidance on conducted and radiated interference from portable and fixed RF transmitting equipment.

Recommended Separation Distances by Transmitter Frequency

Rated Maximum Output Power of Transmitter (Watts)	150 kHz to 80 MHz	80 to 800 MHz	800 MHz to 2.5 GHz
	$d = \frac{3.5\sqrt{P}}{V}$	$d = \frac{3.5\sqrt{P}}{E}$	$d = \frac{7.0\sqrt{P}}{E}$
0.01	117 m (384 ft)	0.12 m (4.7 in)	0.24 m (9.5 in)
0.1	369 m (1210 ft)	0.38 m (15 in)	0.76 m (30 in)
1	1170 m (3840 ft)	1.2 m (3.9 ft)	2.4 m (7.9 ft)
10	3690 m (12100 ft)	3.8 m (12.5 ft)	7.6 m (25 ft)
100	11700 m (34800 ft)	12 m (39.4 ft)	24 m (78.7 ft)

The conducted RF test level is 3 V, and the system has a compliance level of 3 mV. For the system, this means that the imaging system is extremely sensitive to RF interference in the transducer passband. For example, for a 5-MHz imaging transducer, the frequency range of interference from a 3-V/m field may be from 2 to 10 MHz and manifest itself as described in “[Electromagnetic Interference](#)” on page 77.

The 0.3 mV level is where the interference becomes acceptable to some clinical specialists.

Sensitivity to interference is dependent on operating mode and imaging control settings. The order of increasing sensitivity to interference as a function of operating mode is 2D mode, 3D mode, M-mode, Color mode, PW Doppler mode, and CW Doppler mode. The system is more sensitive to interference in the CW Doppler or PW Doppler operating modes, but the

probability of interference is lower than in 2D mode or Color mode, because the susceptible frequency range is lower. Therefore, you are more likely to see interference in 2D or Color modes.

As an example, if a portable transmitter has maximum radiated power of 1 W and an operating frequency of 156 MHz, it should only be operated at distances greater than 1.2 m (3.9 ft) from the system. Likewise, a 0.01-W Bluetooth wireless LAN device operating at 2.4 GHz should be placed no closer than 0.24 m (9.5 in) from any part of the system.

Avoiding Electromagnetic Interference

A medical device can either generate or receive electromagnetic interference. The EMC standards describe tests for both emitted and received interference. Emission tests deal with interference generated by the device being tested. Philips ultrasound systems do not generate interference based on the tests described in the referenced standards.

An ultrasound system is designed to receive signals at radio frequencies and is therefore susceptible to interference generated by RF energy sources. Examples of other sources of interference are medical devices, information technology products, and radio and television transmission towers. Tracing the source of radiated interference can be a difficult task.

Customers should consider the following in an attempt to locate the source:

- Is the interference intermittent or constant?
- Does the interference show up only with one transducer or with several transducers?
- Do two different transducers operating at the same frequency have the same problem?
- Is the interference present if the system is moved to a different location in the facility?
- Can the EMC coupling path be attenuated? For example, placement of a transducer or printer close to an ECG cable can increase electromagnetic interference. Moving the cable or other medical equipment away from the location of the transducer or printer can result in reduced electromagnetic interference.

The answers to these questions will help determine if the problem resides with the system or the scanning environment. After you answer the questions, contact your Philips service representative.

Use Restrictions Due to Interference

The physician must determine if an artifact caused by radiated interference will have a negative impact on image quality and the subsequent diagnosis.

**WARNING**

The physician must determine if tracking is accurate. Tracking in an untested environment or a location known to cause electromagnetic interference can contribute to inaccurate information and possible personal injury.

3 System Overview

Use this section to acquaint yourself with the ultrasound system and its components.

System Capabilities

The EPIQ 7 Ultrasound System is a high-resolution system intended for general imaging, interventional radiology, cardiology, vascular, and OB/GYN applications, and analysis. The cart is ergonomically designed to be both highly mobile and adjustable for a range of users and operating conditions. You can use it for 2D, Live 3D Echo, M-mode, Doppler, and Color imaging. You can also perform Duplex, Triplex, and Live xPlane imaging. Stress echocardiography is standard on the system, and QLAB Advanced Quantification Software Q-Apps are available as options. The system supports a wide range of transducers. The system provides measurement tools, analysis options, and DICOM network capabilities.

Measurements

The system provides tools and controls for measuring distance, area, and volume. Additionally, the following application-specific tools are available:

- Aliasing Velocity
- 3D Volume
- Generic Angle
- Heart Rate
- High Q automatic Doppler analysis
- Hip Tools
- Percent Reduction
- Simpson's Method
- Time/Slope
- Velocity
- Volume Flow

After you perform measurements, the system makes the pertinent calculations and organizes the measurements, calculations, and patient information into a patient report.

For information, see the *Help*. To display the *Help*, touch . To close the *Help*, touch  again.

Transducer Types

Available transducer types include sector array, linear array, curved array, Doppler probes, endocavity, intraoperative, transesophageal, volume, and xMATRIX. Applications for specific transducers are listed in “[Clinical Applications and Transducers](#)” on page 174.

Image Acquisition and Review

You can acquire and review single images and cineloop sequences. Images and cineloop sequences can be stored on DVDs, CDs, or USB devices, or sent over a network to an archive server or a printer.

Stress Echo capabilities also use the ability to acquire and review image loops. Stress Echo protocols of up to 10 stages are used to assess cardiac wall motion at various heart rates.

Peripheral devices are available for recording images and exams. You can connect a black-and-white image printer or a color image printer. You can also connect a report printer.

Patient Data Protection

The data security feature, if enabled on your system, limits access to previously stored patient data and images. To gain access to such data, you must first log on to the system using a password. When you are finished using the system, you can log off manually, or you can simply shut down the system, which logs you off automatically. The system stores a record of each user logon.

This data protection feature can be used to help meet the requirements of the U.S. Health Insurance Portability and Accountability Act (HIPAA).

For more information on protecting patient data, see “[System Security](#)” on page 133.

System Options

In addition to the standard features available in the system, other features are available as purchasable options. The types of options available include clinical applications, QLAB Advanced Quantification Software, protocols, imaging capabilities, and connectivity capabilities. A foot switch is available as an option.

Imaging Options

- 3D/4D (mechanical transducers)
- 3D Single Sweep Color Flow
- 3D Fetal Echo STIC
- Auto Doppler Optimization
- Color for 3D imaging
- Contrast perfusion
- Strain Elastography
- ElastPQ Shear Wave Elastography
- Exam protocols
- Freehand 3D
- iSCAN Intelligent Optimization
- Live 3D and xPlane imaging (xMATRIX transducers)
- Panoramic 2D imaging
- Panoramic 3D imaging
- Physio
- Sleep/Portability Mode (Battery Option)
- Stress Echo protocols
- Tissue Doppler Imaging (TDI)

NOTE

The elastography feature is available only in selected regions. For information specific to your region, contact your local Philips representative.

Connectivity Capabilities

The following features are standard:

- Image and waveform export to removable media
- Printing to DICOM printers
- Printing to local printers
- Printing report pages
- Wireless DICOM transfer

In addition to those standard features, the Basic Connectivity purchasable option includes the following features:

- DICOM Networking
- Image and waveform export to network storage servers
- DICOM Modality Worklist
- DICOM Performed Procedure Step (PPS)
- DICOM Storage Commit (SC)
- DICOM Structured Reporting
- DICOM Query/Retrieve
- Digital Navigation Link (DNL)

Clinical/Analysis Applications

Clinical applications are available on the system as separate purchasable options. The following clinical applications and their presets (for example, small parts superficial) are associated with specific transducers:

- Abdominal
- Adult Echo
- Fetal Echo
- General
- GYN
- Intervention CV
- Intervention GI
- Musculoskeletal
- OB
- Pediatric Echo
- Pediatric GI
- Small Parts
- TCD
- Urology
- Vascular

QLAB Advanced Quantification Software Options

The following QLAB Q-Apps are supported for use on your ultrasound system:

NOTE

The EA Q-App is only available in the United States.

NOTE

The EQ Q-App is not available in the United States.

- Auto 2D Quantification (a2DQ)
- Auto Cardiac Motion Quantification (aCMQ)
- Cardiac 3D Quantification (Cardiac 3DQ)
- Cardiac 3D Quantification Advanced (Cardiac 3DQ Advanced)
- Cardiac Motion Quantification Stress (CMQ-Stress)
- Elastography Analysis (EA)
- Elastography Quantification (EQ)
- Fetal Heart Navigator (FHN)
- General Imaging 3D Quantification (GI3DQ)
- Intima Media Thickness (IMT)
- MicroVascular Imaging (MVI)
- Mitral Valve Navigator (MVN)
- Region of Interest Quantification (ROI)
- Strain Quantification (SQ)

Stress Echocardiography

Stress Echocardiography (Stress Echo) is a protocol-driven study that allows a cardiologist to assess cardiac wall motion at various heart rates by acquiring views of the heart at different stages of the study. Stress Echo includes these Philips protocols:

- Exercise 2-Stage
- Exercise 3-Stage
- iRotate Stress
- Pharmacological 4-Stage
- Quantitative 4-Stage
- Wall Motion and Contrast

You can create custom presets based on those protocols.

Data Security

A data security feature is available to help maintain the confidentiality of archived patient files. With this option, access to patient exam files is restricted to authorized personnel through user ID and password protection. For more information, see ["System Security" on page 133](#).

PercuNav Image Fusion and Interventional Navigation

You can use the PercuNav Image Fusion and Interventional Navigation option to fuse diagnostic images and guide tracked instruments to targets that have been defined by a physician. The target can be indicated either pre-procedurally or intra-procedurally, either using images or relative to an indicated position on the patient.

Features include the following:

- Multiple applications: The PercuNav option supports multiple applications and can be used for ablations, biopsies, and other diagnostic and guidance procedures.
- Multiple modalities: The PercuNav option works with images from multiple modalities, including but not limited to CT, MR, PET, ultrasound, and rotational fluoroscopy.

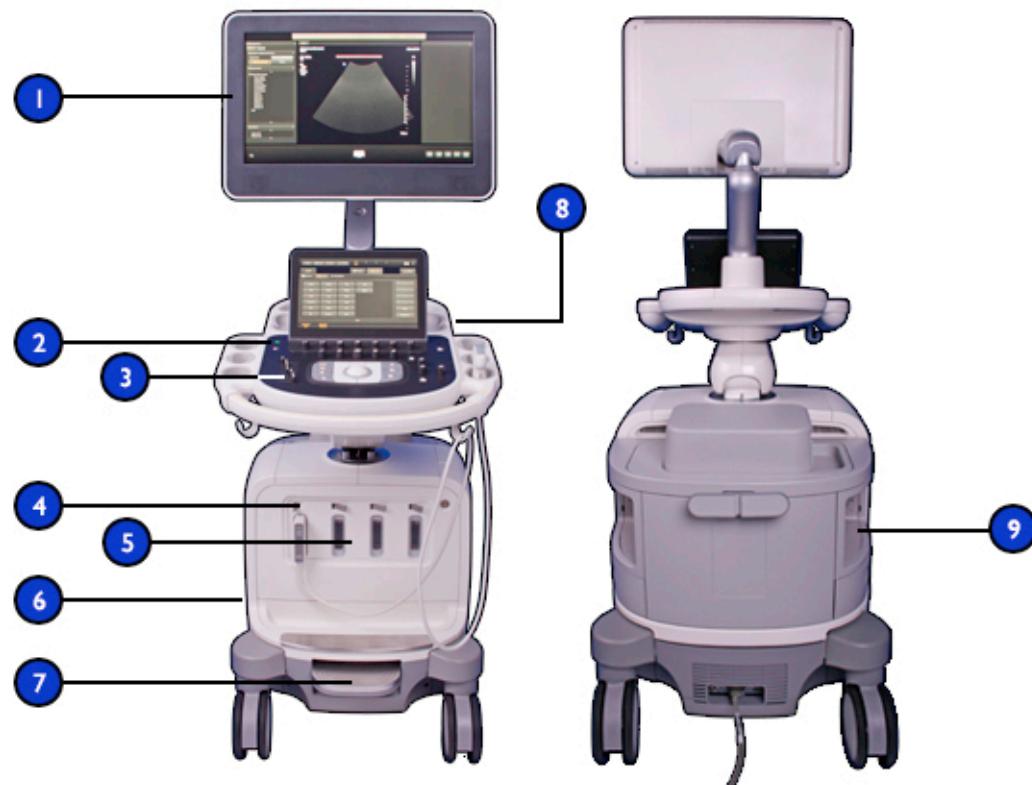
Instructions for using PercuNav are in the *PercuNav User Manual*.

NOTE

PercuNav is a purchasable licensed option. Its user interface is available only when the PercuNav license is enabled.

System Components

The system is housed in an ergonomic cart. The cart is adjustable to accommodate a wide range of operator heights and operating positions. Adjustable components can be locked in place so the cart can be safely moved. The major components include the monitor, control module, On/Off switch, DVD+RW drive, peripheral bay, transducer receptacles, ECG/physio receptacles, USB ports, brakes and steering locks, and foot switch receptacle.

*System Components*

- | | |
|---|-----------------------------|
| 1 | Monitor |
| 2 | On/Off switch |
| 3 | Control module |
| 4 | Transducer receptacle locks |
| 5 | Transducer receptacles |
| 6 | Side panel |
| 7 | Brake/steering lock pedal |
| 8 | Touch screen |
| 9 | Peripheral bays |

Video Monitor

The system video monitor consists of a 53.3-cm (21-in) flat-panel display on an articulated mounting arm. The monitor is adjustable to accommodate different operating positions and operator heights. The monitor can also be locked in position for moving the system (see [“Moving the System” on page 106](#)).

Control Module

The control module includes three main components: the control panel, the touch screen, and the keyboard. For more information on the control module, refer to [“System Controls” on page 119](#).

The control panel contains the main imaging controls. These controls include buttons, knobs, and a trackball. The control module also allows you to select transducers, enter patient data, review and annotate images, perform measurements and calculations, and change setups.

The touch screen, located above the control panel, displays controls used to select applications and imaging modes, as well as controls that are specific to the current operating mode. Touch screen controls include buttons and knobs.

*Control Module*

- | | |
|---|--------------------|
| 1 | Control panel |
| 2 | Touch screen |
| 3 | Trackball |
| 4 | TCG slide controls |

You can adjust the position of the control module vertically and side-to-side. You can also swivel the control module.

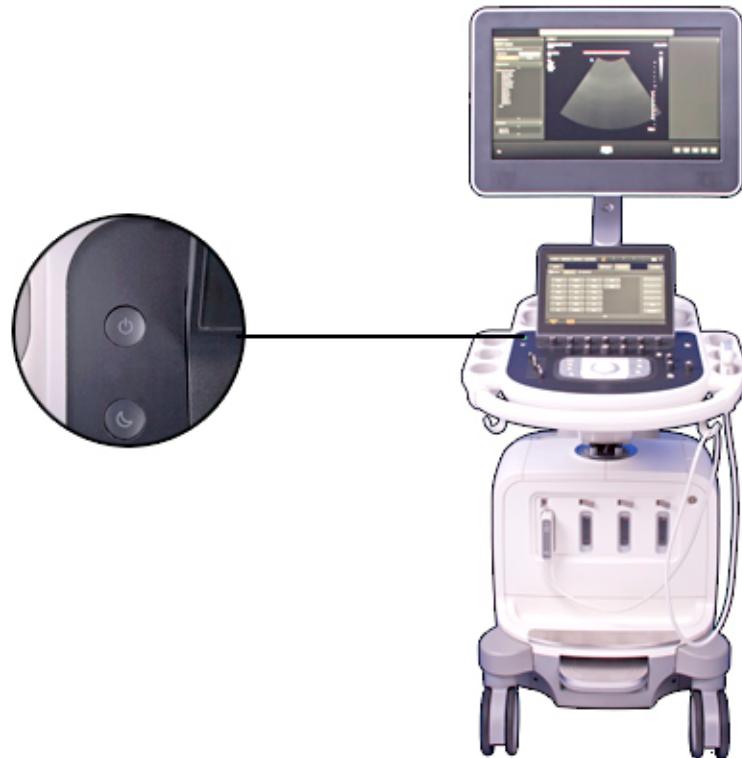
Beneath the control panel is a retractable keyboard. The keyboard is used to enter patient data, comments, and text annotation on images.



Retractable Keyboard

On/Off (Power) Control

The  (On/Off) control is located on the control panel. When the system is off, pushing this control brings the system into a fully operational state. Pushing this control again turns off the system.



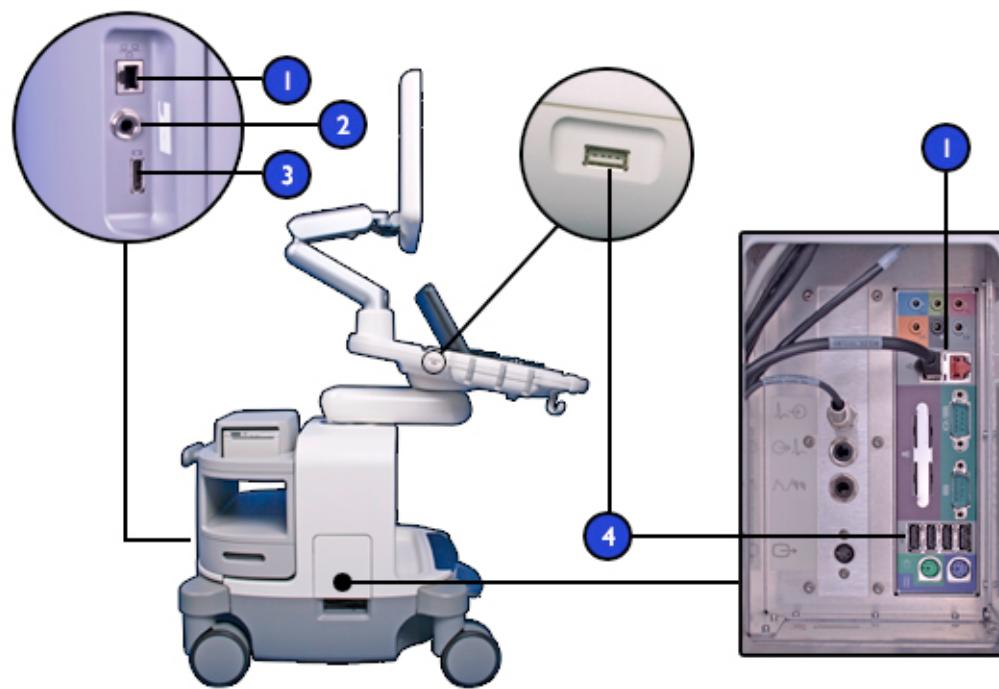
On/Off Control

Data Storage

You can store exam data and images onto removable media. Removable media includes USB storage devices and the DVDs and CDs. The DVD+RW drive is located on the right side of the control panel behind the transducer holders.



DVD+RW Drive



Data Port Locations

- | | |
|---|--------------------|
| 1 | Network connection |
| 2 | Phono (ECG) |
| 3 | External monitor |
| 4 | USB ports |

Peripherals

The peripheral bays at the back of the system provide space for up to two peripheral devices. Those devices can be any combination of the following devices: a black-and-white printer, a color printer, and a DVD recorder.

NOTE

If your system configuration includes the PercuNav Image Fusion and Interventional Navigation option, then the top peripheral bay is dedicated to the PercuNav hardware and is unavailable for other peripherals. Only one other peripheral can be installed in the bay.



Peripheral Bays

Transducer Receptacles and Cable Management

The system includes four receptacles for imaging transducers, one receptacle for a pulsed- or continuous-wave Doppler probe, and one receptacle for physio, if physio is included in your system's configuration. All receptacles can be occupied simultaneously, but only one transducer at a time can be active.

*Transducer Receptacles*

- | | |
|---|-------------------------------|
| 1 | Physio probe receptacle |
| 2 | Doppler probe receptacle |
| 3 | Imaging transducer receptacle |

When a transducer is not in use, store it in one of the transducer holders on the system cart. Always loop transducer cables over the cable hangers to prevent cables from being stepped on or run over by the cart wheels.

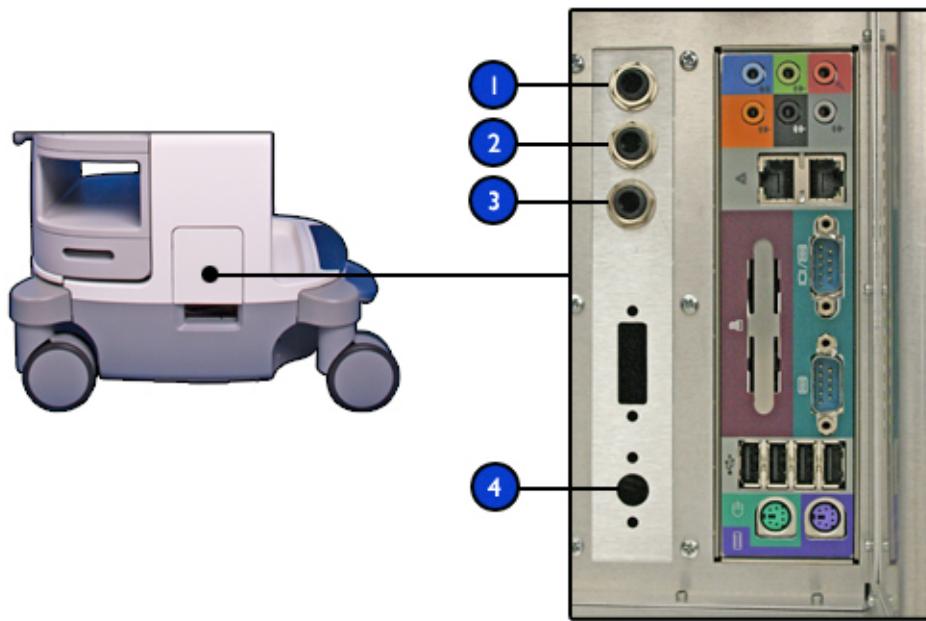


Transducer Holders and Cable Hangers

- | | |
|---|-------------------|
| 1 | Transducer holder |
| 2 | Cable hanger |
-

Physio (ECG) Receptacles

For physio support, your system includes input receptacles for ECG (for the connector location, see the figure in [“Transducer Receptacles and Cable Management” on page 140](#)), pulse, phono, and auxiliary signals.



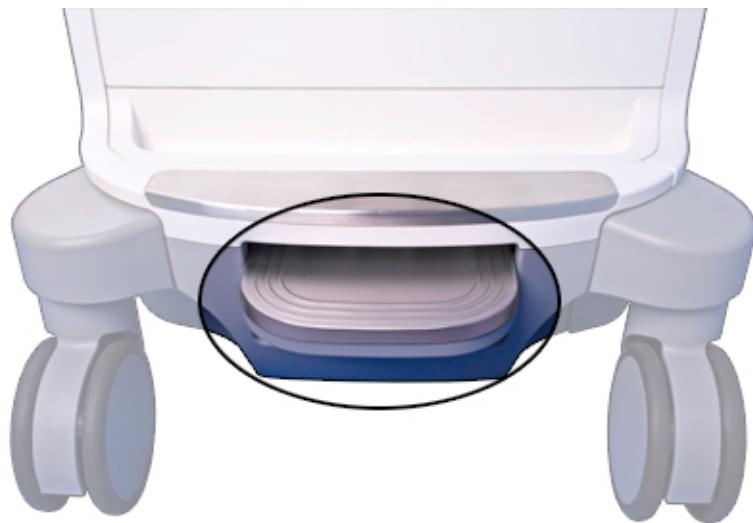
ECG and Physio Receptacles

-
- 1 Physio out
 - 2 Pulse/Phono/Aux 2 input
 - 3 Physio input
 - 4 S-VHS output
-

Wheel Brakes and Steering Locks

The system includes brakes that you can engage to help keep the system stationary during use. You can release the brakes and engage steering locks on the front wheels to aid in steering while moving the system, or you can release all locks, which allows all wheels to move freely. When the pedal is fully pressed down, all brakes are engaged. To release all brakes, move the pedal to the middle position. To engage the steering locks, pull the pedal fully up.

For more information, see “[Using the Brakes and Steering Locks](#)” on page 115.



Brake/Steering Lock Pedal

4 Preparing the System

The information and procedures in this section will help you prepare the system for use. Preparations include connecting transducers and external devices, locking articulated components for moving, and ensuring that system operating requirements are met.

Connecting Devices

In addition to the devices installed in the system cart, the system supports external devices. These devices include printers, a foot switch, and a color monitor.

The system also supports a DVD recorder. This recorder is considered an external device, even when it is installed on the system. The DVD recorder can be installed before the system is shipped, or it can be installed later by your Philips representative.



WARNING

When using additional peripheral equipment powered from an electrical source other than the ultrasound system, the combination is considered to be a medical system. It is your responsibility to comply with IEC 60601-1 and test the system to those requirements. If you have questions, contact your Philips representative.



WARNING

Do not use nonmedical peripherals, such as report printers, within 1.5 m (5 ft) of a patient, unless the nonmedical peripherals receive power from an isolation transformer that meets medical safety standards, as defined by standard IEC 60601-1.



WARNING

Philips ultrasound systems are tested to the requirements of IEC 60601-1, with on-cart peripherals that are powered by the built-in system isolation. The system peripherals meet general electrical safety usage requirements.

**WARNING**

Off-cart devices connecting to the ultrasound system must comply with the applicable IEC or national standards, such as IEC 60601-1, IEC 60950, or the equivalent.

**CAUTION**

Using accessories, transducers, peripherals, or cables not supplied with the ultrasound system or recommended by Philips can affect the system in the form of increased emissions or decreased immunity to external EMI/EMC occurrences. Non-specified peripherals, and cables in some cases, can also increase leakage current or compromise the safety of the grounding scheme.

**CAUTION**

If systems, transducers, and peripherals have been in an environment below 10°C (50°F), allow them to reach room temperature before connecting or turning them on. Philips recommends allowing 24 hours for complete normalization. Otherwise, condensation inside the devices could cause damage. If the device was only briefly exposed to temperatures below 10°C (50°F), then the time required for the device to return to room temperature could be significantly less than 24 hours.

NOTE

Any device that is not purchased from Philips or a Philips-authorized agent is not covered under a Philips service agreement or warranty.

External Printers

You can connect different external printers to your system.

**WARNING**

Images printed on a report printer are intended only for reference and should not be used for diagnostic purposes.

NOTE

Use only the printers listed here with your ultrasound system.

NOTE

The system uses the HP Universal Print Driver and the Epson Universal Print Driver, which support additional printers not listed here. For the supported printers, see the manufacturer's website and search for "universal print driver."

Supported External Printers

Printer Type	Printer Manufacturers and Model Numbers
Black-and-white image printer	Sony UP-D897/SYN
Color printer	Sony UP-D25MD

Connecting an External Printer**WARNING**

When using additional peripheral equipment powered from an electrical source other than the ultrasound system, the combination is considered to be a medical system. It is your responsibility to comply with IEC 60601-1 and test the system to those requirements. If you have questions, contact your Philips representative.

**WARNING**

Do not use nonmedical peripherals, such as report printers, within 1.5 m (5 ft) of a patient, unless the nonmedical peripherals receive power from an isolation transformer that meets medical safety standards, as defined by standard IEC 60601-1.

1. Turn off the system and unplug the power cord from the power source.
2. Connect a standard USB cable between the USB port on the printer and a USB  port on the system.

3. Connect the printer's power cord into the back of the printer, and plug the other end into an appropriate power source (see "[Warnings](#)" on page 16).
4. Plug the system's power cord into an appropriate power source.
5. Turn on the printer, and then turn on the system. The system installs the printer drivers automatically.
6. After the system installs the new printer drivers, restart the system.

Configuring Local Printers

You can add a local printer to the system and then, in the setups, associate it with either a touch screen control or the **Acquire 1** or **Acquire 2** control. You can print only to a printer that has been selected. You can also change other printing parameters.



WARNING

Multi-image prints made on small-size paper are intended only for reference and should not be used for diagnostic purposes. Text annotation and scaling markers may not be visible on such prints.

NOTE

Before adding a local printer, connect the printer to the ultrasound system.

1. Touch **Utilities**.
2. On the **System** tab, touch **Setups**.
3. Click **Acquisition/Capture**.
4. Click the **Archive/Printer** tab.
5. To assign a printer to the **Acquire 1** or the **Acquire 2** control, do the following:
 - a. From the **Acquisition Type** list, select a type.
 - b. Select the printer that you want to use.
6. To assign a printer to a touch screen control, do the following:
 - a. Under **Select a Touch Screen Button**, select the name of the control that you want to assign.
 - b. In **Destination(s) for the Button**, select a printer.
7. To exit the setups, touch **Close**.

Connecting the Foot Switch

The foot switch is available as an option.

1. Turn off the system.
2. Connect the foot switch cable to an available USB connector on the system.

Connecting an External DVD Recorder

You can connect the Sony DVO-1000MD DVD Recorder to your ultrasound system as an external device.

The external DVD recorder record from the ultrasound system; it does not provide playback on the system monitor. The DVD recorder must be installed with the Philips DVD recorder installation kit. (For the kit, contact your Philips representative.) If you connect this DVD recorder without the installation kit or connect any other DVD recorder, you must control it from the front panel controls on the DVD recorder or the remote controls supported by the DVD recorder. The remote controls DSRM-10 or SVRM-100A provide a convenient way to control the external DVD recorder.

1. Turn off the system and unplug the power cord from the power source.
2. Connect an S-Video cable between the S-Video input on the DVD recorder and the S-Video output  on the ultrasound system.
3. Connect the DVD recorder's power cord into the back of the DVD recorder, and plug the other end into an appropriate power source.
4. Turn on the DVD recorder, and then turn on the ultrasound system.

Connecting an External Color Monitor

You can connect a compatible external color monitor to the  receptacle on the rear panel of the system. This receptacle provides standard DisplayPort digital output. You also can connect an external analog monitor to the  (S-Video) receptacle. A digital monitor connected to the DisplayPort receptacle provides the best-quality image. The power cord for the external monitor plugs directly into a wall socket.

For monitors and video projectors requiring other connectors, such as VGA or DVI, a converter is required.

The DisplayPort output includes the entire display. The aspect ratio of the screen is 16:9. To display this properly, select the 16:10 or 16:9 mode on the monitor or projector, if available. Also, you may be able to adjust the horizontal and vertical image size controls to create the correct aspect ratio. You can best judge the aspect ratio by displaying the circle test pattern on the system.

The setups provide these outputs:

Full Screen, 1920x1080 (1080p): The full display, which is output at 60 frames per second on the DisplayPort connector. When this option is selected, you cannot use the S-video output.

Image Area Only,1024x768: Outputs the region of interest of the image area to the S-Video connector in NTSC or PAL format (depending on the system setting).

Connecting the System to a Network

For information on changing the network configuration for the system, see "System Administration" in the *Help*. To display the *Help*, touch  . To close the *Help*, touch  again or touch **Close**.

1. Turn off system power.
2. Connect one end of the provided network connection cable to the wall receptacle for your network.
3. Connect the other end of the cable to the network receptacle on the system.
4. Turn on the system.

Moving the System

Observe the following warnings and cautions before moving the system.



WARNING

Be aware of the wheels, especially when moving the system. The system could cause injury to you or others if it rolls over feet or into shins. Use caution when going up or down ramps.

**WARNING**

When attempting to overcome an obstacle, do not push the system from either side with excessive force, which could cause the system to tip over.

**WARNING**

Position external hardcopy devices away from the system. Ensure that they are secure. Do not stack them on the system.

**WARNING**

When positioning the articulated monitor, move it carefully to avoid pinching hands or extremities against other objects, such as a bed rail.

**WARNING**

Never park the system on an incline.

**WARNING**

The brakes are intended as a convenience. To increase cart security, use wheel chocks when the system is parked.

**WARNING**

Before moving the system, ensure that the keyboard is retracted, the control panel is centered, and the monitor is locked. When extended, the keyboard might be damaged if it hits another object, and the video monitor could swing out during transport, causing injury or equipment damage.

**WARNING**

To avoid injury, Philips recommends against lifting the system cart.

**CAUTION**

Before moving the system, ensure that the brakes are completely released by moving the brake pedal to its middle position. Otherwise, the engaged brake pad can damage the rubber casters on the wheels.

**CAUTION**

Ensure that the cables for all patient-applied parts are secure before moving the system. Use the cable management system to ensure that transducer cables are protected from damage.

**CAUTION**

Do not roll the system over transducer cables or power cables.

**CAUTION**

When transporting the system in a vehicle, avoid exposing the monitor to direct sunlight, and do not let the inside temperature of the vehicle exceed 65°C (149°F). Either of these conditions can permanently damage the monitor.

Preparing and Moving the System

**CAUTION**

When shipping the system, make sure the batteries are inserted upside down to prevent electrical discharge.

1. Press  (On/Off) to turn off the system.
2. Engage the wheel brakes by pressing the pedal fully down.
3. Squeeze the release button on the front handle and use the handle to center the control module and move it to a comfortable height for moving.



Control Module Release Button

4. Disconnect all external cables, including those to power, network, and external devices. Secure all cables, transducers, and accessories so that they do not interfere with the wheels.
5. Retract the keyboard.
6. Lock the monitor arm by pressing the articulating sections of the arm together.



Locking the Monitor Arm

7. Release the wheel brakes and set the steering locks by moving the foot pedal to its top position.



WARNING

Do not move the system with the steering locks engaged and the wheels pointing in the direction you are moving the system. To avoid system instability while moving it, engage the steering lock only after you have moved the system a short distance in the intended direction. This engages the steering locks with the wheels correctly aligned.

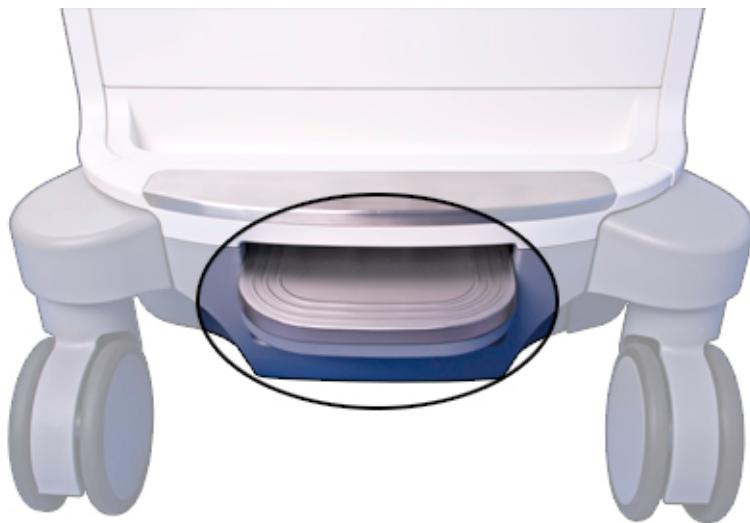
8. Move the cart using the front handle.



Front Handle

Positioning the System in Confined Spaces

1. Release the steering lock and wheel brakes by moving the pedal to its middle position.
2. Move the system in any direction using the front handle.
3. When the system is in position, set the wheel brakes by pushing the pedal down fully.



Brake/Steering Lock Pedal

Setting Up After Moving



CAUTION

If the system behaves abnormally after moving, contact your Philips representative immediately. The components are installed securely and can withstand considerable shock; however, excessive shock can cause a system failure.

1. With the system in position, set the brakes, connect the power, network, and other cables from the system to the appropriate wall receptacles.
2. Release the monitor from its locked transport position.
3. Position the monitor where you want it.
4. Squeeze the release button on the front handle and position the control module to the position you want.
5. Press the (On/Off) control to turn on the system.

5 Using the System

The topics that follow will help you understand and use the features of the system.

Turning the System On and Off

The  (On/Off) control is located on the upper left section of the control panel. The lighting of the control changes to indicate its status. The different indicators are described in the following table.

Power Status and Indicators

System Status	Power Cord Status	Power Control Indicator	Sleep Control Indicator
Power off	Disconnected	Unlighted	Unlighted
Power off	Connected	Lighted white	Unlighted
Power on	Connected	Lighted green	Lighted white
Sleep Mode on	Disconnected	Blinking amber	Unlighted
Sleep Mode on	Connected	Blinking green	Unlighted



CAUTION

If you press and hold the  (On/Off) control to force the system to shut down, you will have to wait longer than usual to use your system the next time you turn it on. You may also corrupt files, which can result in an inoperative system or the loss of patient data. Wait 90 seconds (or 3 minutes if DICOM activity is occurring) before forcing the system to shut down.



CAUTION

The batteries are used to ensure quick system startup and easy movement of the system only. You cannot perform scans while in battery mode.

NOTE

If battery power is unavailable, or if the battery charge level is critically low, as indicated by the  (low battery power) icon, connect the system power cord to a wall outlet.

NOTE

The system must be connected to a wall outlet to be used for imaging.

1. If you are turning off the system, first close all dialog boxes by clicking **Close** or **Done**
2. Do one of the following:
 - When the system is off, press the  (On/Off) control to turn it on.
 - When the system is on, press the  (On/Off) control to turn it off. A confirmation message appears briefly on the display immediately before the system turns off.
3. If the system does not turn off after 90 seconds (or 3 minutes if DICOM activity is occurring), press and hold the  (On/Off) control for 7 to 10 seconds to force the system to turn off.
4. To break the connection from the main power supply, remove the ultrasound system plug from the wall outlet.

Setting the System Time and Date

The system includes a clock/calendar function, which maintains accurate time and date even when the system is turned off and disconnected from power. The system uses the clock/calendar function to display the time and date on the imaging display, and to provide a time stamp on patient studies and acquired images. The system automatically adjusts the date for leap years but does not automatically set the time zone or update for daylight saving time.

NOTE

The system time and date cannot be set when a study is active. It is recommended that you check the system time and date periodically before a study, and set the correct time and date, if necessary.

NOTE

If you change the system date while a study is paused, existing results for date-dependent calculations in the paused study are not recalculated by the system at any time.

NOTE

When you enter invalid characters in the time and date setups on the **Header** tab of **System Settings**, some characters are displayed and then erased, but others are not displayed at all. An invalid date may be displayed in the setups but not entered when you close the setups. After changing a date and exiting the setups, always check the date on the imaging display.

NOTE

This system supports the Network Time Protocol (NTP), which keeps your system's time accurate by synching with the NTP server. To activate this feature, your system administrator must create a connection to an NTP server.

1. Touch **Utilities**.
2. On the **System** tab, touch **Setups**.
3. Click **System Settings** and then **Header**.
4. In **Set Time**, select a **Format** (12 hours or 24 hours), click the time in the **Time** box to select it, and then use the number keys to enter the correct setting. Select **Am** or **Pm**, if necessary.
5. In **Set Date**, select a **Format**, click the **Date** to select it, and then use the number keys to enter the correct setting.

Using the Brakes and Steering Locks

All four wheels swivel to aid in maneuvering the system. You can engage steering locks to make steering easier when moving the cart. Brakes help keep the cart stationary while in use. The brakes and the steering locks are designed so that they cannot be engaged simultaneously.

Your system has a foot pedal at the lower front of the cart. Operate the brakes and the steering locks with the foot pedal using the appropriate procedure.

**WARNING**

Never park the system on an incline.

**WARNING**

The brakes are intended as a convenience. To increase cart security, use wheel chocks when the system is parked.

Do any of the following:

- 1 To engage the steering locks and release the brakes, lift the pedal fully.
- 2 To release both the steering locks and the brakes, move the pedal to its middle position.
- 3 To engage the brakes and release the steering locks, press the pedal fully.



Monitor Adjustments

**CAUTION**

To avoid damaging the flat-panel display in the monitor, do not operate it in direct sunlight. Also, do not operate or store the system where the ambient temperature exceeds 65°C (149°F).

The monitor is mounted on an articulated arm that permits it to be positioned vertically and in an arc from side to side. The monitor arm can also be locked for moving the system. You can adjust the brightness of the monitor image to compensate for ambient light. You can also change the default brightness setting for the monitor.

Positioning the Monitor

You can adjust the position of the monitor to suit different operating positions and operator heights.

1. Press the button on the articulation arm, just above the control panel, to release the monitor from its locked transport position.



Monitor Articulation Arm Button

2. Grasp the monitor firmly and do one of the following:
 - Tilt the monitor up and down
 - Swivel the monitor left and right
 - Move the monitor side to side

Changing the Monitor Tint

In the setups, you can change the tint of the system display. The **Monitor Tint** setting affects only the appearance of images on the monitor; it does not affect saved or exported images. Three settings are available:

- **sRGB** provides the maximum dynamic range and most-balanced tint. Use it to match the look of the system display to a review station display that is set to the sRGB standard.

- **1** is balanced toward a blue tint for those that have a cooler preference
 - **2** is balanced toward a brown tint for those that have a warmer preference
1. Touch **Utilities**.
 2. On the **System** tab, touch **Setups**.
 3. Click **System Settings**, and then click the **Display** tab.
 4. Select the appropriate **Default Monitor Tint** setting. Philips recommends the **sRGB** setting for routine use.
 5. Click **Close**.

NOTE

Rendered 3D volumes are particularly susceptible to changes in display tint. Some clinicians prefer the following settings for optimal viewing of 3D volumes: set **Default Monitor Tint** to **1** or **2** and set **Default Monitor Brightness** to **1**.

You can also change the monitor tint temporarily:

1. Touch **Utilities**.
2. On the **System** tab, touch **Monitor Tint** to choose from **sRGB**, **1**, or **2**.

Changing the Default Monitor Brightness

You can change the default brightness of the monitor image in the setups. The system uses this default value to set monitor brightness each time the system is turned on.

1. Touch **Utilities**.
2. On the **System** tab, touch **Setups**.
3. Click **System Settings**, and then click the **Display** tab.
4. Select a setting for **Default Monitor Brightness** from **1** (darkest) to **6** (lightest).
5. Click **Close**.

You can also change the monitor brightness temporarily:

1. Touch **Utilities**.
2. On the **System** tab, touch **Monitor Brightness** to choose from **1** (darkest) to **6** (lightest).

Automatic Display Dimming

To preserve monitor life and prevent burned-in display artifacts, the system automatically dims the display after more than 2 hours of operation with no control changes. The system restores full brightness as soon as you use any system control.

System Controls

System controls are located on the control panel, the touch screen, and the keyboard.

Control Panel

The control panel contains the main imaging controls. These controls include buttons, knobs, TGC slide controls, and a trackball. The control module also allows you to select imaging modes, review and annotate images, perform measurements and calculations, and access **Philips SupportConnect**.

The touch screen, located above the control panel, displays controls used to select transducers, enter patient data, select applications, and change setups.

*Control Panel*

- | | |
|---|----------------------------------|
| 1 | Touch screen |
| 2 | Power and Sleep Mode controls |
| 3 | TGC slide controls |
| 4 | Trackball |
| 5 | Soft key knobs and mode controls |
| 6 | Philips SupportConnect |

Control Panel Adjustments

The control panel is mounted on an articulated arm that permits it to be positioned vertically and in an arc from side to side. The control panel arm can also be locked for moving the system. You can adjust the brightness of the control panel to compensate for ambient light. You can also change the default brightness setting for the control panel.

Adjusting Control Panel Brightness

The control panel and touch screen brightness controls in the setups allow you to adjust the brightness of the control panel and touch screen to compensate for changes in ambient light.

1. Touch **Utilities**.
2. On the **System** tab, touch **Setups**.
3. Do one of the following:
 - Select **System Settings**, and click **Display**. Select a setting for **Control Panel Brightness**.
 - Turn the **CP Brightness** knob, or touch **CP Brightness** until your preferred brightness is selected.

Positioning the Control Panel

You can swivel the control panel, move it side-to-side, and move it up and down to improve ergonomics.

1. Press the  (On/Off) control to turn on the system.
2. Push the foot pedal fully down to engage the brakes. See “[Using the Brakes and Steering Locks](#)” on page 115.



CAUTION

You must engage the brakes to change the position of the control panel. If the brakes are not engaged, the release button on the front handle will light when pressed, but the control panel will not unlock.

3. Press the release button on the front handle.



Control Panel Release Button

4. When the release button lights, the control panel is unlocked.
5. Use the front handle to rotate the control module or move it up or down.
6. Press the release button again to lock the control panel. When the control panel is locked, the release button light is off.

Setting the Depth Control

The **System Settings** display in the setups provides an option for you to select how the **Depth** control responds when you turn it.

1. Touch **Utilities**.
2. On the **System** tab, touch **Setups**.
3. Click **System Settings**, and then click the **Mode** tab.
4. Under **Depth Control**, do one of the following:
 - Select **Increase Clockwise** to increase depth when the control is turned clockwise.
 - Select **Increase Counter Clockwise** to increase depth when the control is turned counter-clockwise.
5. Click **Close**.

Touch Screen

The touch screen above the control panel provides controls that change function according to the current mode or system function.

For more information about the layout of the touch screen, see “[Touch Screen Layout](#)” on page [123](#).

For more information about the available controls on the touch screen, see “[Touch Screen Controls](#)” on page [124](#).

Touch Screen Layout

The controls on the touch screen are organized by function.



Touch Screen

A **Workflow area:** Contains tools that enable the major workflow activities for starting, performing, and completing an exam.

1 Transducer selection controls

2 Tools

B **Tabs:** Contains mode-specific or application-specific controls in different tabs.

C **Controls:** The main area of the touch screen, which shows the controls for the currently selected tab in the current mode or application.

3 Sub-mode controls

- | | |
|---|---|
| 4 | Page indicator: Touch the indicator to go to the next page of controls, or swipe the screen to move between pages. |
| D | Soft key labels: Displays the labels for the current functions of the soft keys. Some modes and applications have two rows of labels, while some have no soft keys.

You can select the functions assigned to the soft keys by touching the labels or by pressing or turning the knob below the label. |
| 5 | General-purpose soft keys |
| 6 | Dynamic soft keys |

Touch Screen Controls

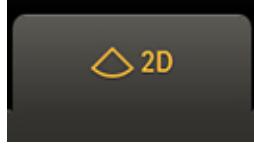
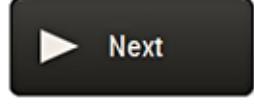
The touch screen can contain several types of controls, which vary by the functions of the controls.

The color and state of the backlight on the soft key controls and their labels indicates the status of controls and modes:

- White backlight: available but inactive
- Amber backlight: active
- Gray (off) backlight: unavailable

For multi-use controls, such as **Res Spd** or **Compress**, touch the control to change the active function.

Types of Touch Screen Controls

For this type of control	Do this
	Touch a tab to display a different set of controls. Touching the tab in this example displays controls associated with 2D mode.
	Touch Next or Previous to display the next or previous page of controls associated with the current tab. Most tabs have two pages of buttons. You can also swipe the tip of your finger left or right across the touch screen to view additional pages.

For this type of control	Do this
	Touch to turn a function on or off. The control is amber when the function is on. In this example, XRES imaging is on.
	Touch to change the value displayed on the control. Repeatedly touching this type of control cycles through the range of available values.

Utilities Touch Screen

The **Utilities** touch screen displays three sub-tabs:

- **Physio**: contains the controls for the Physio features. For details about Physio controls, see the "Physio Touch Screen Controls" topic in the *Help*.
- **DVR**: contains the controls to operate the DVD recorder. For details about the DVD recorder controls, see the "Video Touch Screen Controls" topic in the *Help*.
- **System**: contains controls that allow you to temporarily adjust system configurations for an exam. You can also access **Setups** from this tab to make permanent changes to the system. For details about the System controls, see "["System Tab Touch Screen Controls" on page 125](#)".

System Tab Touch Screen Controls

This topic describes the touch screen controls for the **System** tab on the **Utilities** touch screen. Some of the controls are visible immediately, and others may be visible only when particular transducers or presets are active.

To use a touch screen control or change its setting, touch it. If it is in the bottom row, you can also turn or press the knob directly below it.

System Tab Touch Screen Controls

Name	Description
Accept Prior to Store	A control used to display image loops for approval before they are stored.
Capture Type	A control used to select the capture type: prospective (for a number of beats) or retrospective (for a number of seconds).
CP Brightness	A control used to adjust the brightness of the control panel and the touch screen display.
Export IQ Optimization	A control used to start the Export IQ Wizard .

Name	Description
External Video Brightness/Contrast	A control used to adjust the brightness and controls of an image that is being viewed externally.
Hide Image Info	A control used to show and hide image information in the imaging display.
Hide Patient Info	A control used to show and hide the patient information in the patient bar. See “Hiding Patient Name and ID on Images” on page 157 .
Hide Thumbnails	A control used to show and hide the image thumbnail pane in the imaging display.
Loop Type	A control used to set the loop type to either Time (in seconds) or Beats (heart beats). Loop length is then set using the Time control or the Beats control. The Loop Type depends on the active transducer and preset. For example, the Beats control is available only for cardiac transducers and presets.
Monitor Brightness	A control used to adjust monitor brightness to compensate for changes in ambient light. Use this control to quickly make temporary adjustments to the monitor brightness setting in the setups. Touch Monitor Brightness to select a setting from 1 (darkest) to 5 (lightest).
Monitor Tint	A control used to adjust the tint of the system display. This control affects only the appearance of images on the monitor; it does not affect saved or exported images.
Print Screen	A control used to save an image of the full screen to the system hard drive and a copy to the same destination devices as the Print control. Print Screen is available in review and when the image is frozen.
Setups	A control used to access the system parameters that you can change.

Trackball

The trackball is located in the center of the control panel. Moving the trackball moves the active object on the display, such as the pointer or the measurement caliper.

The tools and icons area of the imaging display includes a trackball icon that identifies the function assigned to each trackball button. The functions of the buttons change to match your current task. There are trackball assignments for each major system mode, protocols, labels, body markers, calculations, and measurements.



Trackball Arbitration Icon

For example, the functions of the left and right trackball buttons can include:

- Cycle through cineloop sequences when the image is frozen or in **Review**.
- Erase traces.
- Select measurements within a group.

The functions of the middle trackball button include:

- Activate the spectral trace in M-mode and Doppler imaging.
- Complete measurements and calculations.

The labels under the trackball image indicate the functions that are available for the entire trackball.

NOTE

For some measurements, the trackball functions become available only after you press **Measure**.

Also, you can configure the left and right trackball buttons by using the **Left Select Key** and **Right Select Key** settings in the **Tools & Results** tab of the **Analysis** setups.

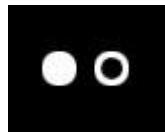
Soft Key Controls

Soft key controls (knobs that can be pressed and turned) are located along the top of the control panel. Two rows of labels for soft key functions and settings appear along the bottom of the touch screen. Each column of labels corresponds to the soft key below it on the control panel. The soft keys select imaging features and settings. The functions of the soft keys change depending on the mode, the application, the preset, and the transducer.

If a function is assigned to a soft key, the ring around the knob is amber. If no function is assigned to a soft key, the ring is dark.

Sometimes, two functions are available for a soft key. Only one of the functions can be active at a time. Pressing the corresponding knob on the control panel or touching the label selects the active function. The label for active functions is amber. The label for inactive functions is white.

Many modes offer two or more pages of soft keys. To display the second page place your finger on the touch screen and swipe to the left. To return to the first page place your finger on the touch screen and swipe to the right. You can also touch the page indicator, located above the soft keys, to display the next available page of soft keys.



Soft Key Page Indicator

Using the Keyboards

The system has two keyboards, which you can use to enter patient data, exam comments, image annotation, and your logon password.

Touch Screen Keyboard

One keyboard is located on the touch screen. That keyboard may appear automatically during certain activities.

To use the touch screen keyboard:

1. If necessary, touch  (keyboard) to display the keyboard.
2. When you are done typing, touch **Close**.

Retractable Keyboard

A retractable keyboard is located beneath the control panel.

To use the retractable keyboard:

1. Pull out the keyboard. The keyboard lights after you pull it out completely.
2. When you are done typing, push in the keyboard in completely.

Status Icons

Status icons on the display let you control certain features and check the status of tasks. Status can be indicated by colors or symbols within an icon, and by the absence of an icon.

Icon	Description
	Displayed when the system is HIPAA compliant.
	Displayed when the iSCAN Intelligent Optimization or AutoSCAN feature is on.
	Displayed when Physio Trace is active.
	Displayed when a Send on Demand request is active.
	Displayed when remote access is enabled, but there is no active remote session.
	Displayed when a remote session is active.
	Displayed when the system is acquiring an image or an image is opening in the Review pane.
	Indicates the status of a remote session: <ul style="list-style-type: none">• No dot: Remote session is enabled but not active• Green dot: Remote session is enabled and active• Red X: Remote session is disabled
	Indicates the status of a Network Packet Capture: <ul style="list-style-type: none">• Green dot: Enabled and running• Red X: Enabled but not running
	Displayed when the microphone is on.

Icon	Description
	<p>Indicates the status of the network and exports:</p> <ul style="list-style-type: none"> Green dot: Connected Red X: Disconnected or error
	Click the icon to view details of network status or export queue.
	<p>Indicates the status of the wireless network:</p> <ul style="list-style-type: none"> Green dot: Connected Red X: Disconnected or error Blue vertical bands: Strength of wireless signal
	Click the icon to open the DICOM Setup dialog box. This icon appears only if the DICOM licensed options are installed.
	<p>Indicates the status of the DVD drive:</p> <ul style="list-style-type: none"> No dot: Available Green dot: Writing data Yellow dot: Drive is empty (or malfunctioning) Red X: Failed
	Click the icon to open the DVD Status dialog box. You can cancel, pause, or resume any data transfer job listed.
	<p>Indicates the status of the DVD recorder (if installed):</p> <ul style="list-style-type: none"> Green dot: DVD recorder is recording. Pause symbol: DVD recording is paused. Icon is hidden: DVD recorder is not recording.
	<p>Indicates the status of the current print job:</p> <ul style="list-style-type: none"> Icon is displayed: a print job is being sent. Icon is hidden: a print job has been sent. Green dot: a print job is being printed. Red X: a print job has failed; an error occurred.

Power Management

The system includes a power management feature that monitors the power level of the optional battery and notifies you when the battery is low on charge. Additionally, the power management feature can safely shut down the system before the battery loses power.

The batteries charge whenever the system is connected to AC power.

**CAUTION**

The batteries are used to ensure quick system startup and easy movement of the system only. You cannot perform scans while in battery mode.

**CAUTION**

When shipping the system, make sure the batteries are inserted upside down to prevent electrical discharge.

NOTE

When the system is turned on and in Sleep Mode, the batteries power the system.

NOTE

When the battery-charge level reaches a critically low state, the system shuts down automatically.

NOTE

The batteries may need to be replaced. For information on replacing the batteries, see the system *Service Manual*.

Sleep Mode

Sleep Mode uses battery power and allows quick startup of the system. It does not eliminate power consumption and should be used only for short periods of time, such as when you transport the system between exam locations. The Sleep Mode control (🌙) is in the upper left corner of the control panel, next to the (On/Off) control. When the system is in Sleep Mode, it freezes live imaging, pauses any open study, exits any QLAB study, and terminates any remote connection. Awaken the system to resume normal system operation.

When the system is on battery power, the Sleep Mode time-out is approximately 20 minutes. The system remains in Sleep Mode until it is awakened or powered off, or until the batteries discharge to a critically low state. If the system batteries discharge to a critically low state, the system safely shuts down from Sleep Mode.

To put the system in Sleep Mode, press  or disconnect the power cord.

To awaken the system, press .

For information on the Sleep Mode status indicators, see “[Turning the System On and Off](#)” on [page 113](#).

NOTE

When the system is in Sleep Mode and is connected to AC power, the system remains in Sleep Mode until it is awakened.

Battery Indicators

The battery charge level is indicated by icons on the system display.



CAUTION

The batteries are used to ensure quick system startup and easy movement of the system only. You cannot perform scans while in battery mode.

NOTE

The system batteries are a purchasable option. If this option is not purchased, the battery icon is not displayed.

Battery Status Indicators



The system is running on AC power and the battery is 80% to 100% charged.



The system is running on AC power and the battery is 60% to 80% charged.



The system is running on AC power and the battery is 40% to 60% charged.



The system is running on AC power and the battery is 20% to 40% charged.



The system is running on AC power and the battery is 0% to 20% charged.



The system is running on AC power and the battery is not charged or is disconnected.

System Security

The data security feature, if enabled on your system, limits access to previously stored patient data and images. To gain access to such data, you must first log on to the system using an ID and a password. When you are finished using the system, you can log off manually or simply shut down the system, which logs you off automatically. Only a registered user can change the password.

The data security feature is set up by your system administrator. For information, see “System Administration” in the *Help*. To display the *Help*, touch .

Logging On to the System

When data security is enabled, you must log on to the system before you are able to view or load patient files.



1. Click (Log On) at the bottom of the imaging display.

2. In the **Logon** dialog box, type your user name.
3. Press the **Tab** key and type your password. (If you forget your system password, contact your system administrator.)
4. Click **OK** to log on to the system and start the valid access period.

NOTE

Logging off of the system does not change the current patient, but it does deny further access to protected patient data.

Logging Off of the System

If you do not log off, the system automatically logs you off when you shut down the system or after the system has been inactive for the length of time shown in **Auto Log Off** on the **User Settings** tab of the **Data Security** setups.



1. Click **Log Off** at the bottom of the imaging display.
2. In the **LogOff** dialog box, click **Yes**.

Changing Your Password

If the data security feature is enabled on your system, you must log on to the system to gain access to patient data and images.

Once the system administrator has given you a password for the system, you can change it as needed. A password must be 6 to 10 characters long and can contain only letters and numbers; punctuation marks and symbols are not allowed.

NOTE

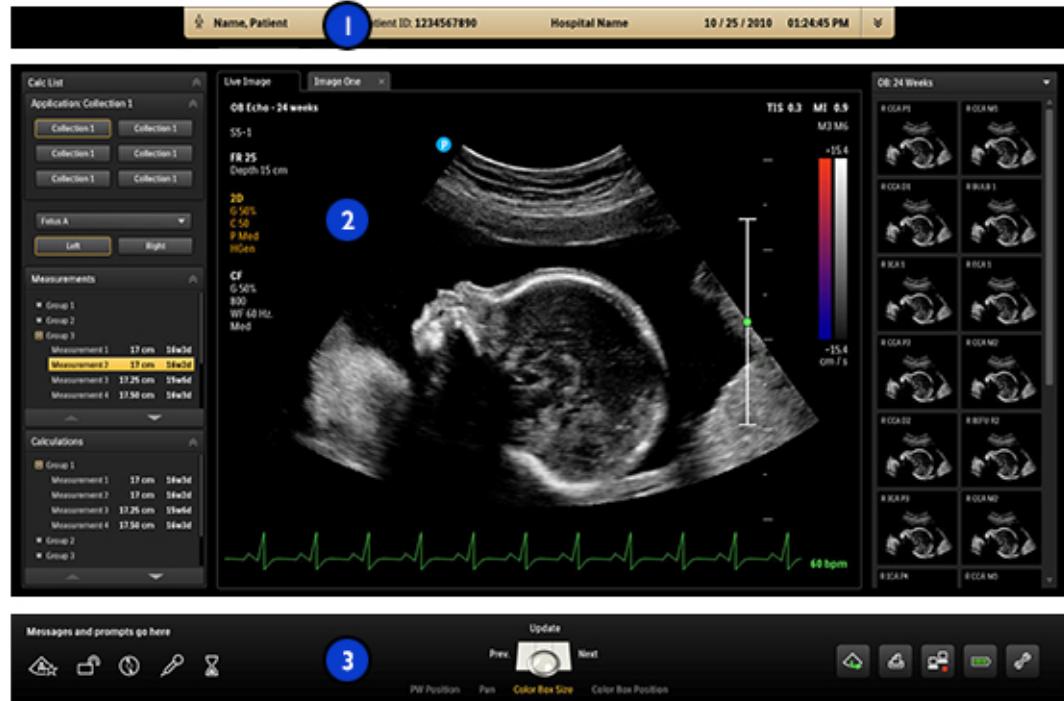
The **Auto Log Off** time shown on the **User Settings** display indicates how long the system can be inactive before you are logged off automatically. Only the system administrator can change this setting.

1. Touch **Utilities**.

2. On the **System** tab, touch **Setups**.
3. Click **Data Security**.
4. On the **User Settings** tab, click **Change Password**.
5. For **Old Password**, type your current password, and then press the **Tab** key.
6. For **New Password**, type the new password you want to use, and then press the **Tab** key.
7. For **Confirm Password**, type your new password again.
8. Click **OK**.
9. To exit setups, click **Close**.

Imaging Display

The imaging display contains three, distinct regions:



Imaging Display

- | | |
|---|-----------------|
| 1 | Patient bar |
| 2 | Image area |
| 3 | Tools and icons |

Patient Bar

After you start an exam, patient and exam data appear in the patient bar, which is directly above the ultrasound image. With the **Header** setting in the **System Settings** setups, you can select three of the five additional information options to display on the patient bar: **Patient Birth Date**, **Patient Gender**, **Institution Name**, **System Model**, and **Performed By** (three initials).



Patient Bar

- | | |
|---|--|
| 1 | Patient name |
| 2 | Patient ID |
| 3 | Date and time |
| 4 | Expand patient bar icon: Click to view all of the available patient data during an exam. |

Image Area

The image area is approximately in the center of the display and includes the following:

- *Image tabs*: The left tab displays the live image. Additional tabs provide quick access to acquired images from the current exam, retrieved images from previous exams, images acquired in other modalities, or analysis summary results (for example, fetal trending graphs).
- *Left pane*: Lists available calculations and protocols, and the calculations and measurements being performed; displays calculation results; and provides other tools as necessary. Tabs at the top of the left pane enable you to switch among those lists. To hide the left pane, click  in the top right corner of the pane.

- *Imaging area:* Displays the live image (or other applications, such as Q-Apps), a depth scale that includes the focus setting (to the right of the image), a TGC curve, a grayscale bar, and a color bar (to the right of the depth scale). In M-mode and Doppler, the sweeping display appears either below the 2D image or to the right of it, depending on the format you select.
- *Thumbnail pane:* Displays thumbnail images from the current exam.

For general imaging, a scan plane orientation marker  appears at the top left of the image. For cardiac exams, the orientation marker appears at the top right of the image. The marker corresponds to the orientation marker on the transducer. The marker always follows the orientation of the image. When you invert the image by using **Left/Right** or **Top/Bottom**, the marker position changes accordingly.

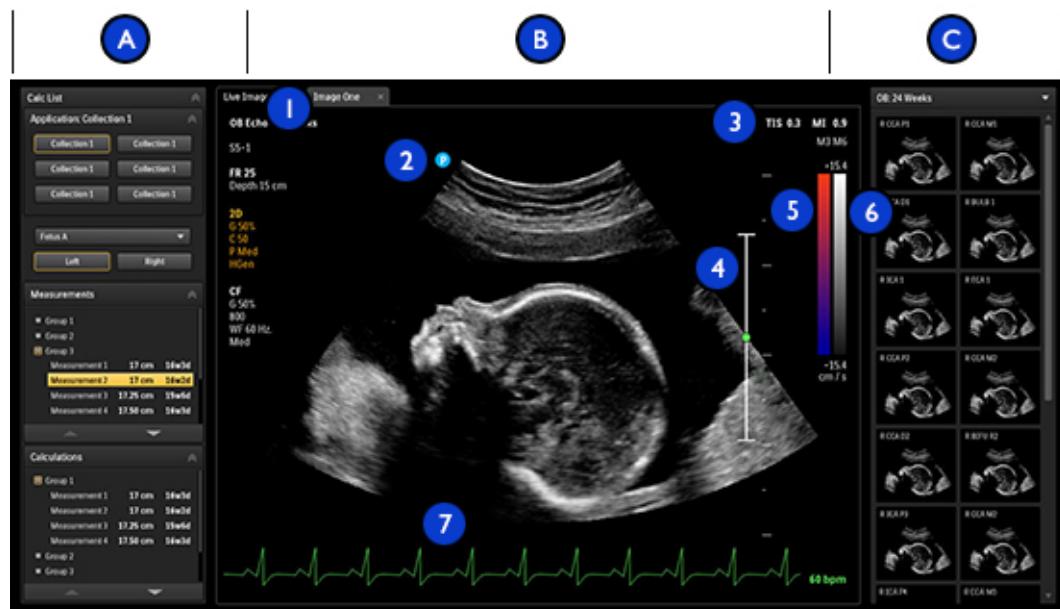


Image Area

A	Left pane
B	Imaging area
1	Image tabs
2	Scan plane orientation marker

3	MI and TI values
4	Focal indicator
5	Color bar
6	Grayscale bar
7	ECG Display
C	Thumbnail images

Tools and Icons Area

The tools and icons area displays the following:

- *Status icons*: Provide status of system features and cannot be selected.
- *Trackball arbitration icon*: Displays the current function of trackball and the trackball buttons. The labels above and to the left and right of the trackball icon indicate the function assigned to the middle trackball button and the left and right trackball buttons, respectively. The labels under the trackball icon indicate the functions that are available for the entire trackball. For details, see “[Trackball](#)” on page 126.
- *System management icons*: Provide status and can be selected. When you click a system management icon, a dialog box displays additional information or available actions.

For definitions of status and system management icons, see “[Status Icons](#)” on page 129.



Tools and Icons Area

1	Status icons
2	Trackball arbitration icon
3	System management icons (interactive)

Emergency Studies

If the system administrator has enabled the data security feature on your system, it is important to understand how to start a study in an emergency situation.

In an emergency, you can start a study without entering patient data. During an emergency study, the system provides a temporary ID for image acquisition and report editing. You should change the temporary ID to correct the patient data before you end the study. Otherwise, the temporary ID is the only identifier for that study.

Temporary ID

Use the temporary ID feature to start an exam quickly. This feature allows you to perform an exam without first entering patient data. When you select this feature, the system enters unique, temporary placeholders for the patient's last name and ID. Using the temporary ID feature allows you to perform an exam as you would normally.

When you use the temporary ID workflow, images can be sent to a PACS or to a DICOM printer before entering actual patient data, if the system is configured to send or print images as you scan.

For an exam started with a temporary ID, edit patient data before ending the exam. After the exam is ended, you cannot change patient data. When the patient data is changed, all images are automatically resent to any local printers that they were previously sent to. If your system is connected to a DICOM Worklist Server, you can load patient data to replace the temporary ID data.

NOTE

If you have configured a DICOM performed-procedure-step-server, PPS messages are sent for the temporary ID. If you have configured a PPS server, PPS discontinue messages are sent for the temporary ID if you edit the patient data before you end the exam.

Starting Emergency Studies

In an emergency, you can use the temporary ID feature to start an exam without first having to enter patient data. Just click **Use Temporary ID** after you acquire an image.

You can create a temporary ID when starting a protocol, printing, acquiring an image, or saving a volume.

1. Touch **Patient** and then click **Use Temporary ID**.
2. Click **Done**.

3. When the exam is finished, do the following:
 - a. Touch **End Exam**.
 - b. Edit the information in the **Patient Data** display
 - c. Click **End Exam**.
 - d. Click **Done**.

Setting the Auto Freeze Function

The Auto Freeze function stops imaging and freezes the image, if a control is not manipulated within the **Wait** time that you specify. The default time is 5 minutes. After Auto Freeze has been invoked, press any control to restart imaging.

1. Touch **Utilities**.
2. On the **System** tab, touch **Setups**.
3. Click **System Settings**.
4. Click the **Display** tab.
5. Under **Auto Freeze**, select **On**, and then select the **Wait** time.
6. Click **Done**.

Transducer Receptacles and Cable Management

The system includes four receptacles for imaging transducers, one receptacle for a pulsed- or continuous-wave Doppler probe, and one receptacle for physio, if physio is included in your system's configuration. All receptacles can be occupied simultaneously, but only one transducer at a time can be active.

*Transducer Receptacles*

- | | |
|---|-------------------------------|
| 1 | Physio probe receptacle |
| 2 | Doppler probe receptacle |
| 3 | Imaging transducer receptacle |

When a transducer is not in use, store it in one of the transducer holders on the system cart. Always loop transducer cables over the cable hangers to prevent cables from being stepped on or run over by the cart wheels.



Transducer Holders and Cable Hangers

- | | |
|---|-------------------|
| 1 | Transducer holder |
| 2 | Cable hanger |

Selecting a Transducer

When the system is turned on, the system initializes the last active transducer. If that transducer is not connected, the system initializes the transducer that is connected to the leftmost connector, unless you have defined another transducer as the default transducer. If you have set a default transducer and it is connected, then the system initializes that transducer. For information on setting a default transducer, see “[Setting the Default Transducer and Preset](#)” on page 148.

If multiple transducers are connected when the system is turned on, the system selects the transducer that was in use when the system shut down. You can select among the connected transducers during system operation. If the system does not recognize a transducer, it will switch back to the original transducer. Disconnect and reconnect the unrecognized transducer or move it to a different receptacle.

You can select or deselect a transducer during live imaging without damaging the transducer or the system.

1. Touch the transducer name to select it.
2. Touch the clinical application preset that you want to use.

After you select the clinical application/preset, the system calibrates the transducer, enables the transducer for operation, and updates system status to reflect the transducer type and the preset you selected.

Selecting a Preset

When the system is turned on, the system selects the same preset that was in use when the system shut down (unless it is incompatible with the initially selected transducer). For more information, see “[Setting the Default Transducer and Preset](#)” on page 148.

During system operation, you can select a different preset for the selected transducer.

1. Touch the transducer name.
2. Touch a preset to select it.

ECG Feature

The system can display three physio traces, each representing a physiological input. These inputs can include low-level ECG, high-level ECG, respiratory, pulse, phono, and auxiliary signals. (Low-level ECG comes from leads connected to the patient; high-level ECG comes from a patient monitor or other similar equipment.) Heart rate, derived from the ECG signal, is displayed on the screen whenever ECG is connected and displayed.

DVD, CD, and USB Devices

The system supports a variety of removable media including DVD, CD, and USB storage devices.

For additional information on specific applications of the DVD drive, see the *Help*. To display the *Help*, touch . To close the *Help*, touch **Close** or touch  again.

For details about DVD and CD devices, see “[DVD Drive](#)” on page 144.

For details about USB devices, see “[USB Devices](#)” on page 145.

Media Compatibility

CD media capacity is approximately 700 MB; single-layer DVD media capacity is approximately 4.7 GB. Rewritable media types (indicated by the RW suffix) can be erased and used again, but you cannot erase media that has the R suffix. Dual-layer DVD media is unsupported.

DVD and CD media are available in a number of types. Not all media types are fully compatible with the system DVD drive. To ensure consistent performance, use only high-quality CD or DVD media in the system DVD drive. For more information, see *Media Compatibility* on the *User Information* CD.

For information regarding USB media, see “[USB Devices](#)” on page 145.

Multiple studies can be written to a disc, during one upload, up to the limit of its capacity. After the studies are written to the disc, the disc is finalized and cannot be written to again. To reuse a finalized RW disc, you must first reformat it. To record multiple studies to a disc, you must end the exam you just recorded before removing the disc.

NOTE

A single disc can be used between different EPIQ 7 systems, but only for writing logs and setup data.

DVD Drive

The system includes a DVD drive, located on the right side of the control module. You can use this drive to store and transfer patient files, including full exams, 3D data sets, and reports. In addition, you can save, restore, and distribute configuration data.

You do not need to format a disc before storing data on it.

Loading and Ejecting a Disc

Do one of the following:

- To load a disc, gently guide a disc into the drive slot, until the disc is pulled into the drive.
- To eject a disc, press the Eject button on the drive.

Erasing a DVD

Erasing a rewritable disc (DVD+RW, DVD-RW, or CD-RW) erases all of the data on it and prepares it for reuse. After a disc is erased, the entire capacity of the disc is once again available. You can also erase a write-once disc (DVD+R, DVD-R, or CD-R), but you will not be able to write files to the erased portion of the disc.

NOTE

If the system cannot erase the disc, use a computer to erase it. If the computer cannot erase the disc, it may be damaged.

1. Touch **Review**.
2. Load a disc into the drive and wait for it to become available.
3. In the **Review Exam** display, click **Erase**.
4. In the **Erase Disc** dialog box, click **OK** to erase the disc.
5. When the dialog box indicates that erasing is complete, click **OK**.
6. Click **Close**.

USB Devices

The system provides USB ports that can be used to connect USB storage devices. Such devices include USB memory devices and USB hard disk drives. USB ports are on the front left of the system behind the transducer holders and on the rear panel. Read the following information before using USB storage devices.

The system supports the following USB devices:

- Single-partition USB flash memory drives
- USB flash memory drives that do not use or contain any antivirus or other executable software
- USB hard disk devices that require 500 mA or less per USB port
- USB 2.0 compliant devices
- USB 3.0 compliant devices

Some portable hard drives do not work when connected to a single USB port on the system. Connect a dual-port USB cable between the drive and two USB ports behind the right panel of the system.

**WARNING**

Connecting externally powered USB hard disk drives to the system involves electrical safety risks. If you connect such drives to the system, you must observe the electrical safety warnings in the “[Safety](#)” section. Philips recommends that you use only USB hard disk drives powered from the USB connector, or use USB flash memory devices.

**CAUTION**

When transferring data to or from a USB device, be sure the transfer is complete before removing the USB device. For USB devices that have an indicator, be sure the indicator is no longer flashing before removing the device.

**CAUTION**

Ultrasound systems may become vulnerable to security breaches when they accept removable media. Removable USB storage devices may contain viruses. Philips recommends that you use the system to format USB storage devices before working with them.

**CAUTION**

Philips does not recommend that you use USB storage devices for long-term storage. Follow your IT department's recommended practices for intended use of USB storage devices. For more information about security on the ultrasound system, see *Shared Roles for System and Data Security*, included on your *User Information CD*.

**CAUTION**

Use only Class-B-compliant USB storage devices with the system. USB devices that are not Class-B compliant may cause RF emissions that exceed Class B limits. See the device's documentation to determine whether it is Class-B compliant.

DICOM Viewer

When you export patient data in DICOM format and select **Include DICOM Viewer**, the system exports a copy of the DICOM viewer along with the patient data. The DICOM viewer lets you view images, play clips, and adjust images. Changes made to the images cannot be saved. The DICOM viewer lets you view stress echo data by stage or anatomic view. The viewer supports the electronic submission requirements of ICAEL (Intersocietal Commission for the Accreditation of Echocardiography Laboratories).

6 Customizing the System

You can customize your system to increase efficiency and streamline your workflow. You can do the following:

- Create presets designed specifically for the exams you perform
- Change system settings to reflect your needs
- Add options to enhance your imaging abilities
- Create custom procedures for specific patients, transducers, and presets.

Presets

A preset is a group of settings that optimizes the system for a specific type of exam. Presets establish many initial settings, such as gain value, color map, filter, and items on the touch screen.

When you turn on your system, the default preset is active. Before you begin an exam, be sure that the appropriate preset is active.

You can choose from several default presets. You cannot delete these default presets. However, they provide a starting point from which you can create your own presets. You can create and store up to 45 presets per transducer/application combination, depending on the space available on the touch screen. If you need to create more than 45 presets per transducer, you can save presets to a DVD or USB storage device and restore them when you need to use them.

The available presets are determined by the selected transducer.

NOTE

Presets are available only if you purchased the corresponding application-package option.

Setting the Default Transducer and Preset

You can set a default transducer and preset so that each time the system is turned on, that transducer and preset are initiated automatically. The system selects the default transducer regardless of which receptacle it is connected to. If the default transducer is not connected when the system is turned on, the system initiates the transducer connected to the left-most connector and the first available preset for that transducer.

1. Touch the name of the transducer you want to use.
2. Touch the preset you want.
3. Touch the transducer name a second time.
4. Touch **Set Default**.

Clinical Applications and Presets

Clinical applications are broad areas of medical study. Within each clinical application, there are Philips presets for specific areas of study. For example, within the Small Organs clinical application, the presets are **Thyroid**, **Testicle**, and **Breast**. The transducer touch screen lists the available clinical application preset combinations for the selected transducer.

You specify how the system will be set up for operation by selecting a clinical application preset.

Quick Save Presets

Quick Save presets provide a quick way to set imaging parameters to the values you prefer for a specific exam type. Using the Quick Save feature, you can define presets for any combination of clinical application, preset, and transducer. A Quick Save preset stores the primary imaging mode and settings that are active when you create the Quick Save preset.

Once you create a Quick Save preset, it appears on the transducer touch screen when the associated transducer is selected. When you select the Quick Save preset, the system automatically invokes the settings in the preset. You can delete existing Quick Save presets, copy them onto a DVD or USB storage device, and load them into another EPIQ 7 system.

The number of Quick Save presets you can store for a transducer/application combination is limited only by the number of buttons available on the corresponding transducer touch screen. The number of buttons available, in turn, is dependent on which application is selected and how many presets that application includes.

Creating Quick Save Presets

You can create a new Quick Save preset that is based on an existing preset. You can do this even during an exam, while using the preset.

1. Touch the **Transducer** name.
2. Touch the preset on which you want to base your Quick Save preset.
3. Adjust the system controls to create the settings for your preset. (You can select an imaging mode, an image orientation, the number of focal zones, and so on.)
4. Swipe the touch screen, from right to left, to view the second page of the transducer presets.
5. Touch **Save Preset**.
 - For the **Quick Save Label**, type the name of the new preset. If you do not enter a name before saving a preset, the system assigns a name.
 - For **Calculation Package**, select a calculation package.
 - For **Annotation/Body Marks**, select the annotation and body mark you want as the defaults.
6. Click **OK**.

Deleting Quick Save Presets

You can delete any Quick Save preset on the system except the active preset.

1. If a preset you want to delete is active, deactivate it by touching the associated transducer name and a different preset.
2. Swipe the touch screen, from right to left, to view the second page of the transducer presets.
3. Touch **Delete User Presets**.
4. Click **OK**.

Copying Quick Save Presets to Removable Media

You can copy Quick Save presets to a DVD or a USB storage device. This function is useful for archiving presets and for sharing presets among other EPIQ 7 systems. When you copy Quick Save presets, all available data is copied.

NOTE

If you receive an error message when exporting data to a DVD or when viewing exam data on a DVD, you may need to eject the DVD from the drive and re-insert it.

1. Load a DVD into the DVD drive, or connect a USB device to a USB port on the system.
2. On the control panel, press **Support**.
3. Click **System Management**.
4. Click **Backup/Restore**.
5. From the **Select the Media** menu, select the removable media that you are using.
6. Click **Backup**. The backup list shows the data that is backed up.
7. If a dialog box indicates that the media is too full to complete the copy process, replace the media and click **Backup** again.
8. After the backup is complete, click **Close**.
9. Click **Done**.

Loading Quick Save Presets from Removable Media

1. Load the DVD containing the data into the DVD drive, or connect the USB device containing the data to a USB port on the system.
2. On the control panel, press **Support**.
3. Click **System Management**.
4. Click **Backup/Restore**.
5. From the **Select the Media** menu, select the media type that you are using.
6. Deselect the data that you do not want to import.
7. After the import is complete, click **OK**.
8. To close the **Philips SupportConnect** display, click **Close**. A displayed message might prompt you to restart the system.

System Setups

Setups are system parameters that you can change. By changing setups, you can customize the system to meet your operating preferences.

Setups are organized into five standard categories: **System Settings**, **Analysis**, **Annotation**, **Acquisition/Capture**, and **Data Security**. An additional category, **Setup Wizard**, helps you quickly prepare your system for use. Changes in setups take effect immediately and remain in effect until you change them again or load setups from a DVD or USB device.

NOTE

The institution name exported with DICOM data always reflects the name shown in the setups at the time the study ended. Philips recommends restarting the system after changing **Institution Name** in the setups.

Procedures for using setup options and descriptions of settings are included throughout the *Help*.

Changing Setups

1. Touch **Utilities**.
2. On the **System** tab, touch **Setups**.
3. Click a setup category on the left side of the setups display.
4. Click a tab or sub-tab at the top of the setups display.
5. Enter text or make selections necessary to set up your system.
6. Click **Close**.

Hiding the Doppler Velocity Minus Sign

You can choose to include only the numeric value of the Doppler velocity measurements. Doppler velocity is marked as negative (-) when the flow is moving away from the transducer. When reporting on the measurements, you may want only the value, not the direction of flow. When hidden, the negative sign does not appear on the displayed or printed patient reports; however, the sign is still part of the number and is visible when editing a patient report and is included in DICOM structured reports exported from the system.

The option to hide the Doppler velocity minus sign is available in all calculation packages except **Adult Echo** and **Pediatric Echo**.

NOTE

When **Hide Doppler Velocity Minus Sign** is enabled, avoid using the Doppler velocity value displayed in the results and report for manual calculations. The sign value, whether visible or not, affects any calculations performed with the reported value. The system includes the sign value in calculations.

To specify the display of the Doppler velocity minus sign:

1. Touch **Utilities**.
2. In the **System** tab, touch **Setups**.
3. Click **Analysis**.
4. Select the tab of the calculations package that you want to change, and then click **Tools & Results**.
5. Under **Hide Doppler Velocity Minus Sign**, select **On** or **Off**.
6. Click **Close**.

System Options

In addition to the standard features available in the system, other features are available as purchasable licensed options. The types of options available include clinical applications, protocols, imaging capabilities, QLAB Advanced Quantification Software Q-Apps, PercuNav Image Fusion and Interventional Navigation, and connectivity capabilities.

To add licensed options to your system, you purchase them from your Philips representative. Once purchased, they are installed in your system by a Philips field service engineer.

Custom Procedures

You can automate a variety of workflows by creating custom procedures for specific patients, transducers, and presets.

Creating a Custom Procedure

1. Touch **Utilities**.
2. On the **System** tab, touch **Setups**.
3. Click **System Settings**.
4. Click the **Patient Data** tab.

5. Under **Procedure Setup**, do one of the following:
 - To create a new procedure, click **Create New**.
 - To modify an existing procedure or create a new procedure from an existing procedure, select an item from the **Procedure** list, and then click **Modify**.
 - To delete an existing procedure, select an item from the **Procedure** list, and then click **Delete**.
6. For new or modified procedures, complete the following:
 - **Procedure Name:** Enter the name of a new procedure, or modify the name of an existing procedure.
 - **Study Description:** Enter the type of study for which the new or modified procedure is intended.
 - **Gender:** Select the gender of the patient.
 - **Study Description:** Enter a brief, meaningful description of the study in which the new or modified procedure is used.
 - **Transducer:** Select a transducer from a list of all of the transducers that are supported by the system.
 - **Preset:** Select a preset from a list of all of the presets that are available for the selected transducer.
7. Click **Save** and then click **Close**.

To use the new custom procedure, see “[Selecting a Custom Procedure](#)” on page 153.

Selecting a Custom Procedure

Custom procedures are available from the **Patient Data** form.

NOTE

Custom procedures are linked to specific transducers. If the transducer required for the procedure is unconnected, procedures that use it do not appear in the **Procedure** menu.

1. Touch **Patient**.
2. In the **Clinical Procedure** section of the **Patient Data** form, select the custom procedure from the **Procedure** menu.
3. Click **Done**.
4. Start the exam.

7 Performing an Exam

This section guides you through procedures commonly used in performing patient exams with the system. These procedures include entering patient data; acquiring, annotating, and reviewing images; and making measurements and calculations.

New Patient Exams



WARNING

Failing to end the current exam before starting a new exam can result in data being acquired and stored under the wrong patient name.

You start an exam by entering patient data into the system. There are two ways to enter patient data.

- If the Modality Worklist feature is disabled or unused on your system, you enter patient data into the **Patient Data** form.
- If your system is connected to a DICOM network with the Modality Worklist feature enabled, you can select an exam to load patient data instead of entering that information manually. See “[Selecting in the Worklist](#)” on page 156.

If you want to start an exam without first entering patient data, you can select **Use Temporary ID** after you acquire an image.

The system uses a unique ID to identify each patient. You can enter an ID, or you can have the system create one automatically. Stored images, fetal growth graphs, and reports are stored based on the patient ID.

If the sonographer name needs to be different on images within the exam, end the current exam and append a new exam with the images from the new sonographer.

An accession number is an optional entry assigned to each patient file by an institution for internal information-management purposes.

The exam date is set by the system when you first acquire an image during the exam.

Entering Patient Data

If you are not using the worklist option, you start an exam by entering patient data into the system.

If you want to start an exam without first entering patient data, you can select **Use Temporary ID** after you acquire an image.

NOTE

You can clear all patient data from the **Patient Data** form by clicking **Clear**. Do not use this control unless you want to delete all of the patient data you have entered into the form.

1. Touch **Patient**.
2. Ensure that the previous exam ended by doing one of the following:
 - Touch **End Exam** while the **Patient Data** form is displayed.
 - Click **End Exam** on the **Patient Data** form.
3. On the **Patient Data** form, type the patient information. (Press the **Tab** key to move the cursor from field to field.)
4. For **Study Type**, select the study you will be performing. It is important to select the correct study type at this time. Selecting a study type after you have entered patient data and exited the **Patient Data** form does not update the report with the correct study type.
5. Enter the pertinent study information for the patient.
6. If you have created a custom procedure for this patient, select the custom procedure from the **Procedure** menu. (For information about custom procedures, see "[Custom Procedures on page 152](#).)
7. When you are finished, click **Done**.

Selecting in the Worklist

1. Touch **Patient**.
2. On the **Patient Data** form, click the **Worklist** tab.
3. On the worklist, select the exam you want, and click **Close**.
The system loads the patient information, and you are ready to begin an exam for that patient.

Searching in the Worklist

If necessary, you can search for a specific exam by using **Patient Search** on the **Patient Data** form.

1. Touch **Patient**, then click the **Worklist** tab.
2. To search for a patient by exam date, click **Search**.
3. To further specify the date criteria, do one of the following:
 - Select the **Exam Date**.
 - Select **Today**; select ± (plus or minus), +, or -; and then select the number of days.

NOTE

You can also search for a patient by last name, patient ID, modality, accession number, or procedure ID.

4. Click **Search**.
5. Select the patient from the worklist.
6. Click **Done**.

Hiding Patient Name and ID on Images



WARNING

Images printed without the patient name and ID could be incorrectly associated with another patient. One way to alleviate this risk is to configure the DICOM printer so that the patient data that is included in the header of the image file is printed along with the image. However, some printers do not support that feature.

NOTE

If the intent of hiding the patient name and ID is patient privacy, be aware that if the original file name includes the patient name, you will need to rename the file when you export it.

The patient name and ID are displayed in the patient bar, which is outside of the image area and not acquired in an image. However, patient information is overlaid on to an image when it is printed. To hide the patient name and ID on the printed image, touch **Utilities**, and then touch **Hide Patient Info** on the **System** tab. All other information displayed in the patient bar (time/date, institution name, and so on) remains in the overlay and is included on the printed image.

Any loop or still frame acquired while the patient name is hidden will also be exported with the patient name hidden.

Imaging Modes

Your ultrasound system offers a set of imaging modes to accommodate a variety of imaging applications. Some modes display a live grayscale image. Others are Doppler modes to evaluate the amplitude or the direction of the blood flow and the spectral information. Special modes are also available for 3D imaging and Panoramic imaging.

NOTE

Some modes are available on your system only if the corresponding option has been purchased and installed.

Selecting a Transducer

When the system is turned on, the system initializes the last active transducer. If that transducer is not connected, the system initializes the transducer that is connected to the leftmost connector, unless you have defined another transducer as the default transducer. If you have set a default transducer and it is connected, then the system initializes that transducer. For information on setting a default transducer, see “[Setting the Default Transducer and Preset](#)” on page 148.

If multiple transducers are connected when the system is turned on, the system selects the transducer that was in use when the system shut down. You can select among the connected transducers during system operation. If the system does not recognize a transducer, it will switch back to the original transducer. Disconnect and reconnect the unrecognized transducer or move it to a different receptacle.

You can select or deselect a transducer during live imaging without damaging the transducer or the system.

1. Touch the transducer name to select it.
2. Touch the clinical application preset that you want to use.

After you select the clinical application/preset, the system calibrates the transducer, enables the transducer for operation, and updates system status to reflect the transducer type and the preset you selected.

Annotation

You can place text labels and arrows on an image to identify anatomical structures and locations. You can also annotate an image with a body marker graphic that indicates the part of the anatomy that you are scanning.

Trackball Functionality in Annotation

Use the touch screen to select annotation labels and body markers, and use the trackball to position them on the imaging display. The trackball icon identifies the function available for each trackball button as you add labels and body markers. When adding body markers the following functionality is available:

- Left or right trackball button: Highlight and move body marker and the transducer icon.
- Middle trackball button: Set the position of the body marker and exit annotation mode. (To reenter annotation mode, touch the **Label** tab.)

Adding Labels

1. Press **ABC Label**.

NOTE

If you press a trackball button, unfreeze the image, or change the imaging mode or settings that affect the trackball assignment, annotation mode goes into standby. To return to annotation, press **ABC Label**.

2. Touch **ABC Labels**.
3. Use the trackball to position the text cursor on the display, or touch **Home** to return it to the home location.

NOTE

You cannot move a label once you have added it to the display.

4. Do any of the following:
 - To add text, type the text that you want to appear on the display.
 - To display predefined labels, touch a label control to display its text.
 - To display an arrow, press the **Arrow** soft key, position the arrow with the trackball, and then click to fix the position.
 - To erase an arrow, touch **Erase Last**.
 - To erase the last word typed, touch **Erase Last** to erase all arrows and then erase words one at a time.
 - To erase all text, touch **Erase All**.
 - To move the text cursor to the home position, touch **Home**.
 - To set a new home position, position the cursor and touch **Set Home**.
 - To exit annotation mode, press **ABC Label** again.
 - To use text replace, see *Changing Labels Using Text Replace* in the online help.

NOTE

Erase Last erases all arrows from the image display before it erases text labels.

Adding Labels Using the Keyboard

You can add labels using either the retractable keyboard or the touch screen keyboard. You can manually format the annotation labels that you add using either keyboard.

1. Press **ABC Label**.
2. Press the space bar on the keyboard.
3. Use the trackball to position the text cursor on the display.
4. Type the text that you want to add. You can use spaces before and after the words to center the text or improve the text flow.
5. To erase text, press the **Backspace** key.
6. When finished, press **ABC Label** again to remove the text cursor.
7. To remove text, press **ABC Label** and then touch **Erase Last Word** or **Erase All Text**.

Adding an Image Title

You can add a title to the image display.

1. Press **ABC Label**.
2. Touch **ABC Labels**.
3. Touch **Keyboard**.
4. Touch **Title** on the keyboard touch screen.
5. Type the text that you want to add for the title.
6. To erase text, touch **Backspace**.
7. When finished, touch **Title** again.

Displaying Body Markers

NOTE

During Review, the **Body Markers** touch screen is available only when **1-up** is selected for **Layout**. You cannot add body markers and system-provided labels to single frame images in Review, although you can add them to loops in Review. You can type text in single frame images in Review.

1. Press **ABC Label**.

2. Touch **Body Markers** on the **ABC Label** touch screen to display the **Body Markers** touch screen for the current transducer and preset.
3. Touch a body marker control to put the corresponding body marker on the display in the home location or to replace an existing body marker.
4. Use the trackball to position the transducer scan plane indicator on the body marker. Turn **Probe Rotate** to change the orientation of the transducer scan plane indicator.
5. Do any of the following:
 - To move the marker, exit and reenter the **Body Markers** touch screen, or exit and reenter annotations mode. When you reenter the **Body Markers** touch screen you can edit the marker.
 - To remove a body marker, touch **Erase Body Mark**.
 - To close the **Body Markers** touch screen, touch another tab title or press **ABC Label**.

Recording

You can record live imaging to a local DVD recorder and simultaneously record comments. You can play back recordings on other DVD players. Playback is not supported on the system.

Using the DVD Recorder

NOTE

Use only DVD+RW media in the DVD recorder.

NOTE

Always format a new disc before using it with the DVD recorder. Also, Philips recommends reformatting a used disc before using it with the DVD recorder.

1. To turn on the DVD recorder, press  on the front panel.
2. To insert a disc, press **OPEN/CLOSE** (on the recorder front panel), place a disc in the tray, and press **OPEN/CLOSE** again.
3. To record, touch **DVR** on the touch screen and use any of the following controls on either the **DVR** touch screen or the DVD recorder:
 - (Play) to play back the video at normal speed

-  (Stop) to stop the recording
-  (Record) to start recording
-  (Pause) to temporarily halt the recording
-  (Eject) to stop the current recording mode and eject the media

Printing

You can print single-frame images and reports to a local printer, usually installed in the system, or to DICOM printers on a network.



WARNING

Multi-image prints made on small-size paper are intended only for reference and should not be used for diagnostic purposes. Text annotation and scaling markers may not be visible on such prints.

Two print controls are available for printing images, **Print** and **Alt Print**. The **Acquire 1**, **Acquire 2**, **Acquire Screen**, and **Acquire Report** controls also have print capabilities associated with them. In the setups, you can assign each of these controls separately to one or more image printers. In addition, you can select whether the controls print the entire display or just the image area.

NOTE

If you print a monochrome image while a Chroma map is selected, the system sends the image to the color printer. Also, if you export a monochrome image while a Chroma map is selected, the system sends the image as a color image. This is normal. To ensure that black-and-white images are sent to the black-and-white printer, set **Chroma** to **Off**.

Printing in Live Imaging

You can print live or frozen images during an exam. To print using the **Acquire 1** or **Acquire 2** controls, a printer must be assigned to those controls in the setups.

1. Display the live or frozen image you want to print.
2. Do one of the following:
 - Press **Acquire 1** or **Acquire 2** on the system control panel.
 - Touch **Alt Print** on the touch screen.
 - Touch **Print Screen** on the **Utilities** tab.

NOTE

If your print setting includes multiple images per page, the printer will not print an image until the total number is reached. For example, if you have a 2x2 format selected, the printer will not print the page until you have captured four images or, if the number captured is less than four, until the end of the exam.

Review

During or after an exam, you can use Review to examine and compare images acquired in the exam. You can also review multiple exams for one patient.

In Review, you can look at the images or cineloop sequences that you stored. You can view, send, print, and back up your stored images. You can also perform analysis on images in Review. Images that are in image memory can be stored on the ultrasound system hard drive, on removable media, or on DICOM-compatible devices on a network. You can display images within an exam in several layouts, and you can display images from different exams.

Starting Review

1. Touch **Review** to enter Review mode. You can also double-click a thumbnail image to open that image in thumbnail review. The display that appears depends on whether an exam is active on the system.

NOTE

If an exam is in progress, pressing **Review** opens the **Image Review** display. If no exam is in progress, pressing **Review** opens the Patient Directory display.

2. To return to live imaging, touch **Review** again.

Navigating Thumbnails and Images

In **Review**, you can view small images, called *thumbnails*. Thumbnails are located on the right side of the **Review Exam** display. From these thumbnails, you can also display one or more images in their original format. If an image represents a 3D data set, it opens in 3D review mode.

NOTE

When reviewing images of an exam loaded from the Patient Directory, thumbnails are unavailable in some circumstances. For example, exams copied from DVD to the hard drive may not have thumbnails, if the images they contain are no longer in their native format.

Do any of the following:

- Click  or  to move up or down through available thumbnails one or two images at a time.
- Click a thumbnail to jump to the page that contains the corresponding image.
- To view a thumbnail full screen, double-click it. (If the image represents a 3D data set, it opens in 3D review mode.) To return to the review screen, double-click the full screen image or set **Layout** to **4-up**.
- Drag the scroll bar to move up or down through available thumbnails quickly.
- Turn **Page** to move backward or forward through the available images, one page at a time.
- To select an image, either click the image or click the number of its corresponding thumbnail.

Capturing Images and Loops

You can capture and save a single frame or a cineloop sequence. The captured frame or cineloop sequence is saved in the patient study, and a thumbnail of it is available in the live imaging display and the Review display. Images are automatically exported across the network,

either when you capture or print an image, or when you end an exam, depending on your selection for **Send Images/Clips** on the **Acquisition/Capture** tab in the **Acquisition/Capture** setups.

Use the **Freeze** control to stop and start system image acquisition and update. Pressing **Freeze** results in the system entering cineloop pause and assigning the trackball to manual cineloop review (frame-by-frame).

During acquisition, a spinning hourglass icon appears at the bottom of the display. When the capture is complete, a thumbnail of the image is displayed.

Do one of the following:

- To capture a single image, press **Freeze**, and then press **Acquire 1** or **Acquire 2**.
- To capture a cineloop sequence, press **Acquire 1** or **Acquire 2** in live imaging or while reviewing a cineloop sequence. Capturing during live imaging saves prospective or retrospective frames, as specified in **Live Capture Type** in the setups. A prospective capture captures a specified acquired loop length. A retrospective capture captures a specified loop length that was acquired previously. A retrospective capture captures a loop that ends when you press **Acquire 1** or **Acquire 2**. Capturing while reviewing a cineloop sequence saves all retrospective frames in the cineloop sequence.

You can configure the **Acquire 1**, **Acquire 2**, and touch screen print controls in the **Acquisition/Capture** setups. The default setting is for **Acquire 1** to capture single frames when the image is frozen and to capture loops when the image is live. **Acquire 2** captures single frames, regardless of the imaging state. If an **Acquire** control is set to acquire a still frame, you can use it to acquire the frame without freezing the image.

NOTE

When an image is captured, you will hear a beep to confirm that the loop or image was saved in the patient's study. Do not press **Review** until you hear the beep.

NOTE

If you press **Acquire 1** in a non-simultaneous mode while a live M-mode or Doppler trace is active, you capture a cineloop sequence. If you press **Acquire 1** in a simultaneous mode, you capture a single image.

NOTE

If you attempt to capture a loop that was imported from media, only a frame of the loop is captured and displayed in the appending exam.

Measurement and Analysis

The measurement tools appear on the touch screen. Touching a tool label on the touch screen launches the tool. (The labels of inactive tools are gray.)

A calculations package contains one or more collections that organize groups, measurements, and calculations into a coherent tool for diagnostic analysis.

Measurement tools provide measurements and derived calculations. Various methods are available for generating results. The two primary methods allow you to “measure then label” or “label then measure.” Either way, the results can appear on the display, on printed pages, and in patient reports, where they are available for your analysis.

The **Analysis** setups provide the configuration capability that allows you to create your own calc lists, including collections, groups, measurements, and calculations. In addition, the measurements and calculations can be associated with system and custom tables and equations.

The ultrasound system supports a number of measurement and quantification methods. The basic measurements report the size, speed, or duration of image data. The image data may be contained in a 2D ultrasound image, a Physio region, an M-mode trace, or a Doppler spectral trace. The accuracy of the measurement depends, in part, on the ability of the operator.

Measurements are available if the image scaling data is available. This prevents measurements on Doppler or M-mode still images in Review that do not include scaling information in the trace data, or on imported image loops that use different scaling parameters.

Measurements must be labeled for the results to appear in patient reports. Unlabeled measurements appear in the results but are not retained, unless they are associated with a labeled measurement.

Labeled measurements and calculations are stored in the patient data and report. The information is labeled according to the measurement or calculation label. Within the report, the information is organized by the calculations package. The values displayed can be the results of multiple measurements.

Calculations packages are system options that are associated with transducers and presets. A calculations package contains one or more collections that organize measurements and calculations into a coherent tool for diagnostic analysis. The **Calc Package** tab provides access to the various measurements and calculations in the available calculations packages.

The measurements and their derived calculations included with the calculations packages are based on medical references. See the "References" section in the *Help*.

NOTE

Ensure that you follow current medical practices when identifying specific measurement points on an image.

Performing a 2D Distance Measurement

A 2D distance measurement uses two calipers to measure the length of a straight line between the two points. You can set the display of the line in the setups.

NOTE

The left and right trackball buttons can each be set to one of three measurement operations: **End Measurement**, **Toggle**, or **Next Measurement**.

1. Obtain the 2D image you want to measure and press **Freeze**.
2. Press or touch **Measure**.
3. Press or touch **Measure**, and then touch **Tools**.
4. Touch **Distance**.
5. Use the trackball to position the caliper for the first end point and click to anchor it.
6. Use the trackball to position the caliper for the second end point. The results update as the distance between the calipers changes.

7. To end the measurement, press the middle trackball button.

Measuring M-Mode Distance

1. Start M-mode by pressing the **M-mode** soft key, and then press the middle trackball button to update the M-mode display.
2. Obtain the desired M-mode display and press **Freeze**.
3. Press or touch **Measure**, and then touch **Tools**.
4. Touch **Distance**.
5. Use the trackball to position the vertical time caliper and press the left or right trackball button.
6. Use the trackball to position the horizontal depth caliper. The distance between the depth calipers appears in the results.
7. To make additional measurements, repeat step 5 and step 6.
8. Press the middle trackball button to complete the measurement.

Measuring the Doppler Trace on a Sweeping Display

The measurements that appear depend on the settings for Doppler in the **Tools and Results** setups.

You can measure Doppler velocity on a live image.

1. Press **PW**.
2. Press the middle trackball button to update the Doppler display.
3. Obtain the Doppler image you want to measure (spectral waveform).
4. Touch **Measure**.
5. Use the trackball to position the horizontal cursor.
6. There are no measurement values in the results; you can read the velocity or frequency value from the velocity or frequency scale.

Obtaining a Typical Labeled Measurement

This general procedure describes how to measure by using a typical labeled measurement tool.

1. Obtain the image you want to measure and press **Freeze**.
2. Press or touch **Measure**.
3. Do one or more of the following:
 - On the **Calc Package** tab of the touch screen, touch a collection and then a measurement label.

- In the **Calc List**, click a collection and then click a measurement label.
4. If a set of associated measurements are required, touch or click a group label to display multiple measurement labels.
 5. Touch or click a measurement label and make the measurement. First, the caliper or trace tool appears on the display. Then, as you make the measurement, the results and derived calculations appear in the results and are simultaneously added to the patient report.
 6. For each measurement label within a group, touch or click a label and make the measurement.
 7. Press the middle trackball button to complete the measurement.

NOTE

The measurement automatically completes if you unfreeze the image, change modes, or enter a report.

Measuring Then Labeling

The measure-then-label method of obtaining results uses caliper controls for making measurements, without first having to select measurement labels. These measurements are not explicitly associated with a report region and do not appear in the report unless associated with a measurement. You can assign these measurements to labels on an as-needed basis.

After making a measurement, you can choose whether to assign the value to a label.

NOTE

The measurement will be lost if you unfreeze the image or change modes before you assign a label to it.

Ending an Exam

Each time you finish an exam, you must end the exam to save images, reports, and other exam data. You can end an exam in the current exam display or with the current exam open in the Review display. You cannot end a paused exam while in the Patient Directory.

You will not be able to end the exam until the system has saved exam data for the current exam. (The system saves exam data when you acquire an image.) Ending an exam stores all exam data, clears the **Patient Data** form, and prepares for the next exam.



WARNING

Failing to end the current exam before starting a new exam can result in data being acquired and stored under the wrong patient name. If you turn off the system without ending the exam, the system pauses the exam before shutting down.

When the exam is complete, do one of the following:

- Touch **End Exam**.
- Click **End Exam** in the **Patient Data** display.

Performing an Exam

Ending an Exam

8 Transducers

The transducer that you select is the most important factor in image quality. Optimal imaging cannot be obtained without the correct transducer. The system is optimized for use based on your transducer selection.

The system limits patient contact temperature to 43 degrees Celsius, and acoustic output values to their respective U.S. Food and Drug Administration limits. A power-protection circuit protects against over-current conditions. If the power monitor protection circuit senses an over-current condition, then the drive voltage to the transducer is shut off immediately, preventing overheating of the transducer surface and limiting acoustic output. Validation of the power protection circuit is done under normal system operation.

Non-TEE transducers are rated minimum IPX7 in accordance with IEC 60529. Transesophageal transducers are rated minimum IPX1 (control area) and IPX7 (endoscope area) in accordance with IEC 60529.



WARNING

All TEE transducers are designed to be defibrillator safe in accordance with IEC 60601-1. Nevertheless, always remove the transducer from the patient before defibrillation.



WARNING

To limit potential harm when scanning neonatal, pediatric, and medicated patients, minimize the time spent imaging at temperatures above 41°C (106°F).

Selecting a Transducer

When the system is turned on, the system initializes the last active transducer. If that transducer is not connected, the system initializes the transducer that is connected to the leftmost connector, unless you have defined another transducer as the default transducer. If

you have set a default transducer and it is connected, then the system initializes that transducer. For information on setting a default transducer, see “[Setting the Default Transducer and Preset](#)” on page 174.

If multiple transducers are connected when the system is turned on, the system selects the transducer that was in use when the system shut down. You can select among the connected transducers during system operation. If the system does not recognize a transducer, it will switch back to the original transducer. Disconnect and reconnect the unrecognized transducer or move it to a different receptacle.

You can select or deselect a transducer during live imaging without damaging the transducer or the system.

1. Touch the transducer name to select it.
2. Touch the clinical application preset that you want to use.

After you select the clinical application/preset, the system calibrates the transducer, enables the transducer for operation, and updates system status to reflect the transducer type and the preset you selected.

Setting the Default Transducer and Preset

You can set a default transducer and preset so that each time the system is turned on, that transducer and preset are initiated automatically. The system selects the default transducer regardless of which receptacle it is connected to. If the default transducer is not connected when the system is turned on, the system initiates the transducer connected to the left-most connector and the first available preset for that transducer.

1. Touch the name of the transducer you want to use.
2. Touch the preset you want.
3. Touch the transducer name a second time.
4. Touch **Set Default**.

Clinical Applications and Transducers

A clinical application, available for one or more transducers, optimizes the system for a specific application.

The clinical applications for each transducer available for the system are listed here.

The following table lists the transducers that are compatible with your ultrasound system.

System Transducers and Supported Clinical Applications

Transducer	Clinical Applications
C5-1	Abdominal, Fetal Echo, GYN, Intervention, OB, Pediatric Abdomen, Vascular
C8-5	Pediatric Abdomen, Neonatal Head, Vascular
C9-2	Abdominal, Fetal Echo, GYN, OB, Pediatric Abdomen
C10-3v	Fetal Echo, GYN, OB, Urology
C10-4ec	Fetal Echo, GYN, OB, Urology
D2cwc	Adult Echo
D2tcd	TCD
D5cwc	Vascular
L12-3	Abdominal, Musculoskeletal, Small Parts, Vascular
L12-5 50	Abdominal, Musculoskeletal, OB, Pediatric Abdomen, Pediatric Hip, Small Parts, Vascular
L15-7io	Epiaortic, Musculoskeletal, Vascular
L18-5	Musculoskeletal, Pediatric Abdomen, Pediatric Hip, Small Parts, Vascular
S5-1	Adult Echo, Pediatric, TCD
S7-3t	Adult Echo, Pediatric
S8-3	Adult Echo, Pediatric
S12-4	Adult Echo, Neonatal Head, Pediatric
V6-2	Fetal Echo, OB
X5-1	Abdomen Vascular, Adult Echo, Pediatric, TCD
X6-1	Abdominal, Fetal Echo, GYN, Intervention, OB
X7-2t	Adult Echo

Indications for Use and Supporting Transducers

The following are the indications for use for this system and the transducers supporting each indication.

Use only transducers that are approved by Philips for use with your Philips ultrasound system. In the United States, the FDA 510(k) regulatory clearance for use of the product is applicable only when Philips-manufactured transducers are connected to the system.

System Indications for Use and Supporting Transducers

Indication for Use	Supporting Transducers
Abdominal	C5-1, C8-5, C9-2, L12-3, L12-5 50, L18-5, S5-1, V6-2, X5-1, X6-1
Cardiac Adult	D2cwc, S5-1, S8-3, S12-4, X5-1
Cardiac other (Fetal)	C5-1, C9-2, C10-3v, C10-4ec, S5-1, V6-2
Cardiac Pediatric	D2cwc, S5-1, S8-3, S12-4, X5-1
Cerebral Vascular	C8-5, D2tcd, D5cwc, L12-3, L12-5 50, L15-7io, L18-5, X6-1
Cephalic (Adult)	D2tcd, S5-1, X5-1
Cephalic (Neonatal)	C8-5, L12-3, S8-3, S12-4
Fetal/Obstetric	C5-1, C9-2, C10-3v, C10-4ec, L12-5 50, L18-5, S5-1, S8-3, V6-2, X6-1
Gynecological	C5-1, C9-2, C10-3v, C10-4ec, X6-1
Intraoperative (Vascular)	L15-7io
Intraoperative (Cardiac)	L15-7io
Musculoskeletal (Conventional)	L12-3, L12-5 50, L15-7io, L18-5
Musculoskeletal (Superficial)	L12-3, L12-5 50, L15-7io, L18-5
Other: Urology	C5-1, C9-2, C10-3v, C10-4ec
Pediatric	C5-1, C8-5, C9-2, L12-5 50, L15-7io, L18-5, S5-1, S8-3, S12-4, X5-1, X6-1
Peripheral Vessel	C5-1, C8-5, C9-2, C10-4ec, D5cwc, L12-3, L12-5 50, L15-7io, L18-5, S5-1, X6-1
Small Organ (Breast, Thyroid, Testicle)	L12-3, L12-5 50, L15-7io, L18-5
Transesophageal (Cardiac)	S7-3t, X7-2t
Transrectal	C10-4ec
Transvaginal	C10-3v, C10-4ec

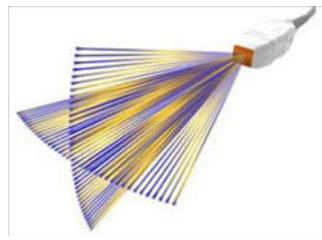
xMatrix Array Transducers

xMatrix array transducer technology provides volume acquisitions of the beating heart with remarkable image quality. You can use these transducers to acquire two planes simultaneously from the same heartbeat. The system's multi-directional beam steering lets you select unlimited planes in all directions, so you can get the precise view you want, with no degradation in image quality.

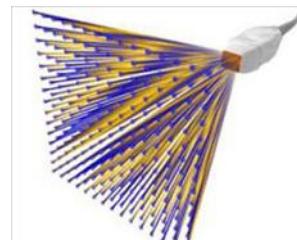
The following xMatrix array transducers are available with this system:

- X5-1 (see “[X5-1 Description](#)” on page 177)
- X6-1 (see “[X6-1 Description](#)” on page 178)
- X7-2t (see “[X7-2t TEE Transducer Description](#)” on page 209)

Use Live xPlane imaging to simultaneously create two full-resolution planes.



Use Live Volume imaging to acquire and render full volume data at true real-time frame rates.



X5-1 Description

Features of the X5-1 transducer include:

- Operating range: 1.3 to 4.2 MHz.
- 2D xMATRIX phased array with 3,000 elements.
- 2D imaging provides a 90-degree field of view, while volumetric imaging is 90 x 90 degrees.
- 2D imaging modes with PW, CW, M-mode, Color M-Mode, Color, TDI, TDI PW and LVO, xPlane, xPlane Color, and xPlane LVO.
- 3D imaging modes with 3D Zoom, Live 3D grayscale, Live 3D color, Live 3D LVO, Full Volume grayscale, Full Volume Color, and Full Volume LVO. (All 3D imaging modes available with one-beat and multi-beat acquisition.)

X6-1 Description

Features of the X6-1 transducer include:

- Operating range: 1.5 to 6 MHz.
- Biopsy capable.
- Internal temperature monitoring.
- 2D xMATRIX phased array with more than 9,000 elements.
- 2D imaging provides a 100-degree field of view, while volumetric imaging is 90 x 90 degrees.
- 2D imaging modes with Tissue Harmonic Imaging, M-mode, PW, Color, and CPA.
- 3D and 4D imaging modes with xPlane, Elevation Compounding, single-sweep 3D grayscale, Color, CPA, Directional CPA, live 4D grayscale imaging, 3D Panoramic, and iSTIC grayscale and color with automated heart rate estimation.

Transducer Maintenance

Transducers require proper care, cleaning, and handling. Reasonable care includes inspection, cleaning, and disinfection or sterilization, as necessary.

Inspect the transducer cable, case, and lens before each use. Check for cracks or other damage that jeopardizes the integrity of the transducer. Report any damage to your Philips customer service representative, and discontinue use of the transducer.

For all information on transducer cleaning and disinfection, see the “[Transducer Care](#)” section. For all information about the use of acoustic coupling gels, see “[Ultrasound Transmission Gels](#)” [on page 184](#).



CAUTION

Some ultrasound coupling gels, as well as some solutions for precleaning, disinfecting, and sterilizing can damage a transducer. Before using a gel or solution on a transducer, see “[Ultrasound Transmission Gels](#)” [on page 184](#) or the “[Transducer Care](#)” section. You can also contact your local Philips representative. For contact information, see “[Customer Service](#)” [on page 22](#).

If you encounter poor image quality or transducer problems, see “[Troubleshooting](#)” on page [295](#).

Acoustic Artifacts

The transducer adds its own signature to the echo information in the form of beam width effects, axial resolution limitations, and frequency characteristics. The control choices made by the sonographer that affect amplification, signal processing, and echo signal display can lead to significant differences in the displayed appearance of echo data. Following is a brief discussion of acoustic artifacts. An understanding of the physical basis for the production of signals displayed on ultrasound images is helpful in minimizing artifacts on images and interpreting the results of studies.

An artifact is an echo displayed in a different position than its corresponding reflector in the body. Artifacts can also be caused by intervening tissue properties. Artifacts can originate from external noise, reverberations, multi-path reflections, or misadjusted equipment. They can also come from the ultrasonic beam geometry and unusual changes in beam intensity. Artifacts and their manifestations are listed below, and following are some definitions of various artifacts.

- Added objects displayed as speckle, section thickness, reverberation, mirror image, comet tail, or ring down
- Missing objects due to poor resolution
- Incorrect object brightness due to shadowing or enhancement
- Incorrect object location due to refraction, multi-path reflections, side lobes, grating lobes, speed error, or range ambiguity
- Incorrect object size due to poor resolution, refraction, or speed error
- Incorrect object shape due to poor resolution, refraction, or speed error

Acoustic saturation occurs when received signals reach a system's high-amplitude limit. At that point the system becomes unable to distinguish or display signal intensities. At the point of saturation, increased input will not increase output.

Aliasing occurs when the detected Doppler frequency exceeds the Nyquist limit. It is characterized on the spectral display by the Doppler peaks going off the display, top or bottom, and then continuing on the other side of the baseline. On the Color display an immediate change in color from one Nyquist limit to the other is seen.

Comet tail is a form of reverberation artifact produced when two or more strong reflectors are close together and have a high propagation speed. In this case, sound does not travel directly to a reflector and back to the transducer; and a strong linear echo appears at the reflector and extends deeper than the reflector.

Enhancement is an increased relative amplitude of echoes caused by an intervening structure of low attenuation.

Focal enhancement, also known as **focal banding**, is the increased intensity in the focal region that appears as a brightening of the echoes on the display.

Mirror imaging artifact is most commonly seen around the diaphragm; this artifact results from sound reflecting off another reflector and back.

Mirroring is the appearance of artifacts on a spectral display when there is improper separation of forward and reverse signal processing channels. Consequently, strong signals from one channel mirror into the other.

Multi-path positioning and **refraction** artifacts describe the situation in which the paths to and from a reflector are different. The longer the sound takes traveling to or from a reflector, the greater the axial error in reflector positioning (increased range). Refraction and multi-path positioning errors are normally relatively small and contribute to general degradation of the image rather than to gross errors in object location.

Propagation speed errors occur when the assumed value for propagation speed by the ultrasound system is incorrect. If the actual speed is greater than that assumed, the calculated distance to a reflector is too small, and the reflector will be displayed too far from the transducer. Speed error can cause a structure to be displayed with incorrect size and shape.

Range ambiguity can occur when reflections are received after the next pulse is transmitted. In ultrasound imaging, it is assumed that for each pulse produced, all reflections are received before the next pulse is sent out. The ultrasound system calculates the distance to a reflector from the echo arrival time assuming that all echoes were generated by the last emitted pulse. The maximum depth to be imaged unambiguously by the system determines its maximum pulse repetition frequency.

Reverberation is the continuing reception of a particular signal because of reverberation rather than reflection from a particular acoustic interface. This phenomenon is analogous to the effect created by mirrors positioned on opposite walls when an object, a head for instance, is placed

between the mirrors. The image of the head is reflected back and forth infinitely between the two mirrors, creating the optical illusion of multiple heads. Reverberations are easily identifiable, because they are equally spaced on the display.

Scattering is the diffuse, low-amplitude sound waves that occur when acoustic energy reflects off tissue interfaces smaller than a wavelength. In diagnostic ultrasound, Doppler signals come primarily from acoustic energy back-scattered from red blood cells.

Shadowing is the reduction in echo amplitude from reflectors that lie behind a strongly reflecting or attenuating structure. This phenomenon occurs when scanning a lesion or structure with an attenuation rate higher than that of the surrounding tissue. The lesion causes a decrease in beam intensity, which results in decreased echo signals from the structures beyond the lesion. Consequently, a dark cloud behind the lesion image forms on the display. This cloud, or shadow, is useful as a diagnostic clue.

Side lobes (from single-element transducers) and **grating lobes** (from array transducers) cause objects that are not directly in front of the transducer to be displayed incorrectly in lateral position.

Speckle appears as tissue texture close to the transducer but does not correspond to scatterers in tissue. It is produced by ultrasound wave interference and results in general image degradation.

Spectral broadening is a display phenomenon that occurs when the number of energy-bearing Fourier frequency components increases at any given point in time. As a consequence, the spectral display is broadened. Spectral broadening can indicate the disturbed flow caused by a lesion, and therefore it is important diagnostically. However, broadening can also result from interaction between flow and sample volume size, in which case it is an artifact.

Speed of sound artifacts occur if the sound propagation path to a reflector is partially through bone, and the speed of sound is greater than in the average soft tissue. Echo position registration artifacts will be produced. Reflectors appear closer to the transducer than their actual distance because of this greater speed of sound, resulting in a shorter echo transit time than for paths not containing bone.

Acoustic Artifacts in 3D Imaging

Acquisition, rendering, and editing artifacts are specific to 3D volume images. Acquisition artifacts are related to patient motion, organ motion, or position-sensing errors. Rendering artifacts include elimination of structures by limiting the region of interest boundaries,

thresholding that eliminates structures, and adjacent structure artifacts that add additional information or hide structures. Editing artifacts result from data deleted from a rendered image.

Color and Color Power Angio artifacts relating to gain may also be confusing in rendered images. A color flash artifact can occur when the gain is set high and the transducer or patient moves. When the gain is set too high, the color ROI box fills with color flash. When the gain is set low, color bleed can occur. When the gain is set too low, insufficient color data renders the image undiagnosable.

Color gain, directional, and motion artifacts can present themselves in 3D imaging. Color and Color Power Angio gain artifacts are mainly related to the use of excessive gain resulting in random color patterns in the 3D image that might be interpreted as diagnostically significant. Directional artifacts are due to aliasing or directional confusion: The velocity range must be set properly, and the relationship between the transducer orientation and the flow vector must be understood. Patient motion can produce flash artifacts that are less obvious in 3D images than in 2D imaging.

Dropout and shadowing are present in 3D imaging although they are more difficult to recognize due to different and unfamiliar displays. Acoustic shadowing and other artifacts look very different when displayed in 3D volumes and may be more difficult to recognize than on standard 2D imaging. Those artifacts may produce apparent defects, such as limb abnormalities or facial clefts, where they are not present. Acquiring data from multiple orientations may avoid artifacts of this type.

Fetal limb deficit artifacts are specific to 3D volume images. Partially absent fetal limb bones have been demonstrated. One explanation for the missing limbs was shadowing caused by adjacent skeletal structures. Overcoming the limb deficit artifact can be accomplished by changing the transducer position and the acquisition plane.

Motion artifacts in 3D volumes can be caused by patient motion, fetal movement, cardiac motion, and movement of adjacent structures. Patient motion can produce flash artifacts that are more obvious in 3D images than in 2D imaging.

Pseudocleaving and pseudonarrowing artifacts may be related to limb deficit artifacts. Artifacts may be present in 3D imaging of the fetal face. Being aware of pseudocleaving of the fetal face and pseudonarrowing of the fetal spine can help the sonographer understand and identify these artifacts. As with 2D imaging, it is important to verify putative physical defects by using additional images and other modalities.

Resolution, attenuation, and propagation artifacts are all common to 3D imaging. Careful scrutiny of the original 2D images is necessary to identify and preclude these types of artifacts from the 3D volume image.

Transducer Covers

To prevent contamination by blood-borne pathogens, sterile transducer covers are required for intraoperative and biopsy procedures; in China, sterile covers are also required for transrectal, intravaginal, and transesophageal procedures. Protective covers are recommended for transrectal, intravaginal, and transesophageal procedures; the protective covers are mandatory in China and Japan. Philips recommends the use of qualified covers.

For procedures for using transducer covers, see the instructions provided with the covers.



WARNING

Latex and talc are commonly used in sheaths marketed to help with infection control in transesophageal, endocavity, and intraoperative imaging applications and during biopsies. Examine the packaging to confirm latex and talc content. Studies have shown that patients can experience allergic reactions with natural rubber latex. See the FDA Medical Alert, March 29, 1991, reprinted in “[FDA Medical Alert on Latex](#)” on page 49.



WARNING

In intraoperative applications, sterilized transducers should be used with sterile gel and a sterile transducer cover.



WARNING

Do not apply the transducer cover until you are ready to perform the procedure.



WARNING

Inspect transducer covers before and after use.

**WARNING**

If the sterile transducer cover becomes compromised during an intraoperative application involving a patient with Creutzfeldt-Jakob disease, follow the recommendations described in “[Transmissible Spongiform Encephalopathy](#)” on page 257.

**WARNING**

Transducer covers are disposable and must not be reused.

**WARNING**

If an installed transducer cover is cut or contaminated before use, the probe should be cleaned and disinfected or sterilized, and a new sterile cover installed.

Ultrasound Transmission Gels

For proper transmission of the acoustic beam, use the ultrasound transmission gel supplied by or recommended by Philips, or another glycol-, glycerol-, or water-based acoustic coupling medium. Products that do not contain mineral oil are acceptable for use. Never use lotion-based products.

**WARNING**

Do not apply the transducer gel until you are ready to perform the procedure. Transducers should not be left soaking in gel.

**WARNING**

For intraoperative applications, use only the Sterile Aquasonic or Sterile Ultraphonic gel provided with the transducer cover.

**CAUTION**

Do not use gels that contain mineral oil or lotion. Such products may damage the transducer and void the warranty.

**CAUTION**

Gels listed here are recommended because of their chemical compatibility with product materials.

Some recommended gels include:

- Aquasonic 100
- Aquasonic Clear
- Carbogel-ULT
- ECG Gel (Nicom)
- Nemidon Gel
- Scan

For additional compatibility information, call Philips at 800-722-9377 (North America) or your local Philips Ultrasound representative (outside North America).

Transducer Storage

Use the appropriate guidelines for storing transducers for transport, and daily and long-term storage.

Storage for Transport

If a carrying case is provided with your transducer, always use the carrying case to transport the transducer from one site to another. Follow these guidelines to properly store transducers for transport:

- Make sure that the transducer is clean and disinfected before placing it in the case to avoid contaminating the foam that lines the carrying case.
- Place the transducer in the case carefully to prevent kinking of the cable.
- Before closing the lid, make sure no part of the transducer is protruding from the case.
- Wrap the case in plastic material containing air pockets (such as Bubble Wrap material), and pack the wrapped case in a cardboard carton.
- To avoid damaging the shaft or steering mechanism of TEE transducers, do not bend or coil the flexible shaft of the transducer in less than a 0.30-m (1-ft) diameter circle.

Daily and Long-Term Storage

Follow these guidelines to protect your transducer:

- Always store transducers in the transducer holders on the side of your system or on a securely mounted wall rack when you are not using them.
- Ensure the transducer holders are clean before storing transducers (see “[Disinfecting System Surfaces](#)” on page 290).
- Avoid storing transducers in areas of temperature extremes or in direct sunlight.
- Store transducers separately from other instruments to avoid inadvertent transducer damage.
- When storing transducers, use the cable-management clips to secure the transducer cable.
- Before storing transducers, make sure they are thoroughly dry.
- For TEE transducers, be sure the distal tip is straight and protected before storing the transducer.
- Never store a TEE transducer in the carrying case, except to transport it.

9 Intraoperative Transducers

An intraoperative transducer is used during surgery to help the surgeon locate and visualize anatomical structures, to visualize blood flow patterns and quantify velocities, and to image and measure anatomical and physiological parameters of interest to the surgeon.

The system supports the L15-7io transducer for use in intraoperative applications.



WARNING

All intraoperative transducers are designed to be defibrillator safe in accordance with IEC 60601-1. Nevertheless, always remove the transducer from the patient before defibrillation.

NOTE

Intraoperative transducers will be unavailable in the US and Canada until regulatory clearance is received.

Operators of Intraoperative Transducers

Philips intraoperative transducers are designed to be used under the guidance of physicians who are properly trained in intraoperative ultrasound imaging techniques according to currently approved relevant medical practices. Philips recommends that physicians operating any Philips intraoperative transducer have the following qualifications:

- Proficiency in recognizing and interpreting imaging patterns.
- Thorough familiarity with the safe operation, care, and maintenance of the ultrasound system and the intraoperative transducers.
- Thorough familiarity with the latest intraoperative methods through literature and seminars.

Intended Uses for Intraoperative Transducers

Intraoperative studies are performed by surgeons, anesthesiologists, or sonographers to obtain images that can be used for the following purposes:

- Helping a surgeon locate and visualize anatomical structures before, during, or after a surgical procedure
- Helping a surgeon visualize blood flow patterns and quantify velocities before, during, or after a surgical procedure
- Imaging and measuring anatomic and physiologic parameters before, during, or after a surgical procedure



WARNING

Intraoperative transducers used in animal studies should not be used on humans. Transducer disinfection procedures for cross-usage between animals and humans have not been validated.

Patient Safety During Intraoperative Studies

To operate an intraoperative transducer, you must be under the guidance of a physician who is properly trained in intraoperative ultrasound imaging techniques, according to currently approved relevant medical practices. You also must be thoroughly familiar with the safe operation, care, and maintenance of the ultrasound system used with the transducer, as well as proficient at interpreting the images generated.

To help ensure patient safety when using an intraoperative transducer, observe the following guidelines:

- Scrutinize the entire transducer before each use. (See the “[Transducer Care](#)” section.)
- Use mandatory protective equipment, including an approved sterile protective transducer cover, during intraoperative studies. For information about using transducer covers, see “[Preparing Transducers for Intraoperative Use](#)” on page 191.
- Operate the transducer properly.

- Do not allow water or other liquids to drip onto the transducer connector, the interior of the system, or the keyboard.
- Maintain a sterile field.

**WARNING**

All intraoperative studies must be performed with a Type CF classified transducer. If your transducer is not labeled Type CF on the transducer connector, contact your Philips service representative.

**WARNING**

Be sure to use a market-approved sterile transducer cover and sterile ultrasound transmission gel when performing all intraoperative studies.

**WARNING**

Always remove the transducer from the patient before defibrillation.

Patient-Contact Parts

Latex is commonly used in sheaths marketed to help with infection control in transesophageal, endocavity, and intraoperative imaging applications and during biopsies. Examine the packaging to confirm latex content. Studies have shown that patients can experience allergic reactions with natural rubber latex. See “[FDA Medical Alert on Latex](#)” on page 49.

NOTE

The ultrasound system and transducers discussed here do not contain natural rubber latex that contacts humans. Natural rubber latex is not used on any Philips ultrasound transducers.

Preventing Intraoperative Transducer Problems



WARNING

If you find any signs of damage to the transducer, patient safety may be compromised. Do not use the transducer, and contact your Philips service representative.

Meticulous inspection and correct and careful operation of intraoperative transducers are imperative to patient safety. The situations listed here affect safe operation as well as the ability to service mechanical problems under the Philips warranty or service contract.

Transducer repairs necessitated by misuse are not covered and can be very costly, often requiring complete disassembly and rebuilding of the transducer.

There are three primary areas of transducer misuse:

- Cuts and abrasions on the transducer insulation and lens from sharp instruments such as scalpels, scissors, and clamps
- Improper disinfection techniques, causing fluid to enter the transducer or damage transducer materials
- Damage caused by dropping the transducer on a hard surface

To minimize the chance of damage, Philips strongly recommends that you clearly post stringent protocols for the care of intraoperative transducers, based on the information provided here.

L15-7io Description

The L15-7io transducer is described here. For more information on connecting, activating, caring for, and maintaining transducers, see the “[Transducers](#)” and “[Transducer Care](#)” sections.



L15-7io Transducer

NOTE

This transducer is available only in countries or regions where it is approved. For information specific to your region, contact your local Philips representative.

L15-7io Transducer Features and Specifications

Features	Linear array designed for mid- to high-frequency superficial imaging and high-resolution intraoperative vascular applications. Supports 2D, PW Doppler, Color Doppler, Color Power Angio imaging, and XRES processing. Used for evaluating blood vessels, musculoskeletal exams, small parts (breast, testicles, thyroid) imaging, and epicardiac imaging. <ul style="list-style-type: none">• Phased linear array with 128 elements• 8 degrees of trapezoidal imaging, 23 mm (0.9 in) effective aperture length
Frequency	Operating range: 15 to 7 MHz
Biopsy Capable	No
Specifications	<ul style="list-style-type: none">• Lens footprint: elevation, 10 mm (0.4 in); scan plane, 32 mm (1.25 in)• Transducer length: 89 mm (3.5 in)• Cable length: 2 m (80 in)

Preparing Transducers for Intraoperative Use

1. Place 20 cc of sterile gel or saline into the transducer cover.

2. Carefully inspect each transducer cover before use, and discard it if you find tears or blemishes. Also inspect each transducer cover after use. If you find a tear, the patient or the transducer may have been contaminated.
3. Insert the transducer into the transducer cover and unfurl the transducer cover until it covers the transducer and its cable. The cover must be unfurled far enough to maintain the sterile field.
4. Use a sterile elastic band or clip to hold the proximal end of the transducer cover in place.
5. Ensure that wrinkles and bubbles over the face of the transducer are minimized. Check the transducer cover for tears or damage before proceeding.
6. When operating the transducer, make sure that proper orientation is maintained to avoid interpretation confusion.

NOTE

To achieve good acoustic contact, make sure that the imaging surface is moist.

NOTE

Imaging improves with adequate coupling between the patient surface and the transducer-cover surface. Sterile water is a good acoustic-coupling agent during surgery.

Disposable Drapes

During studies in which you believe contamination of the ultrasound system can occur, Philips recommends that you take universal precautions and cover the system with a disposable drape. Consult your hospital's rules regarding equipment use in the presence of infectious disease.

Accessories for Intraoperative Transducers

For information on ordering accessories, see [“Supplies and Accessories” on page 21](#).

Electrical Safety and Intraoperative Transducers

All Philips ultrasound systems and transducers comply with common medical device electrical safety standards.

Intraoperative transducers are classified as a Type CF  isolated patient-applied part, as described in IEC 60601-1. There are no exposed conductive surfaces on the transducer head. To ensure safe operation of this transducer, read the cautions and warnings in the “Safety” section, especially those that address electrosurgical units, pacemakers, and defibrillators.

Leakage Current Testing for Intraoperative Transducers

Philips transducers approved for intraoperative use are labeled on the transducer connector as Type CF  in accordance with the IEC 60601-1. Type CF classification indicates that the degree of protection from electrical shock afforded by the transducer is suitable for all patient applications, including direct cardiac and intraoperative applications.

Leakage current tests should be performed by a technically qualified person any time that the transducer is dropped or if cracks or cuts are found on the transducer.

Normal leakage current testing frequency should be based on the procedures established by the hospital for operating-room-based equipment.

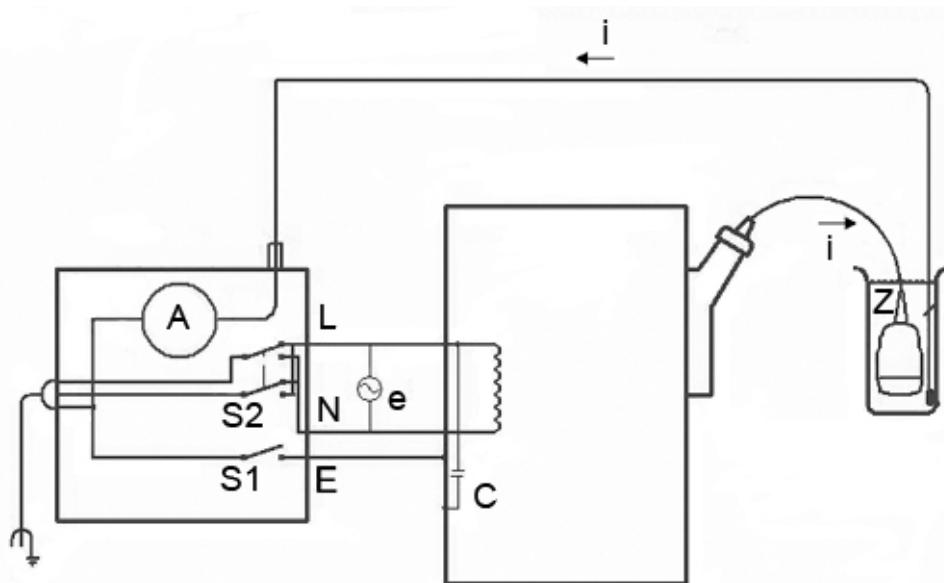
Regularly perform the electrical safety check to ensure that IEC 60601-1 Type CF leakage limits are not exceeded. You can perform this procedure with any commercially available safety analyzer that is designed for hospital use.



WARNING

Only a technically qualified person should perform the leakage current test procedure.

Test 1 tests the current leakage, using a Dynatech Nevada 232 Safety/ECG Analyzer. This procedure shows one example of a current leakage test (source and sink). The procedure for your safety analyzer may be very different.

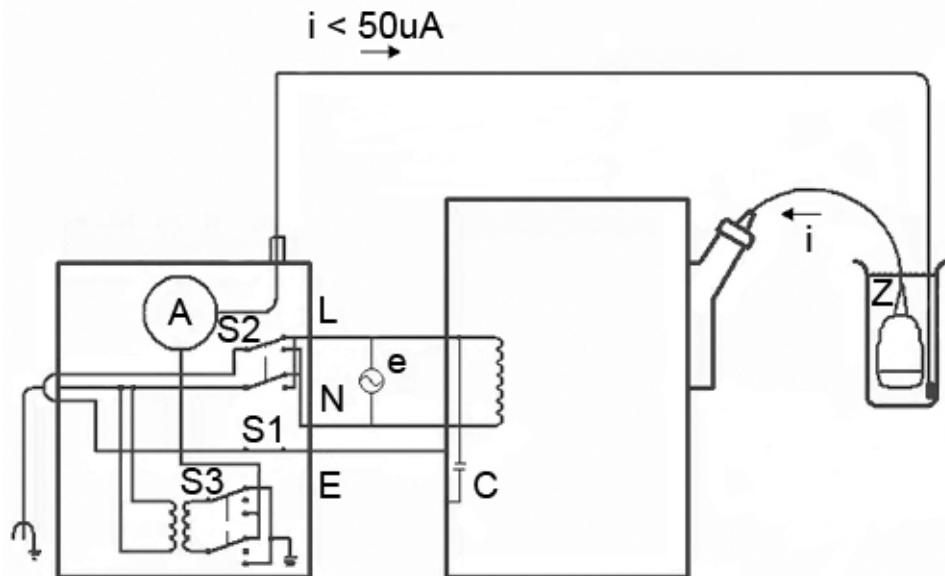


Test 1: Leakage Current Test with Mains Voltage Applied (Source) for Intraoperative Transducers

Key to Source Test Diagram

- C Stray capacitance from the ultrasound system power wiring to the system grounded metal chassis (1 to 3 MΩ reactance)
- Z Impedance between the metal parts of the transducer and a test electrode placed in the bucket of saline solution (about 850 kΩ with an intact outer insulating layer, 500 Ω with a hole in the layer)
- A Microammeter to measure leakage current from the transducer to the earth lift ground through Z to the test electrode
- e Line power source, either 110 Vac or 220 Vac
- I Current caused by e and stray capacitance, and optionally Z
- S1 Open earth lift ground switch
- S2 Line polarity switch

- L Line mains supply
 N Neutral mains supply
 E Earth ground



Test 2: Leakage Current Test with Mains Voltage Applied (Sink) for Intraoperative Transducers

Key to Test 2 Diagram

- C Stray capacitance from the ultrasound system power wiring to the system grounded metal chassis (1 to 3 MΩ reactance)
 Z Impedance between the metal parts of the transducer and a test electrode placed in the bucket of saline solution (about 850 kΩ with an intact outer insulating layer, 500 Ω with a hole in the layer)
 A Microammeter to measure leakage current from a line supply to the transducer and back to earth ground through electrode Z and the equipment chassis
 e Line power source, either 110 Vac or 220 Vac

I	Current caused by e and stray capacitance, and optionally Z
S1	Open earth lift ground switch
S2	Line polarity switch
S3	Isolation test button
L	Line mains supply
N	Neutral mains supply
E	Earth ground

Testing Intraoperative Transducer Leakage Current (Source)

This test checks leakage current without mains voltage applied. For a diagram of this test, Test 1, see “[Leakage Current Testing for Intraoperative Transducers](#)” on page 193.



WARNING

Electrical shock hazard: Do not touch the lead that you connect to the safety analyzer in step 7.

1. Plug the safety analyzer into the power source.
2. Plug the ultrasound system into the safety analyzer.
3. Connect the transducer being tested to the ultrasound system.
4. Immerse 5 cm (2 in) of the transducer in saline solution.
5. Set the safety analyzer **Mode** switch to the **ECG** position.
6. Set the safety analyzer **Leads** switch to the **ALL** (all ECG leads) position.
7. Connect a lead to any ECG terminal on the safety analyzer, and immerse the other end into the saline solution.
8. Set the safety analyzer **Line Polarity** switch to **Normal**.
9. Note the normal condition leakage reading.
10. Hold the safety analyzer **Ground Open** switch in the **Open** position (single fault condition), and note the leakage reading.
11. Repeat step 9 and step 10 with the **Polarity** switch in the **Reverse** position. These are the applicable limits:

- 10 µA RMS (normal condition)
- 50 µA RMS (single fault condition)

Testing Intraoperative Transducer Leakage Current (Sink)



WARNING

There is considerable hazard in performing this test. Use precautionary measures to avoid accidental contact with line voltage. In addition, any time that the ground connection has been opened, do not touch the chassis or the patient cable during the test.

This test checks leakage current with mains voltage applied. For a diagram of this test, Test 2, see “[Leakage Current Testing for Intraoperative Transducers](#)” on page 193.

1. Plug the safety analyzer into the power source.
2. Plug the ultrasound system into the safety analyzer.
3. Connect the transducer being tested to the ultrasound system.
4. Immerse 5 cm (2 in) of the transducer in saline solution.
5. Set the safety analyzer **Mode** switch to the **ECG** position.
6. Set the safety analyzer **Leads** switch to the **Isolation Test** position.
7. Connect a lead to any ECG terminal on the safety analyzer. Leave the other end of the lead disconnected for now.
8. Press and hold the **Isolation Test** button and note the leakage reading. This is the correction factor that will be subtracted from the final reading.
9. Immerse the other end of the lead into the saline solution.
10. Press and hold the Isolation Test button and take the leakage reading again.
11. Subtract the correction factor found in step 8 to get the accurate leakage measurement.

The leakage must be less than 50 µA RMS.

10 Transesophageal Transducers

A transesophageal echocardiography (TEE) study is performed with a transducer mounted in a gastroscope, which is positioned in the esophagus or stomach. TEE transducers offer images that are unobstructed by lungs and ribs, making them important diagnostic tools for conditions that transthoracic echocardiography cannot adequately image.

All transesophageal transducers are rated minimum IPX1 (control area) and IPX7 (endoscope area) in accordance with IEC 60529.

The system supports the compact X7-2t and S7-3t TEE transducers. The imaging array in the X7-2t and the S7-3t transducers can be rotated electronically using controls on the transducer or on the control panel.



WARNING

All TEE transducers are designed to be defibrillator safe in accordance with IEC 60601-1.
Nevertheless, always remove the transducer from the patient before defibrillation.

Operators of TEE Transducers

Philips TEE transducers are designed for use under the guidance of physicians who are properly trained in esophagogastrosopic techniques, according to currently approved relevant medical practices. Philips recommends that physicians operating any Philips TEE transducer have the following qualifications:

- Proficiency in recognizing and interpreting transesophageal imaging patterns
- Thorough familiarity with the safe operation, care, and maintenance of the ultrasound system and TEE transducers
- Thorough familiarity with the latest TEE methods through literature and seminars

Patient Safety During TEE Studies

Philips recommends that you practice using the TEE transducer controls before performing any procedure mentioned here. You must also be thoroughly familiar with the safe operation, care, and maintenance of the ultrasound imaging system used with the TEE transducer, as well as proficient at interpreting the images generated.

You can help ensure patient safety when using a TEE transducer by following these guidelines:

- Have a backup system present during TEE exams to ensure completion of the exam in the event that the primary system fails.
- Use informed judgment when selecting patients for TEE studies. See "[Patient Selection for TEE Transducer Use](#)" on page 224.
- Verbally prepare each patient for the procedure before the study. See "Preparing Patients for TEE Studies" in the Help.
- Scrutinize the entire transducer, turn on the system, and test all of the transducer controls and related system controls, before inserting the TEE transducer into the patient's esophagus. See "[Checking the TEE Transducer](#)" on page 223.
- Insert, remove, and operate the transducer properly.
- Ensure that the transducer handle does not rest on or touch the patient.
- Use protective equipment, such as a bite guard and a market-approved sterile transducer cover during a TEE study. See "[TEE Accessories and Supplies](#)" on page 233.
- Do not allow water or other liquids to come in contact with the interior of the system, the interior of the transducer connector, the inside of the transducer control handle, or to drip onto the keyboard.
- Minimize the possibility of transducer tip fold-over. This problem has occurred rarely, but its consequences can be serious. See "[Tip Fold-Over](#)" on page 226.

To prevent tissue damage such as pressure necrosis, gastroesophageal lacerations, bleeding, tearing of adhesions, ligament damage, and perforation, observe the following warnings and cautions.



WARNING

Never apply excessive force when inserting or withdrawing a TEE transducer, or when operating the transducer deflection controls.

**WARNING**

Do not allow the transducer to remain at a maximum deflection for long periods of time.

**WARNING**

Lock medial/lateral movement of the TEE transducer during insertion.

**WARNING**

Whenever the TEE transducer is not being used during a procedure, ensure that it is in freewheeling mode and unplugged from the system.

**WARNING**

To prevent tissue damage, Philips recommends that the tip of the TEE transducer be straightened and both detent brakes released before you reposition the transducer or withdraw the transducer from the patient. In the neutral position, the tip is straight when the indicators on the control wheels are aligned and point toward the center of the array rotation button.

**WARNING**

Bite guards are mandatory; protective transducer covers are recommended for TEE transducers, but in China and Japan, the covers are mandatory. See “[Electrical Safety and TEE Transducers](#)” on page 205.

**CAUTION**

To avoid damaging gastroscope cables, be sure that the distal tip of the transducer is in the neutral (straight) position when inserting a transducer into, or removing it from, the transducer cover.

The TEE transducers are classified as Type BF isolated patient-applied parts, as described in IEC 60601-1. There are no exposed conductive surfaces distal to the transducer handle. To ensure safe operation of this transducer, read the cautions and warnings in the “[Safety](#)” section, especially those that address electrosurgical units, pacemakers, and defibrillators.

The following table summarizes patient safety problems, describes how to prevent them, and lists the sections in this manual where details are provided.



WARNING

If you encounter an irregularity not listed in the following table, do not use the transducer. Potentially serious consequences could result. Contact your Philips representative.

Ensuring Patient Safety During TEE Studies

Problem	Effect on Patient	Prevention	See
Mechanical damage	Severe trauma, cuts, bleeding, perforations	Inspect the transducer, using both sight and touch, before the study.	“ Checking the TEE Transducer ” on page 223
Electrical damage	Esophageal burns	Check the transducer for frayed insulation, kinks, or other abnormalities. Follow procedures for checking electrical safety.	“ Electrical Safety and TEE Transducers ” on page 205
Biting, scraping transducer	Tooth damage, esophageal burns	Always use a bite guard.	“ Bite Guards ” on page 233
Insufficient cleaning protocol	Spread of illness or disease	Thoroughly clean and disinfect the transducer after each use. Cover the tip and shaft with a transducer cover. Cover the imaging system with a disposable drape if highly pathogenic organisms are known or suspected.	“ Transducer Care ” section

Problem	Effect on Patient	Prevention	See
Improper insertion or withdrawal	Esophageal cuts, bleeding, ligament damage, perforations	To prevent improper insertion or withdrawal when using a TEE transducer, never use force when inserting, removing, or manipulating the transducer. During insertion, lock the medial/lateral controls. During withdrawal, release both brakes to place both steering knobs in the freewheeling position.	"TEE Study Guidelines" on page 225
Pressure necrosis	Death of esophageal lining tissue	Keep deflection controls in freewheeling mode and unplug the transducer from the system when not imaging. Minimize the pressure applied to deflection area and distal tip. Do not let the distal tip displace a tissue area for more than 5 consecutive minutes.	"TEE Study Guidelines" on page 225
Increased transducer temperature	Esophageal burns	Use the TEE preset that has been established to minimize the effects of temperature. For febrile patients, use the Auto-Cool feature.	"Entering Patient Temperature" on page 231
Improper patient position	Transient unilateral vocal cord paralysis	Never use the transducer during any procedure requiring extreme neck flexion, such as sitting craniotomies.	"TEE Study Guidelines" on page 225
Nonisolated ESUs	Electrical burns	Only use isolated-output electrosurgical units (ESUs). The ESU label or service guide or your biomedical department should identify whether or not the ESU is isolated. Unplug transducer from the system when you are not imaging.	"Electrical Safety and TEE Transducers" on page 205
Defibrillation issues	Electrical burns	Remove the transducer from the patient before defibrillation.	"Electrical Safety and TEE Transducers" on page 205

Patient-Contact Parts

Latex is commonly used in sheaths marketed to help with infection control in transesophageal, endocavity, and intraoperative imaging applications and during biopsies. Examine the packaging to confirm latex content. Studies have shown that patients can experience allergic reactions with natural rubber latex. See “[FDA Medical Alert on Latex](#)” on page 49.

NOTE

The ultrasound system and transducers discussed here do not contain natural rubber latex that contacts humans. Natural rubber latex is not used on any Philips ultrasound transducers.

Preventing TEE Transducer Problems

Meticulous inspection and correct and careful operation of the TEE (transesophageal) transducer is imperative to patient safety. The situations listed here affect safe operation as well as the ability to service mechanical problems under the Philips one-year warranty or service contract. Transducer repairs necessitated by misuse of the transducer are not covered and can be very costly, often requiring complete disassembly and rebuilding of the transducer.

There are three primary areas of transducer misuse:

- Cuts and abrasions on the transducer and insulation from teeth or sharp instruments such as scalpels, scissors, and clamps
- Improper disinfection techniques, including allowing fluid to enter the connector or transducer handle and the use of unapproved disinfectants
- Consistently applying too much force to the control wheels of a TEE transducer, which can break the steering mechanism

Review the following table to familiarize yourself with specific problems, to learn how to avoid them, and to identify the sections in this manual where details are provided. Philips also strongly recommends that you clearly post stringent protocols for TEE transducer care, based on the information in this manual, to minimize the chance of damage.

**WARNING**

**For any other irregularity not listed in the following table, do not use the transducer.
Potentially serious consequences could result. Contact your Philips representative.**

Preventing TEE Transducer Equipment Problems

Problem	Effect on Equipment	Prevention	See
Current leakage	Serious electrical hazards	Check the transducer for cuts, frayed insulation, kinks, or other abnormalities.	“Checking the TEE Transducer” on page 223
Biting transducer	Mechanical and electrical hazards	Cover the patient's teeth with a bite guard (mandatory). Cover the distal tip and flexible shaft with a transducer cover (recommended, but in China and Japan, mandatory).	“Bite Guards” on page 233
Forcing deflection controls	Steering mechanism broken	Operate the deflection controls gently.	“X7-2t Deflection Controls” on page 211 and “S7-3t TEE Controls” on page 218
Incorrect storage	Possible damage to highly sensitive elements, cuts in flexible shaft	Suspend the transducer from a wall-mounted rack and the distal tip with a tip protector when not in use.	“Transducer Storage” on page 185
Internal exposure to liquids	Severe transducer damage that affects the image quality, the steering mechanism, and electrical safety	Never sterilize the transducer by using bleach, steam, heat, or ethylene oxide (EtO). Never immerse the steering mechanism in any disinfectant or liquid.	“Transducer Care” section

Electrical Safety and TEE Transducers

The ultrasound system and its transducers comply with common medical device electrical safety standards.

For electrical safety information about TEE transducers, see [“Leakage Current and TEE Transducers” on page 206](#) and [“Reducing Risks of Using TEE Transducers” on page 206](#).

For safety information on electrosurgical units, pacemakers, defibrillators, and related topics, see “[Electrical Safety](#)” on page 29.

Leakage Current and TEE Transducers

For the TEE transducers discussed in this document, the insertion tube and tip are Type BF , as described in IEC 60601-1. There are no exposed conductive surfaces distal to the transducer handle. Within the flexible shaft, all active circuits and conductors are surrounded by a chassis-grounded shield that runs the length of the transducer.

If the outer layer of the shaft is punctured or cracked, a patient’s esophagus could be exposed to chassis leakage current. This leakage current is not hazardous provided that the ground connector (third wire) in the ultrasound system power cable is intact and connected to a properly grounded wall outlet. Even if the ground connector breaks, leakage current is in compliance with the limits noted in IEC 60601-1.

Leakage hazards are further reduced when the ultrasound system is plugged into an isolated power outlet, which is standard in most operating rooms.

Reducing Risks of Using TEE Transducers



WARNING

Before defibrillation, if you cannot remove the transducer from the patient, always disconnect invasive transducers that remain in contact with the patient from the system.

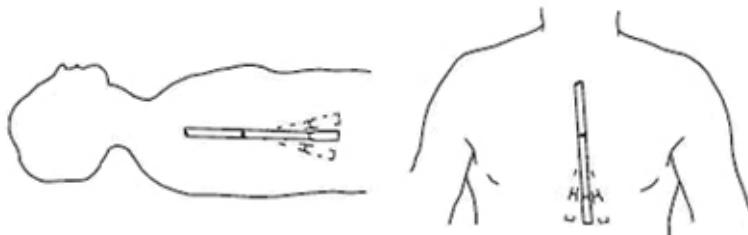
To reduce the possibility of electrical risks associated with use of TEE transducers, follow these recommendations:

- Visually and tactually inspect a TEE transducer for bumps, cracks, and cuts before each TEE exam. A small bump on the shaft surface could indicate that a strand from the ground shield has broken and is beginning to puncture the outer layer. If you suspect a problem with the flexible shaft, perform the electrical safety check procedure. See “[TEE Leakage Current Test](#)” on page 234.
- Use electrosurgical units (ESUs) that have isolated outputs. Return fault/ground fault detection circuits provide additional protection. To determine if an ESU has an isolated output, read the label on the ESU, see the ESU service guide, or ask a biomedical engineer.

- Require periodic electrical safety checks to ensure that the grounding system in your area remains intact.
- If the transducer is left in a patient during periods when imaging is not taking place, unplug the transducer from the system to reduce the possibility of leakage current or ESU interaction. Also make sure that the deflection control brakes are off and that the transducer is in freewheeling mode.
- Always remove the transducer from the patient before defibrillation.

TEE Deflection Control Basics

The deflection controls on the TEE transducer move the deflection area, located between the distal tip and flexible shaft. The deflection area bends when you operate the controls, permitting anterior, posterior, and lateral positioning.



Deflection Control Movement

To prevent tissue damage such as pressure necrosis, gastroesophageal lacerations, bleeding, tearing of adhesions, ligament damage, and perforation, observe the following warnings. See “[TEE Transducer References](#)” on page 238.



WARNING

Never apply excessive force when inserting or withdrawing a TEE transducer, or when operating the transducer deflection controls.



WARNING

Lock medial/lateral movement of the TEE transducer during insertion.

**WARNING**

Whenever the TEE transducer is not being used during a procedure, ensure that it is in freewheeling mode and unplugged from the system.

**WARNING**

Do not allow the TEE transducer to remain at a maximum deflection for long periods of time.

**WARNING**

To prevent tissue damage, Philips recommends that the tip of the TEE transducer be straightened and both detent brakes released before you reposition the transducer or withdraw the transducer from the patient. In the neutral position, the tip is straight when the indicators on the control wheels are aligned and point toward the center of the array rotation button.

**WARNING**

Bite guards are mandatory; protective covers are recommended for TEE transducers, except in China and Japan, where protective transducer covers are mandatory for TEE transducers.

**WARNING**

To avoid damaging gastroscope cables, be sure that the distal tip of the transducer is in the neutral (straight) position when inserting a transducer into, or removing it from, the transducer cover.

X7-2t TEE Transducer Description



X7-2t TEE Transducer

X7-2t TEE Transducer Features and Specifications

Features	PureWave technology sensor enables high-resolution imaging and 360-degree views of the heart, unobstructed by lungs and ribs. Capable of 2D, 3D, Harmonic imaging, Live 3D, xPlane imaging, color Flow, steerable CW Doppler mode, and PW Doppler mode, frequency agility, and electrocautery suppression. Tip surface constantly monitored for patient safety. Convenient hanging ring.
Specifications	<ul style="list-style-type: none">Tip: 1.5 cm (0.6 in) wide, 3.5 cm (1.4 in) longShaft: 1.0 cm (0.4 in) wide, 1.0 m(3.3 ft) long

NOTE

Philips recommends that you use the X7-2t transducer only on patients weighing at least 30 kg (66 lb), to ensure that the esophagus can comfortably accommodate the transducer.

Using the X7-2t TEE Transducer

Philips recommends familiarizing yourself with the controls and parts of the TEE transducer before using it in a study.

TEE Transducer Components

Component	Description
 A close-up photograph of the distal tip of the transducer, showing a black, rounded probe tip with a small rectangular sensor element attached to its side.	Distal tip
 A photograph of the transducer connector, which is a grey, rectangular plastic component with a cable attached to one side.	Transducer connector

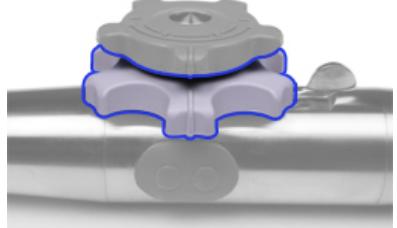
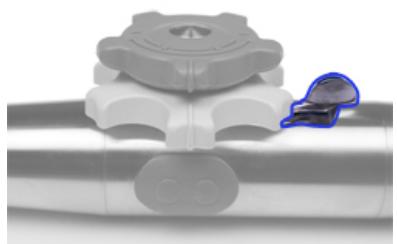
Component	Description
 A photograph showing the top view of the transducer handle. It features a grey, multi-directional deflection control knob mounted on a silver cylindrical handle.	Transducer handle
 A close-up photograph focusing on the deflection controls. It shows the large grey knob and the smaller grey knob, both mounted on the handle. A small circular button is visible on the handle body below the knobs.	Deflection controls

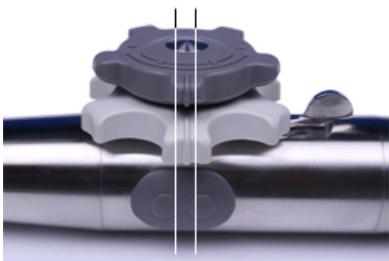
X7-2t Deflection Controls

The smaller knob controls medial/lateral movement, while the larger knob controls anterior/posterior movement. To place the tip of the TEE transducer into the neutral position, align the ribs on each knob with the center of the array rotation buttons (as shown below).

The knobs can be controlled by a detent brake that holds the tip position without locking it in place. This allows the tip to straighten if it meets additional resistance. When the detent brake actuator is rotated to the right (as shown) both knobs are in the freewheeling mode. When the detent brake actuator is centered, the small knob (medial/lateral movement) is in the detent mode, and when the actuator is rotated to the left, both knobs are in the detent mode.

X7-2t Transducer Controls

Control	Description
	Medial/lateral control
	Anterior/posterior control
	Detent brake actuator

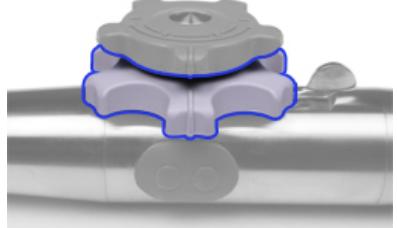
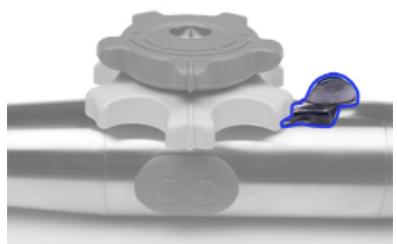
Control	Description
	Image plane rotation buttons
	Neutral position indicators, showing no deflection

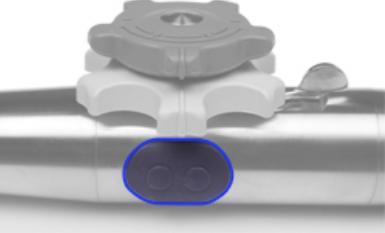
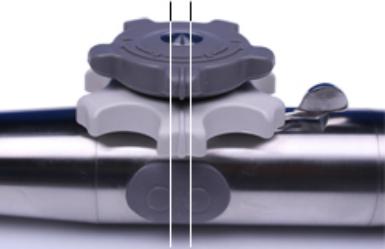
Manipulating the X7-2t Tip

Review the warnings and caution in “[Patient Safety During TEE Studies](#)” on page 200 and “[TEE Deflection Control Basics](#)” on page 207 before using the transducer in a study.

1. Turn the detent brake actuator fully away from the image plane rotation buttons to put both knobs into freewheeling mode.
2. Turn the large knob to deflect the tip in the anterior/posterior plane.
3. Turn the small knob to deflect the tip in the medial/lateral plane.
4. When the tip is positioned properly, do one of the following:
 - Turn the detent brake actuator fully toward the image plane rotation buttons to put both knobs in detent mode.
 - Center the detent brake actuator to put only the small knob (medial/lateral movement) in the detent mode.

X7-2t Transducer Controls

Control	Description
	Medial/lateral control
	Anterior/posterior control
	Detent brake actuator

Control	Description
	Image plane rotation buttons
	Neutral position indicators, showing no deflection

Rotating the X7-2t Image Plane

You can rotate the image plane on the X7-2t TEE transducer to achieve a 360-degree view of the heart. Rotation stops when you release either button.

The current degree of rotation appears in either the upper or lower part of the display, depending on image orientation. Because the center of the image array is the pivot point, you can achieve a 360-degree view.

- To rotate the X7-2t transducer image plane, do either of the following:
 - To rotate the imaging plane toward the 180-degree position, press the image plane rotation button that is distal to the system.
 - To rotate the imaging plane toward the 0-degree position, press the button that is proximal to the system.
- To rotate the X7-2t transducer image plane using a system control, use the **Seek Angle** soft key.

S7-3t TEE Transducer Description



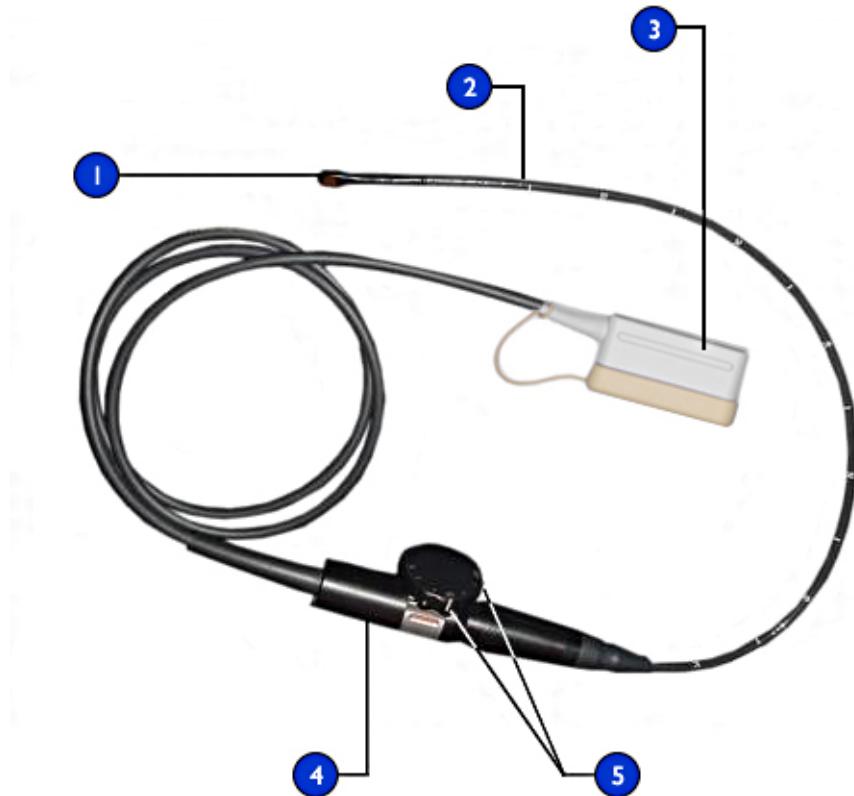
S7-3t TEE Transducer

S7-3t TEE Features and Specifications

Features	A small transducer that enables high-resolution imaging and 360-degree views of the heart, unobstructed by lungs and ribs. The array inside the tip can be rotated 180 degrees using a control on the handle of the transducer. Another control on the handle sets the deflection of the tip. This transducer is capable of color flow imaging, steerable CW and PW Doppler, and frequency agility. Tip surface temperature is constantly monitored for patient safety.
Specifications	Tip: 10.9 mm x 8.3 mm, 27 mm long (0.43 in x 0.33 in, 1.1 in long) Shaft: 7.5 mm diameter, 70 cm long (0.3 in diameter, 27.5 in long)

Using the S7-3t TEE Transducer

Philips recommends familiarizing yourself with the controls and parts of the TEE transducer before using it in an exam. For more information on transducer controls, see “[S7-3t TEE Controls](#)” on page 218.



S7-3t TEE Transducer Parts

- | | |
|---|----------------------|
| 1 | Distal tip |
| 2 | Flexible shaft |
| 3 | Transducer connector |

4	Transducer handle
5	Deflection and array controls

S7-3t TEE Controls

The transducer handle is designed for one-hand operation. Normally, you should operate the transducer handle with your left hand. The thumb, first, and second fingers control the deflection and the array rotation control wheels.

The smaller wheel on the transducer handle is for controlling the transducer tip deflection. This wheel has a locked mode and a freewheeling mode. In the locked mode, the movement of the deflection wheel is restrained to allow you to hold the tip in a certain position. A metallic ring around the body of the handle, which clicks on and off, controls the lock.

The larger wheel on top is for rotating the imaging array. The array can be rotated continuously from 0 degrees (transversal plane) through 90 degrees (longitudinal plane) to 180 degrees (transversal plane, left/right inverted).



WARNING

Verify that the maximum deflection of the tip is 120 degrees up and 90 degrees down. If the up/down deflection shows an unwanted amount of free play or exceeds the maximal deflection angles, do not use the transducer. Contact Philips to readjust the steering of the transducer. Ensuring proper deflection limits minimizes the risk of the tip folding over in the esophagus.



WARNING

To protect the patient and the transducer, straighten the tip of the transducer and unlock the deflection control when inserting or withdrawing the transducer. On the S7-3t, the tip is straight when the white line on the control wheel is aligned along the shaft of the transducer handle.

*S7-3t Controls*

1	90-degree rotation indicator
2	Array control
3	Deflection control
4	Deflection lock
5	Neutral position indicators (no deflection) Unlocked, freewheeling (white)
	Locked (red)

Manipulating the S7-3t TEE Tip

Review the warnings and caution in “[Patient Safety During TEE Studies](#)” on page 200 and “[TEE Deflection Control Basics](#)” on page 207 before using the transducer in a study.

1. Put the deflection control knob into freewheeling mode by sliding the deflection lock so that the indicator is white.
2. Do one of the following:
 - To deflect the tip toward the posterior, turn the smaller knob clockwise.
 - To deflect the tip toward the anterior, turn the smaller knob counterclockwise.
 - To set the tip in the neutral position (no deflection), turn the smaller knob so that its white bar is in line with the center of the proximal end of the transducer handle.
3. Once the tip is positioned properly, lock the deflection control knob by sliding the deflection lock so that the indicator is red.



Manipulating the S7-3t Transducer Tip

1 Deflection lock

2 Deflection control

S7-3t TEE Array Rotation

You can rotate the imaging array continuously from 0 degrees (transversal plane) through 90 degrees (longitudinal plane) to 180 degrees (transversal plane, left/right inverted). Because the transducer allows you to select all planes between 0 degrees and 180 degrees, you can scan a conical imaging volume.

An icon shows the current degree of rotation. Depending on image orientation, the icon appears in the upper or lower part of the display.

S7-3t Array Rotation



Short axis Angle = 0°



Long axis Angle = 90°



Short axis Angle = 180°

Rotating the S7-3t TEE Array



CAUTION

Do not use excessive force on the array rotation control wheel at its outer positions because this may damage the endoscope mechanism.

1. To rotate the imaging array, turn the array control (the larger wheel).
2. To rotate the array to 90 degrees, align the white bar on the side of the array control with the center of the proximal end of the transducer handle.
3. To rotate the array to a specific setting, align a setting on the top of the array control with the center of the proximal end of the transducer handle.



Rotating the S7-3t Imaging Array

1 Array control

2 Align settings on the control with the proximal end of the transducer handle (90° setting as shown).

Checking the TEE Transducer

Before each TEE exam, carefully inspect the transducer and try the controls, as described in the subordinate topics.

TEE Transducer Inspection

Carefully inspect the entire surface of the distal tip and flexible shaft for protrusions, holes, dents, abrasions, cuts, burrs, or cracks that could be extremely hazardous to both you and your patient.

Carefully feel the tip and shaft, and inspect the entire transducer. If you suspect an electrical problem, follow the electrical safety check procedure described in "Electrical Safety Check for TEE Transducers" in the "Transesophageal Transducers" section of the *User Manual*.

Also check for excessive flexibility in the tip, particularly in the medial/lateral direction. Do not use the transducer if the tip is extremely flexible. If you have any questions about tip flexibility, contact your Philips service representative.

TEE Transducer Controls Inspection

Use the deflection controls to position the tip in every possible direction, both to ensure that the controls work properly and to get used to the feel of the TEE transducer. Make sure that the controls operate smoothly without binding, and that you can achieve all possible positions easily before introducing the TEE transducer into the patient.

Test the detent brakes and freewheeling mode. Remember that the controls must be in freewheeling mode (no deflection and no brake resistance) when repositioning or withdrawing the transducer, as well as whenever you are not imaging. See "[Manipulating the X7-2t Tip](#)" on page 213 and "[Manipulating the S7-3t TEE Tip](#)" on page 220

Special Considerations for TEE Studies

Special considerations regarding TEE studies are advisable for patients with existing gastroesophageal abnormalities, such as esophageal varices, hiatal hernia, tumor, diverticula, esophageal webs and rings, fistulae, or peptic ulcers, as well as for patients who have had anti-reflux procedures. In addition, you should do the following:

- Consider the patient's size and ability to accommodate the transducer tip and shaft.

- Check the patient's history for gastroesophageal disease or difficulty swallowing.
- Evaluate the potential overall effects of any treatment that the patient is undergoing, such as mediastinal radiation, chemotherapy, anticoagulation, or steroid therapy.
- Be aware that you may discover unsuspected esophageal pathology during a study. Be alert for congenital problems with the esophagus or stomach, particularly with pediatric patients.
- When examining a patient with an above-normal temperature, use the Auto-Cool feature and enter the patient temperature. The Auto-Cool feature is described in "[TEE Temperature Sensing](#)" on page 228.

This list is not comprehensive. Rather, it suggests areas to investigate when considering TEE for a particular patient.

Patient Selection for TEE Transducer Use

Although the TEE transducers can provide clinical data not available from other instruments, you should consider which patients can safely use the TEE transducers.



WARNING

The ability of a patient to swallow or accommodate the transducer should be considered.



WARNING

You must consider any history of gastroesophageal diseases as well as the possible effects of other therapies that the patient is undergoing. You must also consider all gastroesophageal abnormalities or difficulty swallowing.

The following table lists the minimum patient weight recommendations when using TEE transducers.

TEE Transducer Minimum Patient Weight Recommendations

TEE Transducer	Minimum Patient Weight
S7-3t	3.5 kg (7.7 lb)
X7-2t	30 kg (66 lb)

Preparing Patients for TEE Studies

These suggestions for pre-study patient preparation do not constitute an exhaustive list of all possible factors to explore before performing transesophageal echocardiography, nor do they imply medical protocols. Instead, they reflect basic guidelines resulting from extensive consultation with physicians throughout the design, development, and clinical investigation periods of Philips TEE transducers.

- Besides gathering routine background information such as current medication and allergies, investigate any history of chronic obstructive lung disease, esophageal strictures, varices, or bleeding.
- Thoroughly explain the procedure to the patient before the study.
- Inform the patient not to eat or drink for at least 6 hours before the study.
- Advise the patient that he or she should not plan to drive after the study, because sedatives are often used.
- Follow institutional guidelines for obtaining patient consent for a transesophageal echocardiography (TEE) study.
- Be sure that a recent ECG, CBC, and SMA6 are available as a baselines.

TEE Study Guidelines

During a TEE study, an assistant can provide oral and pharyngeal suctioning of the patient and can monitor the patient's blood pressure and general responses. For unexpected occurrences, an emergency cart with basic life-support equipment should be ready. Throughout the study, it is important to carefully monitor the patient's reactions and to ensure that ventilation and vital signs are stable.

In the operating room, do not use TEE transducers during surgical procedures requiring extreme neck flexion, such as sitting craniotomies. The following are important guidelines for TEE studies. (See "[TEE Transducer References](#)" on page 238.)

- Minimize the possibility of transducer tip fold-over. This problem has occurred rarely, but its consequences can be serious. See "[Tip Fold-Over](#)" on page 226.
- Maintain a patent airway. For surgical patients, endotracheal intubation establishes a stable, patent airway before insertion of the transducer. For patients who are awake, carefully monitor the patient's breathing at all times.

- Minimize the possibility of pressure necrosis (tissue death). Do not let the distal tip displace any one segment of tissue for more than 5 consecutive minutes. Also make sure the deflection area and the distal tip are in the position of least potential pressure. Be sure that the transducer is in a freewheeling mode and unplugged whenever you are not imaging.
- Prevent potential esophageal damage. Philips recommends that you stop TEE scanning and unplug the transducer from the system during periods of poor perfusion, circulatory arrest, or the hypothermic phase of open heart surgery. To discontinue scanning, unlock the transducer connector.
- Before each TEE study, carefully inspect the transducer, as described in “[Checking the TEE Transducer](#)” on page 223. A thorough inspection procedure is required for the safety of the patient and yourself, and to ensure the continued correct functioning of the transducer.
- Never use excessive force when inserting, operating, or withdrawing a transducer, and make sure the deflection area is straight during insertion and withdrawal. Forceful insertion, manipulation, or withdrawal of a transducer can result in lacerations, bleeding, perforation, tearing of adhesions, and ligament damage. Also be aware that the tip can fold over, causing similar damage.
- Refrain from handling the distal tip whenever possible. If you must handle the distal tip, grasp it on the sides. Do not touch the top or bottom. Support the transducer’s proximal head, either by having an assistant hold the steering mechanism or by clamping the transducer at the steering mechanism. Ensure that the clamp does not interfere with steering, and do not clamp any part of the flexible shaft, as this will damage the transducer.

Tip Fold-Over

On rare occasions, the tip of a TEE transducer has folded over during insertion. The effects can be serious if the situation is handled incorrectly. The esophagus can be scraped, perforated, or otherwise damaged.

Recognizing Tip Fold-Over

The TEE transducer tip might be folded over in the patient if you encounter any of the following:

- Resistance to advancing or removing the transducer
- An inability to turn the control knobs
- Fixation of the control knobs in the maximum flexion position
- Extreme difficulty in obtaining an image

Correcting Tip Fold-Over

If you suspect the transducer tip is folded over, Philips' physician consultants recommend that you gently try to manipulate the transducer. If the tip is neither locked nor jammed in a doubled-over position, and you can move it forward, advance the transducer into the stomach. Then straighten the tip and remove the transducer.

If you cannot move the tip in any direction, Philips' consultants recommend that you X-ray the patient to evaluate the situation. You might also want to involve a gastroenterologist or anesthesiologist.

Preventing Tip Fold-Over

The following steps can prevent the tip from folding over. This list is not exhaustive; other factors can also be involved.

Using Correct Insertion Technique

You may find transducer insertion easier if you guide the transducer into the patient's mouth with your fingers. You also may want to lock medial/lateral tip movement.



WARNING

All patients should wear a bite guard during a TEE exam. A bite guard protects against dangerous transducer mechanical and electrical malfunction caused by involuntary biting. Even anesthetized patients require bite guards to prevent damage to both their teeth and to the transducer. For information on bite guards available from Philips, see “[Bite Guards](#)” on page 233.

Avoid the following when inserting any TEE transducer into a patient:

- Any excessive flexion of the transducer tip, particularly in the medial/lateral direction
- Catching the tip in pharyngeal recesses
- Insertion when a patient is being uncooperative or is having a convulsion or spasm

Reviewing Patient Esophageal Pathology

Carefully review a patient's medical history for obstructing pathologies or anatomical irregularities before performing a TEE exam.

Ensuring Proper Transducer Maintenance

Thoroughly examine the transducer and test the controls before each exam. Be sure to check for excessive flexibility in the tip. See "[TEE Transducer Inspection](#)" on page 223.

TEE Temperature Sensing

The transesophageal transducers contain built-in temperature sensors near the distal tip. The sensor monitors the transducer's temperature to prevent potential burning of esophageal tissue. The patient's actual temperature is required to accurately estimate the distal tip temperature. By default the system assumes that the patient temperature is 37°C (98.6°F). You must manually enter the actual patient temperature if it is above 37°C (98.6°F).

The Auto-Cool feature provides warning messages at two points:

- At 41.0°C (105.8°F), the **TEE Auto Cool Imminent** message appears.
- At 42.5°C (108.5°F), the **TEE Auto Cool In Progress** message appears, and the system automatically stops scanning.



WARNING

If the patient temperature is above 37°C (98.6°F) and the Patient Temp control is set below the actual patient temperature, then the system can overestimate the temperature of the TEE transducer's distal tip. This can prematurely trigger the Auto-Cool feature. If the patient temperature is at or near 37°C (98.6°F) and the Patient Temp control is set above the actual patient temperature, then the system can underestimate the temperature of the distal tip. This can expose patients to excessive temperatures.

Ensuring Safe TEE Temperatures

To ensure patient safety and to avoid unnecessary interruption while scanning, follow these suggestions:

- Ensure distal-tip-temperature accuracy by entering an accurate patient core temperature.
- Decrease the transducer temperature by using the **Output Power** knob before introducing a TEE transducer to decrease acoustic output, and keep the control at the lowest possible setting during an exam.
- Use the TEE Manual Auto-Cool safety feature to enter the patient temperature if it is above 37°C (98.6°F) as described in “[Entering Patient Temperature](#)” on page 231.
- If the transducer temperature begins to rise when you are using high-power modes such as Live 3D, Color, Tissue Harmonic Imaging, and Doppler, temporarily switching to fundamental 2D mode or freezing the image can help cool the transducer.

Manual Auto-Cool Feature

Use the TEE Manual Auto-Cool safety feature to enter above-normal patient temperatures. When the temperature display is enabled, you can see both the patient temperature and the distal tip temperature while scanning.

NOTE

The patient temperature shown on the ultrasound display is always either 37°C (98.6°F) or the temperature that you manually enter. The system does not monitor or report the actual patient temperature.

If the distal tip temperature reaches 41°C (105.8°F), a warning message appears and the transducer temperature is displayed in inverse video. If the temperature reaches 42.5°C (108.5°F), a warning appears with the patient and the transducer temperatures, and the system stops imaging until the distal tip cools to below 42°C (107.6°F). The system shuts down if the patient-applied part temperature of the TEE transducer exceeds 42.5°C (108.5°F), given an entered patient temperature of 37°C (98.6°F). It resumes scanning when the temperature falls below 42°C (107.6°F). If the patient temperature is higher than 37°C (98.6°F), the system shutdown temperature adjusts accordingly. You may need to restart the system by turning it on.

**WARNING**

To avoid the risk of esophageal burn for adult patients, minimize the time spent imaging at distal tip temperatures in excess of 42°C (107.6°F). Exposure should be limited to 10 minutes or less at 42°C (107.6°F) or higher.

**WARNING**

Sufficient data on thermal tolerance of the esophagus in neonate and pediatric patients does not exist, but it is likely these patients are more vulnerable than adults. Minimize the time spent imaging at distal tip temperatures in excess of 41°C (105.8°F).

Using the Temperature Display

Both the patient temperature (assumed or entered) and the transducer temperature appear in the lower left corner of the display when enabled. On the display, the patient temperature is labeled **PAT T**, and the transducer temperature is labeled **TEE T**.

A less-than sign (<) after **TEE T** indicates that the transducer's distal tip temperature is below the patient temperature (**PAT T**) assumed by the system, which is either 37°C (98.6°F) or the temperature you entered.

NOTE

If you want the temperature display enabled by default, turn on the temperature display and then create a preset as described in “[Creating Quick Save Presets](#)” on page 149.

1. Connect the transducer and select a preset.
2. Swipe to the second touch screen.
3. Touch **Temp Display** to display or hide the temperature display.
4. Touch **Temp Units** to switch the temperature scale between Fahrenheit and Celsius.

Patient Temperature

Entering a patient's temperature enables the Auto-Cool feature to calculate tip temperature more accurately, which can prevent unnecessary interruptions while scanning. If a patient's temperature is above normal, entering a temperature can avoid exposing the patient to excessive temperatures.

Always check the patient's temperature before inserting a TEE transducer. If it is above normal, whether from fever or therapeutic heating from a cardiac bypass heart-lung machine, perform the procedure in "[Entering Patient Temperature](#)" on page 231 before inserting the transducer. Also, follow that procedure if a patient's temperature rises during a study.

Measure the patient's core temperature, or more specifically, the actual temperature in the esophagus. For patients undergoing surgery, determine the temperature in the esophagus by direct measurement or by monitoring the temperature of blood returning from the bypass pump heat exchanger.

For closed-chest situations, rectal temperature is the best estimate of core temperature. You can also use oral temperatures, even though they can be one degree lower than the core temperature. If you measure an auxiliary temperature, which can be two degrees lower than the core temperature, add one or two degrees.

Entering Patient Temperature

1. If necessary, select the TEE transducer.
2. Turn **Pat Temp** to enter the patient's measured temperature.

NOTE

Each time you turn off or reset the system, or enter a new patient ID, the system assumes that the patient temperature is 37°C (98.6°F).

Resuming Imaging After Auto-Cool

If the distal tip temperature drops below 42.5°C (108.5°F), the system resumes imaging. If the Auto-Cool message persists longer than 1 minute or an error message appears, contact your Philips service representative.

The system shuts down if the patient-applied part temperature of the TEE transducer exceeds 42.5°C (108.5°F), given an entered patient temperature of 37°C (98.6°F). If the patient temperature is higher than 37°C (98.6°F), the system shutdown temperature adjusts accordingly. You may need to restart the system by pressing the  (On/Off) control .



WARNING

The Reconnect the Transducer error message is often caused by a poorly seated transducer connector, but it could be caused by a failure in the Auto-Cool safety logic. In the case of a logic failure, distal tip temperatures could reach 46.5°C (115.7°F) in hyperthermic patients (40°C to 41°C or 104°F to 106°F) before the error causes scanning to stop. At this temperature, esophageal burns may occur (see “[TEE Transducer References](#)” on page 238).

1. Move the locking lever to the unlocked position, and pull the connector out of the receptacle.
2. Reseat the connector in the receptacle and move the locking lever to the locked position.
3. Select the transducer and preset.
4. If the system does not resume imaging after the transducer has initialized, shut down the system and then restart it.

Patient Care After a TEE Study

Follow your institutional guidelines for post-TEE studies. Additionally, you might want to include the following recommendations in your guidelines as part of your post-TEE study routine.

- Inspect the patient’s throat for any bleeding.
- Examine the patient for postural hypotension or difficulty walking.
- Instruct the patient to contact you immediately if he or she experiences any fever, chills, chest pain, or bleeding.
- Instruct the patient not to eat or drink for at least 2 hours or until swallowing returns to normal after anesthesia has worn off. It is especially important that the patient not ingest hot foods or fluids during this period.
- Follow up with a call to the patient the day after the a study to make sure there are no complications.

TEE Accessories and Supplies

Each TEE transducer comes with disposable bite guards and a disposable tip protector. Bite guards, TEE transducer covers, tip protectors, and disposable drapes are described here. For information on ordering TEE accessories, see “[Supplies and Accessories](#)” on page 21.

Bite Guards



WARNING

The M2203A bite guard strap contains natural rubber latex, which may cause allergic reactions. For more information, see “[FDA Medical Alert on Latex](#)” on page 49.



CAUTION

Damage caused when patients bite or scrape a TEE transducer is not covered in the transducer warranty or your service contract. Use bite guards to help prevent such accidents.

All patients must wear a bite guard during a TEE study. A bite guard prevents dangerous transducer mechanical and electrical malfunctions caused by involuntary biting. Even anesthetized patients require bite guards to prevent damage to their teeth and to the transducer. Philips supplies disposable bite guards that are suitable for both awake and anesthetized patients.

TEE Transducer Covers



WARNING

Transducer covers often contain natural rubber latex and talc, which may cause allergic reactions. For more information, see “[FDA Medical Alert on Latex](#)” on page 49.

Philips recommends the use of a market-approved transducer cover during every TEE study.

For procedures on using transducer covers (protective sheaths), see the instructions provided with the covers.

Tip Protectors

When not using a carrying case to transport a TEE transducer, use a tip protector on its distal tip. The tip protector helps prevent serious damage to the transducer lens. Philips supplies tip protectors designed for each of its TEE transducers.

Disposable Drapes

During studies in which you believe contamination of the imaging system can occur, Philips recommends that you take universal precautions and cover the system with a disposable drape. Consult your hospital's rules regarding equipment use in the presence of infectious disease.

TEE Leakage Current Test

The electrical safety check described here should be performed regularly to determine if there is a hole in a transducer's outer insulating layer. This procedure detects liquid pathways to the interior parts of the transducer shaft and tip by measuring third-wire leakage current. This procedure can be performed with any commercially available safety analyzer that is designed for hospital use.

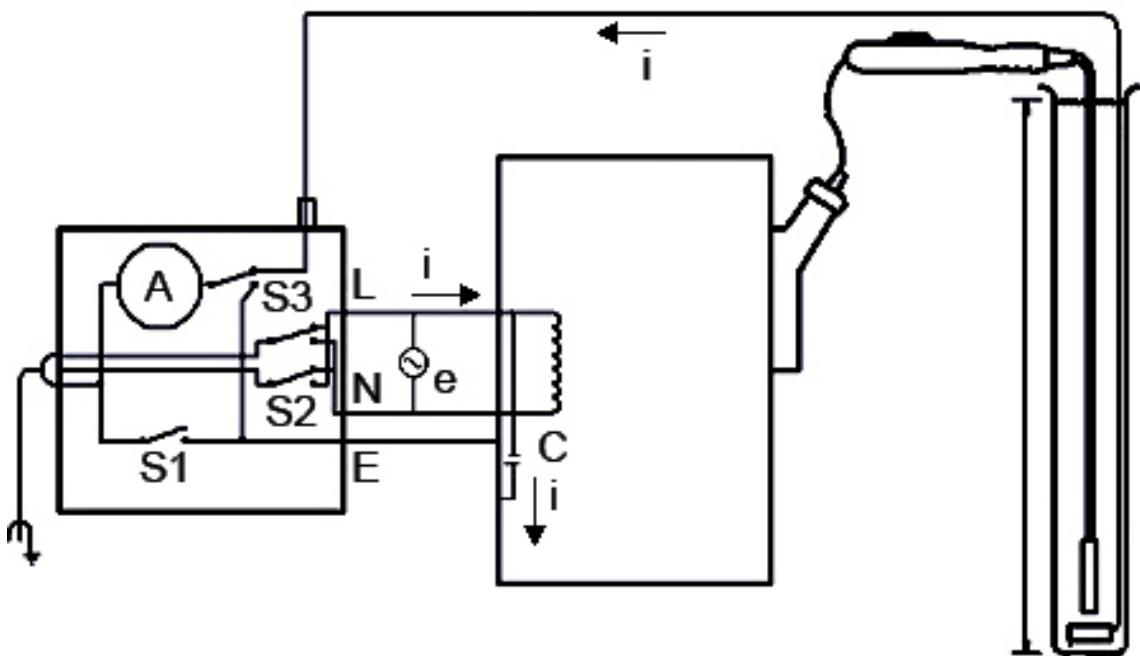


WARNING

Only a technically qualified person should perform the leakage-test procedure.

TEE Test Background

The test procedure (see figure) involves making an AC measurement of the ultrasound system current without a transducer. The results are then compared with the current measured when it is forced to flow through the insulating layer of the TEE transducer. If the two currents are nearly the same, it means there is a hole in the transducer's outer insulating layer that must be fixed before using the transducer.



Electrical Safety Check for TEE Transducers

TEE Leakage Current Test

Symbol	Definition
C	Stray capacitance from the ultrasound system power wiring to the system grounded metal chassis (1 to 3 MΩ reactance)
Z	Impedance between the metal parts of the TEE transducer and a test electrode placed in the bucket of saline solution (about 850 kΩ with an intact outer insulating layer, 500 Ω with a hole in the layer)
A	Microammeter to measure third-wire current, either directly from the chassis or through Z to the test electrode
e	Line power source, either 110 Vac or 220 Vac
I	Current caused by e and stray capacitance, and optionally Z

Symbol	Definition
S1	Open earth lift ground switch
S2	Line polarity switch
S3	Microammeter switch
L	Line mains supply
N	Neutral mains supply
E	Earth ground

Current I , driven by line supply e , flows through all stray capacitances between the primary wiring and the ultrasound system's metal chassis. Ordinarily, current then flows from the metal chassis through S3 and back to e through a third-wire ground. When S3 is thrown in the other position, current I is forced:

- From the chassis through the metal parts of the transducer
- Through impedance Z , produced by the insulating layer that covers the metal parts of the transducer and the saline solution
- Through the test electrode

Saline generally presents an impedance of about 500Ω , so Z will vary between $850 \text{ k}\Omega$ and 500Ω , depending on whether or not there is a conductive pathway caused by a hole in the transducer's insulating layer.



CAUTION

Do not make a DC measurement of impedance. This could set up a voltaic cell, with the metal of the transducer and a test electrode in the salt bath forming the two electrodes and an electrolyte. Such a voltaic cell produces inaccurate resistance measurements.

You need the following equipment to perform the electrical safety check procedure:

- Dempsey 432HD or 232D safety analyzer or equivalent
- Philips 21110A Disinfection Basin or equivalent
- Saline solution, 9 grams (0.3 oz) of salt to 1 liter (1 qt) of tap water, or one of the tested disinfectants listed in the “[Transducer Care](#)” section.

Testing TEE Transducer Leakage Current

For a list of the equipment needed to perform the electrical safety test procedure, see “[TEE Test Background](#)” on page 234.



WARNING

Only a technically qualified person should perform this procedure.

1. Gather the equipment in the preceding list.
2. Fill the basin to the fill line with saline solution.
3. Place the distal tip and shaft of the transducer into the basin.
4. Connect the transducer to the system.
5. Plug the ultrasound system’s power cord into the test receptacle on the safety analyzer.
6. Attach a lead from the safety analyzer binding post labeled RL to a metal plate submerged in the basin.
7. On the safety analyzer, set the **Leads** switch to **RL**. Set the **Line Polarity** switch (S2) to **NORMAL**.
8. Turn on the safety analyzer and the ultrasound system.
9. Set the **Mode** switch (S3) on the safety analyzer to the **Case Leakage - Ground Conductor** position. Press the **Lift Ground** switch (S1) on the safety analyzer and record the chassis leakage current.
10. Set the **Mode** switch (S3) on the safety analyzer to the **ECG** position. Press the **Lift Ground** switch (S1) on the safety analyzer and record the patient leakage current.

The transducer fails the test if the patient leakage current recorded in step 10 is greater than 80% of the chassis leakage current recorded in step 9.

This failure indicates that there is a hole in the insulating layer of the TEE shaft. A hole enables a conductive pathway to internal metal parts of the transducer and presents a potentially hazardous condition to a patient undergoing external defibrillation or electrosurgery. A hole also allows invasion of organic material, making it difficult to completely disinfect all portions of the transducer. For these reasons, the transducer must be repaired before it is used.

TEE Transducer References

- Cucchiara, R.F., et al. "Air Embolism in Upright Neurosurgical Patients: Detection and Localization by Two-dimensional Transesophageal Echocardiography." *Anesthesiology*, 353-355, 1984.
- Gussenhoven, Elma, et al. "Transesophageal Two-dimensional Echocardiography: Its Role in Solving Clinical Problems." *Journal of the American College of Cardiology*, 975-979, 1986.
- Radwin, Martin, et al. "Transesophageal Echocardiography: Intubation Techniques." *Philips Application Note 5091-2804E*, 1992.
- Urbanowitz, John H., et al. "Transesophageal Echocardiography and Its Potential for Esophageal Damage." *Anesthesiology*, Vol. 72, No. 1, 1990.

11 Endocavity Transducers

Endocavity transducers provide high-resolution endocavity imaging for obstetric and GYN applications. The system supports the C10-3v and the C10-4ec endocavity transducers.



WARNING

All endocavity transducers are designed to be defibrillator safe in accordance with IEC 60601-1. Nevertheless, always remove the transducer from the patient before defibrillation.

Operators of Endocavity Transducers

Philips endocavity transducers are designed for use under the guidance of physicians who are properly trained in endocavity ultrasound imaging techniques, according to currently approved relevant medical practices. Philips recommends that physicians operating any Philips endocavity transducer have the following qualifications:

- Proficiency in recognizing and interpreting imaging patterns
- Thorough familiarity with the safe operation, care, and maintenance of the system and endocavity transducers
- Thorough familiarity with the latest endocavity methods through literature and seminars

Patient Safety During Endocavity Studies

To operate an endocavity transducer, you must be under the guidance of a physician who is properly trained in endocavity ultrasound imaging techniques, according to currently approved relevant medical practices. You also must be thoroughly familiar with the safe operation, care, and maintenance of the ultrasound system used with the transducer, as well as proficient at interpreting the images generated.

To help ensure patient safety when using an endocavity transducer, observe the following guidelines:

- Scrutinize the entire transducer before each use.
- Operate the transducer properly.

- Do not allow water or other liquids to drip onto the transducer connector, the interior of the system, or the keyboard.
- Use sterile ultrasound transmission gel when performing all endocavity studies.
- Protective covers are recommended for endocavity procedures; the protective covers are mandatory in China and Japan.

**WARNING**

All endocavity transducers are designed to be defibrillator safe in accordance with IEC 60601-1. Nevertheless, always remove the transducer from the patient before defibrillation.

Preparing Transducers for Endocavity Use

1. Place 20 cc of sterile gel or saline into the transducer cover.
2. Carefully inspect each transducer cover before use, and discard it if you find tears or blemishes. Also inspect each transducer cover after use. If you find a tear, the patient or the transducer may have been contaminated.
3. Insert the transducer into the transducer cover and unfurl the transducer cover until it covers the transducer and its cable. The cover must be unfurled far enough to maintain the sterile field.
4. Use a sterile elastic band or clip to hold the proximal end of the transducer cover in place.
5. Ensure that wrinkles and bubbles over the face of the transducer are minimized. Check the transducer cover for tears or damage before proceeding.
6. When operating the transducer, make sure that proper orientation is maintained to avoid interpretation confusion.

NOTE

To achieve good acoustic contact, make sure that the imaging surface is moist.

NOTE

Imaging improves with adequate coupling between the patient surface and the transducer-cover surface. Sterile water is a good acoustic-coupling agent during surgery.

C10-3v Description

The C10-3v transducer is described here. For more information on connecting, activating, caring for, and maintaining transducers, see the “[Transducers](#)” and “[Transducer Care](#)” sections.



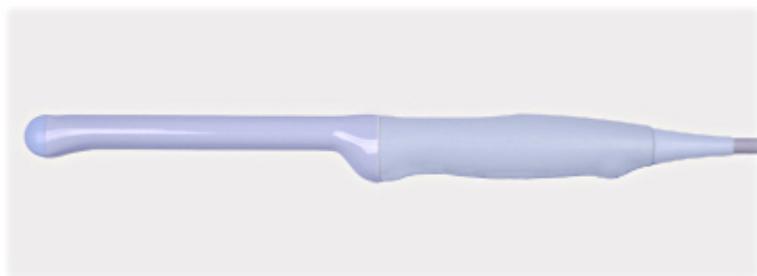
C10-3v Endocavity Transducer

Features of the C10-3v Transducer

Features	Curved array designed to be easy to hold and manipulate and to provide maximum clinician and patient comfort. Enables high resolution and contrast for gynecological, obstetrical, urological, and fetal echo procedures.
Frequency	Operating range: 3 to 10 MHz
Biopsy capable?	Yes
Specifications	<ul style="list-style-type: none">• Length (transducer, cable, and connector): 2.5 m (8.17 ft)• Length (handle to tip): 30 cm (12 in)• Radius of curvature: 11.5 mm (0.45 in)

C10-4ec Description

The C10-4ec transducer is described here. For more information on connecting, activating, caring for, and maintaining transducers, see the “[Transducers](#)” and “[Transducer Care](#)” sections.



C10-4ec Endocavity Transducer

Features of the C10-4ec Transducer

Features	Curved array designed to be easy to hold and manipulate and to provide maximum clinician and patient comfort. Enables high-resolution imaging for gynecological and obstetrical studies, and for urological procedures.
Frequency	Operating range: 4 to 10 MHz
Biopsy Capable?	Yes
Specifications	<ul style="list-style-type: none">Length (transducer, cable, and connector): 2.6 m (8.5 ft)Length (handle to tip): 31.7 cm (12.5 in)Radius of curvature: 10 mm (0.4 in)

Patient-Contact Parts

Latex and talc are commonly used in transducer covers marketed to help with infection control in transesophageal, endocavity, and intraoperative imaging applications and during biopsies. Examine the packaging to confirm latex and talc content. Studies have shown that patients can experience allergic reactions with natural rubber latex. See the “[FDA Medical Alert on Latex](#)” on [page 49](#).

NOTE

The ultrasound system and transducers discussed here do not contain natural rubber latex that contacts humans. Natural rubber latex is not used on any Philips ultrasound transducers.

Biopsy with Endocavity Transducers

Endocavity transducers are biopsy capable.

For more information on the biopsy guide feature, see the “[Biopsy Guides](#)” section.

NOTE

CIVCO Medical Solutions supplies biopsy kits for Philips transducers that are biopsy capable. For information on proper attachment of a biopsy bracket, consult the manufacturer’s instructions.

12 Biopsy Guides

The biopsy guide feature helps you position transducers with biopsy needle-guide attachments. The biopsy guide feature displays guidelines on the image that show the anticipated path of the needle. You can use those guidelines to ensure that the needle or instrument is following the correct path.

Starter kits, which include the biopsy guide or biopsy guide bracket and procedure kits, are available from Philips. Biopsy guides and supplies are available from CIVCO Medical Solutions (see “[Supplies and Accessories](#)” on page 21).

For detailed information about using, cleaning, and sterilizing biopsy guides and brackets, see the instructions provided with the biopsy starter kits, guides, and brackets.

NOTE

The biopsy guides for the L12-5 50 mm, and L18-5 transducers have infinite-angle capability and can be installed on either side of the transducer; they do not constrain the biopsy needle to a particular path. Because the needle path is unpredictable, the **Biopsy** control is unavailable, and the biopsy graphics do not appear on the display when you are using these transducers. A biopsy with these transducers is a manual action. The C5-1 and the C9-2 also support infinite-angle biopsy guides but the graphics should not be used.

Attaching and Removing a Biopsy Guide

Detailed information about attachment and removal of biopsy guides is provided with the biopsy starter kits, guides, and brackets.



WARNING

Do not attempt to use the biopsy guide until you have read the instructions for selecting the display, installing the sterile transducer cover, and verifying alignment of the biopsy guide.

**WARNING**

Inspect all components and the transducer. Ensure that the biopsy guide you are using is the correct one for the transducer, the system, and system software. Your Philips representative can verify this information for you.

**WARNING**

Use only Philips-approved biopsy guides, transducers, covers, brackets, supplies, components, and accessories. Other brands may not properly fit Philips transducers. Improper installation may result in patient injury.

**WARNING**

Some biopsy guides must be installed over a sterile transducer cover.

**WARNING**

After each use, biopsy guides must be either sterilized or disposed of, depending upon the type. See the instructions included with the biopsy guide.

**WARNING**

Most transducers can only be disinfected; they cannot be sterilized. Only the transducer cover provides the sterile barrier.

Biopsy Guideline Display

**WARNING**

Do not attempt to use the biopsy guide until you have read the instructions for selecting the display, installing the sterile transducer cover, and verifying alignment of the biopsy guide.

The system generates a biopsy guideline through the displayed real-time ultrasound image to indicate the anticipated path of the needle. You can use that guideline to ensure that the needle or instrument is following the correct path.

When the biopsy display is active, a biopsy guideline is displayed, entering from the left or right side of the screen, depending on the clinical application and image presentation you have selected. When you reverse the image presentation by touching **Left/Right**, the biopsy guideline moves to the opposite side. Image presentation is defined by the location of the orientation marker.

When depth is changed, the biopsy display redraws to reflect the new relationships at the new depth setting.

Displaying the Biopsy Guideline



WARNING

When using a transducer with an infinite-angle biopsy guide, do not display a fixed-angle biopsy guideline.

The biopsy guideline can have a single, fixed path or multiple paths. The system determines which guideline to display based on the type of biopsy guide available for the transducer you have selected.

NOTE

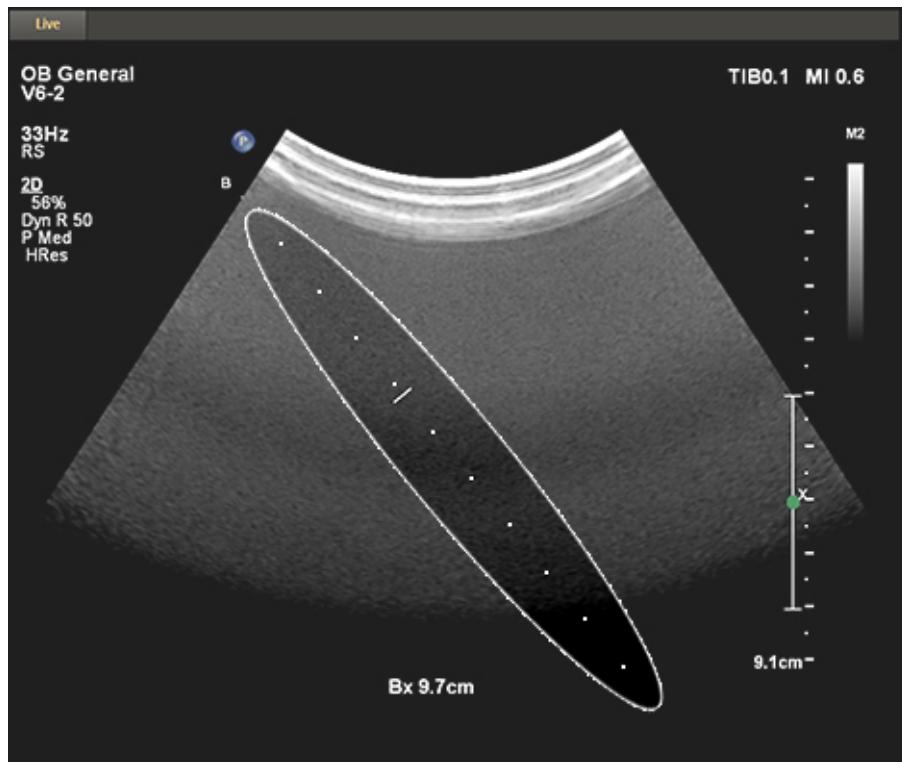
The following procedure applies specifically to non-intervention applications.

1. Connect the transducer.
2. Touch a preset.
3. Touch the **2D** tab.
4. Touch **Biopsy**.

Moving the Biopsy Depth Cursor

A depth cursor appears on the biopsy guideline. The distance from the origin of the biopsy guide to the depth cursor appears at the bottom of the imaging screen.

Rotate the trackball to move the depth cursor along the guideline. The **Bx** measurement value changes to reflect the distance between the biopsy guide reference point origin and the depth cursor.



Biopsy Depth

Biopsy Guide Alignment

Perform the alignment verification before each use of the biopsy guide. The procedure verifies the system, transducer, and biopsy guide relationships.



WARNING

Alignment verification is necessary before performing procedures with the biopsy guide.



WARNING

Do not use the biopsy guide if the needle is not following the intended path. Contact your Philips representative.



WARNING

The needle used for this alignment verification must not be used for the actual procedure. Always use a new, sterile needle for each biopsy procedure.



WARNING

To assist in an accurate projection of the needle, use a straight, new needle for each alignment procedure.

Preparation for Alignment Verification

Assemble the following items before performing the alignment verification:

- Transducer
- Biopsy guide or bracket (The bracket is not disposable. The type of bracket you use depends upon the transducer you are using. For the correct bracket, contact CIVCO Medical Solutions; see “[Supplies and Accessories](#)” on page 21.)
- Needle guide (Contact CIVCO for the needle guide that fits your biopsy guide bracket.)
- Sterile procedure kit (disposable)
- New, straight, biopsy needle

- Beaker of water (or water bath)

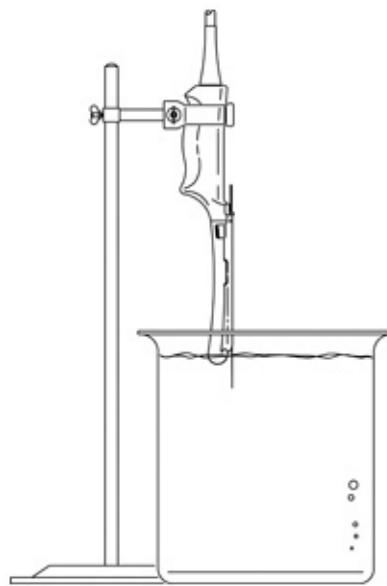
Verifying the Biopsy Guide Alignment



WARNING

If the needle enters from the unexpected side of the display or cannot be seen, verify that the biopsy guide is correctly mounted on the transducer and that the orientation of the transducer is correct. If the needle is still not following the expected path along the guideline, do not use the biopsy guide. Contact your Philips representative.

1. Attach the biopsy guide. Although some transducers require the use of a second transducer cover for biopsy procedures, a second transducer cover is unnecessary for this alignment verification.
2. Connect the transducer to the system, and select the appropriate applications and preset.
3. Set the system depth for the procedure to be performed.
4. Display the biopsy guideline.
5. Without changing the position of the biopsy depth cursor, note the default depth shown at the bottom of the display.
6. Immerse the transducer no more than 6 mm (0.25 in) into the water bath.

*Immersing the Transducer*

7. Select a new, straight needle that matches the needle-gauge size on the biopsy guide clip you are using (if applicable), select the guide channel on the biopsy guide (**A**, **B**, and so on), and use the **Biopsy** soft key to select the matching biopsy angle setting.
8. Insert the straight, new needle into the biopsy guide.
9. Move the needle down into the water bath until its ultrasound image is visible on the video display.
10. Verify that the needle, as seen on the video display, falls along the guideline along the entire depth of the guideline display. The biopsy guideline is intended only to provide an indication of the expected path of the needle. Actual position must be verified by identifying the echoes from the needle.
11. Remove the needle from the biopsy guide.
12. From the tip of the needle, measure a distance equal to the value noted in step 5. Mark this point on the needle.
13. Immerse the transducer no more than 6 mm (0.25 in) into the water bath.

14. Insert the needle into a guide channel that corresponds to the size of the needle and the angle you selected. Continue sliding the needle in until the mark on the needle aligns with the origin on the biopsy guide. (The origin is the point at which the needle enters the biopsy guide.)
15. Move the biopsy depth cursor to the tip of the needle, as seen on the display, and verify that the displayed depth is within 4 mm (0.16 in) of the value noted in step 5.
16. Confirm that the needle is visible along its expected path. If so, then the biopsy guide is properly aligned.

Performing a Biopsy Procedure



WARNING

Before the biopsy procedure, perform alignment verification at the selected depth, to ensure that the biopsy guide and the needle have been installed properly.



WARNING

Use a straight, new, sterile needle for each procedure.



WARNING

Do not perform the biopsy guide procedure if the needle is not visible



WARNING

The biopsy guideline is intended only to provide an indication of the expected path of the needle. Actual position must be verified by identifying the echoes from the needle.



WARNING

If the needle is not following the expected path, discontinue the procedure and contact your Philips representative.

**WARNING**

Thin needles can bend when entering tissue. Actual position must be verified by identifying the echoes from the needle.

**WARNING**

Reverberation or other tissue artifacts may produce false needle images, which can cause confusion in locating the actual needle image. Ensure the needle path is along the guideline, and that you are not using a false needle image to locate the needle.

**WARNING**

When using a transducer with an infinite-angle biopsy guide, do not display a fixed-angle biopsy guideline.

**WARNING**

Philips does not recommend anatomical survey of the prostate with the biopsy guide attached.

1. Install the transducer cover and the biopsy guide according to the instructions provided with the biopsy guide.
2. Select a new, straight needle that matches the needle-gauge size on the biopsy guide clip you are using (if applicable), and select the guide channel on the biopsy guide.
3. Set the system imaging controls for the biopsy procedure.
4. Touch a preset.
5. Touch the **2D** tab.
6. Touch **Biopsy**.
7. Orient the transducer to match image presentation. Use the orientation marker .
8. If necessary, apply sterile acoustic coupling gel to the patient.
9. Begin scanning the patient. Position the transducer so that the puncture target is intersected by the guideline on the display.
10. Do one of the following:
 - For guides with a single angle, insert the needle into the needle guide groove closest to the transducer.

- For guides with multiple angles, insert the needle into the needle guide groove that corresponds to the angle you previously selected.
11. Perform the puncture by sliding the needle through the groove in the guide until the needle, as shown on the display, intercepts the target.
 12. If you are using a biopsy guide bracket and procedure kit, you can remove the transducer from the patient while the needle is still inserted in the patient: Separate the needle from the biopsy guide by pulling the tab up so that the clip snaps out of the needle guide, allowing the clip (still attached to the needle) and needle to separate from the biopsy guide (still attached to the transducer).
 13. Remove the biopsy guide after use.

Biopsy Guide Maintenance



WARNING

The biopsy procedure kit components are disposable and must not be reused.

For information and instructions on cleaning, disinfecting, and sterilizing the biopsy guide, see the instructions provided with the biopsy guide.

13 Transducer Care

This section contains information on cleaning, disinfecting, and sterilizing transducers that are compatible with your ultrasound system.

For information on the gels that are safe to use with your system's transducers, see ["Ultrasound Transmission Gels" on page 184](#).

These instructions are intended to assist in effective cleaning, disinfection, and sterilization. In addition, these instructions will help avoid damage, which could void your warranty, during cleaning, disinfection, and sterilization.

Transducer Care Safety

Observe the following warnings and cautions when using disinfectants. More specific warnings and cautions are included within the various procedures in this section and on the labels of the cleaning or disinfection solutions.



WARNING

Disinfectants listed in this manual are recommended because of their chemical compatibility with product materials, not their biological effectiveness. For the biological effectiveness of a disinfectant, see the guidelines and recommendations of the disinfectant manufacturer, the U.S. Food and Drug Administration, and the U.S. Centers for Disease Control.



WARNING

The level of disinfection required for a device is dictated by the type of tissue it will contact during use. Ensure the disinfectant type is appropriate for the type of transducer and the transducer application. For information on the levels of disinfection requirements, see ["Choosing the Correct Transducer-Care Method" on page 257](#). Also, see the disinfectant label instructions and the recommendations of the Association for Professionals in Infection Control, the U.S. Food and Drug Administration, and the U.S. Centers for Disease Control.

**WARNING**

Sterile transducer covers with sterile ultrasound transmission gel are required for intraoperative and biopsy procedures, and protective covers are recommended for transrectal and intravaginal procedures, but in China and Japan, the covers are mandatory. Philips recommends the use of qualified covers.

**WARNING**

Bite guards are mandatory for TEE transducers. See “[Bite Guards](#)” on page 233.

**WARNING**

In intraoperative applications, sterilized transducers should be used with sterile gel and a sterile transducer cover.

For information on ordering transducer covers, contact CIVCO Medical Solutions (see “[Supplies and Accessories](#)” on page 21).

Latex Product Alert

Philips ultrasound systems and transducers do not contain natural rubber latex that contacts humans. Natural rubber latex is not used on any ultrasound transducer, including transthoracic, intraoperative, and transesophageal echocardiography (TEE) transducers. It also is not used on Philips ECG cables for the products in this manual.

**WARNING**

Transducer covers can contain natural rubber latex, which may cause allergic reactions in some individuals.

**WARNING**

The M2203A bite guard strap contains natural rubber latex, which may cause allergic reactions.

For information on allergic reactions to latex-containing medical devices, see “[FDA Medical Alert on Latex](#)” on page 49.

Transmissible Spongiform Encephalopathy



WARNING

If a sterile transducer cover becomes compromised during an intraoperative application involving a patient with transmissible spongiform encephalopathy, such as Creutzfeldt-Jakob disease, follow the guidelines of the U.S. Centers for Disease Control and this document from the World Health Organization: WHO/CDS/ APH/2000/3, WHO Infection Control Guidelines for Transmissible Spongiform Encephalopathies. The transducers for your system cannot be decontaminated using a heat process.

Choosing the Correct Transducer-Care Method

To choose an appropriate care method for your transducer, you first must determine the transducer's classification, based on its use.

Care Methods by Transducer Type

Transducer Use	Example	Classification	Care Method
Contacts intact skin	Curved, linear, xMatrix, and sector transducers	Noncritical	Low-level disinfection (see “ Transducer, Cable, and Connector Cleaning ” on page 258)
Contacts mucous membranes	Endocavity and transesophageal (TEE)	Semi-critical	High-level disinfection (see “ Transducer, Cable, and Connector Cleaning ” on page 258 and “ Transducer Disinfection ” on page 263)
Enters otherwise sterile tissue	Intraoperative	Critical	Sterilization (see “ Transducer, Cable, and Connector Cleaning ” on page 258 and “ Transducer Sterilization ” on page 273)

The care method for your transducer determines the appropriate disinfectant for your transducer. For details about compatible disinfectants, see “[Disinfectants Compatibility](#)” on [page 276](#).

Transducer, Cable, and Connector Cleaning

These general cleaning (low-level disinfection) instructions are indicated for all transducers and cables. It is important that you clean the transducer and cable according to the following procedures.



WARNING

Always use protective eyewear and gloves when cleaning and disinfecting any equipment.



WARNING

If a premixed solution is used, be sure to observe the solution expiration date.



WARNING

Transducers **must** be cleaned after each use. Cleaning the transducer is an essential step before effective disinfection or sterilization. Be sure to follow the manufacturer’s instructions when using disinfectants.



CAUTION

Attempting to disinfect a cable or connector by using a method other than the one included here can damage the device and voids the warranty.



CAUTION

Do not allow sharp objects, such as scalpels or cauterizing knives, to touch transducers or cables.

**CAUTION**

When handling a transducer, do not bump the transducer on hard surfaces.

**CAUTION**

Do not use a surgeon's brush when cleaning transducers. Even the use of soft brushes can damage transducers.

**CAUTION**

Do not use a brush on the connector label.

**CAUTION**

During cleaning, disinfection, and sterilization, orient the parts of the transducer, connector, or cable that must remain dry higher than the wet parts until all parts are dry. This will help keep liquid from entering unsealed areas of the transducer.

**CAUTION**

Do not allow any type of fluid to enter the connector. Ensure that fluid does not enter through the strain relief, through the connector, through the electrical contacts, or through the areas surrounding the locking-lever shaft and the strain relief. Fluid in the connector may void the device warranty.

**CAUTION**

You can use an alcohol solution for disinfection on the connector only. Ensure the solution is only 70% alcohol or less. Solutions of more than 70% alcohol can cause product damage.

**CAUTION**

Do not use any alcohol or alcohol-based products on the cable or strain relief.

**CAUTION**

Avoid disinfectant contact with the connector label.

**CAUTION**

Be sure to use the proper concentration of enzymatic cleaner and rinse thoroughly.

**CAUTION**

Do not use paper products or products that are abrasive when cleaning the transducer. They damage the soft lens of the transducer.

**CAUTION**

Before storing transducers, ensure that they are thoroughly dry. If it is necessary to dry the transducer lens after cleaning, use a soft cloth and a blotting motion, instead of a wiping motion.

Cleaning a Transducer

NOTE

All imaging transducers are rated at a minimum IPX7 in accordance with IEC529. This rating indicates that the device is protected against the effects of immersion. Continuous wave (nonimaging) transducers are rated IPX1. This rating indicates that the device is protected against the effects of vertically falling water. For all TEE transducers, the control module is rated IPX1, while the endoscope is rated IPX7, in accordance with IEC529.

Before cleaning a transducer, read the warnings and cautions in “[Transducer, Cable, and Connector Cleaning](#)” on page 258 and “[Transducer Care Safety](#)” on page 255.

1. After every patient study, use a moist cloth to remove the ultrasound transmission gel from the transducer.

2. Disconnect the transducer from the system, and remove any accessories attached to or covering the transducer.
3. To remove all organic matter and other residue, use a pre-cleaner or detergent to assist in removing protein residuals. Enzymatic cleaners must be diluted prior to use per the manufacturer's instructions for dilution. Enzymatic cleaners are generically approved for use.
4. When cleaning the lens, use a blotting motion rather than a wiping motion.
5. To remove remaining particulate and cleaning residue, rinse thoroughly with water up to the immersion point shown in "[Disinfecting Non-TEE Transducers by Immersion](#)" on page 268 and "[Disinfecting TEE Transducers by Immersion](#)" on page 270.
6. Optional: Wipe with a dry cloth. To dry the lens, use a soft cloth and a blotting motion instead of a wiping motion.

NOTE

If you use cleaning wipes, it may be unnecessary to rinse the transducer with water. Always follow the product label recommendations.

Cleaning and Disinfecting Cables and Connectors

Before cleaning the cables and connectors, read the warnings and cautions in "[Transducer, Cable, and Connector Cleaning](#)" on page 258 and "[Transducer Care Safety](#)" on page 255.

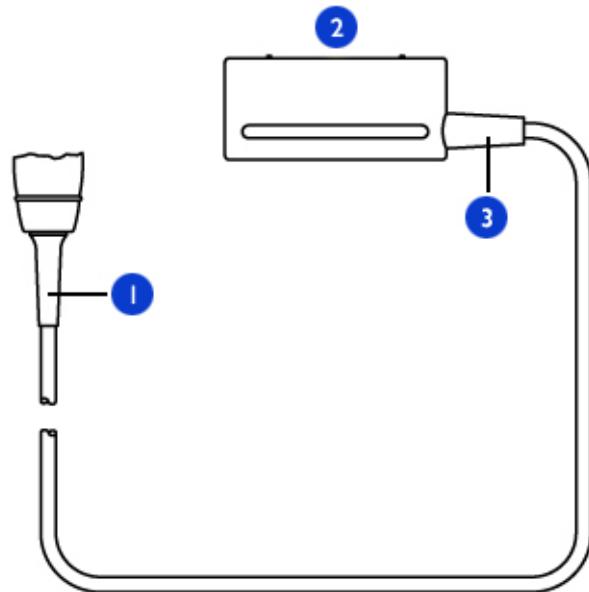
The cables and connectors of all transducers can be disinfected using a recommended wipe or spray disinfectant.

**CAUTION**

Do not bend or crimp the gastroscope or cable.

1. Disconnect the device from the system.
2. Push the connector cover, if available, onto the connector to protect against fluid splashing onto the contacts.
3. Orient the device and the connector so they are both facing up (strain reliefs on the bottom).

4. Use a soft cloth lightly dampened in a mild soap or detergent solution to clean the cable, the strain reliefs, and the connector. A soft-bristled brush can be used to clean only the metal surfaces of the connector.
5. Mix the disinfection solution compatible with your cable (see “[Disinfectants and Cleaning Solutions Compatibility Table](#)” on page 278) according to label instructions for solution strength.
6. Wipe or spray the cable, strain relief, and connector with the disinfectant, following disinfectant label instructions for wipe durations, solution strengths, and duration of disinfectant contact with the cable. Ensure that the solution strength and duration of contact are appropriate for the intended clinical use of the device. Ensure that the disinfectant solution does not enter the device or the connector or come into contact with the connector label.
7. Air dry or towel dry with a sterile cloth according to the instructions on the disinfectant label.
8. Examine the device and cable for damage such as cracks, splitting, sharp edges, or projections. If damage is evident, discontinue use of the device and contact your Philips representative.

*Cleaning Cables and Connectors*

-
- 1 Transducer strain relief
 - 2 Electrical contacts
 - 3 Connector strain relief
-

Transducer Disinfection

To disinfect transducers, you can use either an immersion method or a wipe method with a disinfectant recommended by Philips Ultrasound. Use the method that is biologically appropriate, as described in “[Choosing the Correct Transducer-Care Method](#)” on page 257.

**WARNING**

Always use protective eyewear and gloves when cleaning and disinfecting any equipment.

Isopropyl Alcohol Restrictions

The use of 70% isopropyl alcohol (rubbing alcohol) and alcohol-based products on transducers is restricted. Isopropyl alcohol can cause damage to parts of the transducer. This damage is not covered by the warranty or your service contract.



CAUTION

Wipe only the distal tip of the transducer up to 2.5 cm (1 in) from the strain relief/housing joint with an isopropyl alcohol solution.



CAUTION

Do not use isopropyl alcohol on the strain relief/housing joint, the strain relief, or the cable.



CAUTION

Do not use isopropyl alcohol on TEE transducers, except for the handle.

Disinfecting Transducers Using a Wipe or Spray Method

This topic provides instructions on using the wipe or spray method.

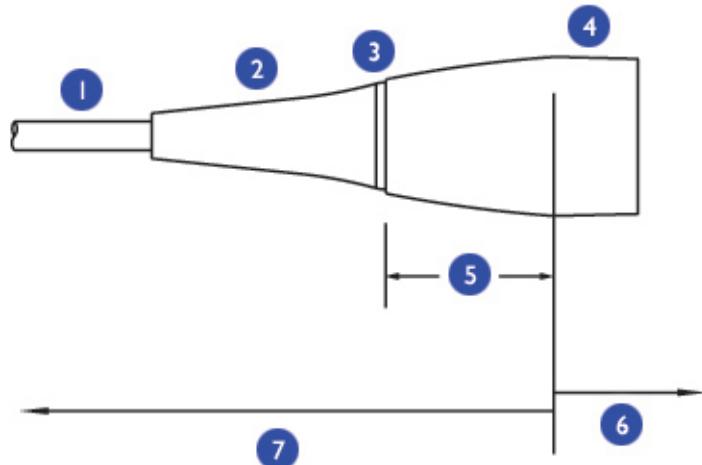


CAUTION

The use of 70% isopropyl alcohol (rubbing alcohol) on transducers is restricted. Wipe only the distal tip of the transducer up to 2.5 cm (1 in) from the strain relief/housing joint with an isopropyl alcohol solution. Do not use isopropyl alcohol on the strain relief/housing joint, the strain relief, or the cable. Do not use isopropyl alcohol on TEE transducers, except for the handle. Isopropyl alcohol can cause damage to these parts of the transducer. This damage is not covered by the warranty or your service contract.

NOTE

Transducers can be disinfected using the wipe method only if the product labeling of the compatible disinfectant you are using indicates it can be used with a wipe method.

*Restricted Use of Isopropyl Alcohol to Clean Transducers*

1 Cable

2 Strain relief

3 Strain relief/housing joint

4 Housing

5 2.5 cm (1 in) between housing and strain relief/housing joint

6 You can use alcohol in this area of non-TEE transducers

7 Do not use alcohol in this area

1. Clean the transducer and cable according to the procedures in “[Transducer, Cable, and Connector Cleaning](#)” on page 258.
2. After cleaning, wipe or spray the transducer and cable with a low-level disinfectant. Allow for the manufacturer’s recommended contact time. For a list of compatible disinfectants, see “[Disinfectants Compatibility](#)” on page 276.

NOTE

If you use cleaning wipes, it may be unnecessary to rinse the transducer with water. Always follow your product label recommendations.

3. Examine the device and cable for damage such as cracks, splitting, sharp edges, or projections. If damage is evident, discontinue use of the device and contact your Philips representative.

Transducer Disinfection by Immersion

Methods for disinfecting transesophageal (TEE) and non-TEE transducers differ. Observe the following warnings and cautions and then see the procedure for your transducer. For non-TEE transducers, see “[Disinfecting Non-TEE Transducers by Immersion](#)” on page 268. For TEE transducers, see “[Disinfecting TEE Transducers by Immersion](#)” on page 270 or “[Disinfecting TEE Transducers with an AER](#)” on page 273.

**WARNING**

If a premixed disinfectant is used, be sure to observe the expiration date.

NOTE

All imaging transducers are rated at a minimum IPX7 in accordance with IEC529. This rating indicates that the device is protected against the effects of immersion. Continuous wave (nonimaging) transducers are rated IPX1. This rating indicates that the device is protected against the effects of vertically falling water. For all TEE transducers, the control module is rated IPX1, while the endoscope is rated IPX7, in accordance with IEC529.

**CAUTION**

Using non-recommended disinfectants, using incorrect solution strengths, or immersing a transducer deeper or longer than recommended can damage or discolor the transducer and voids the transducer warranty.

**CAUTION**

Do not immerse transducers longer than the minimum time needed for your level of disinfection. For information on the levels of disinfection requirements, see “[Choosing the Correct Transducer-Care Method](#)” on page 257.

Minimizing the Effects of Residual Disinfectant

If you use an OPA-based disinfectant, residual solution may remain on your transducers if you do not carefully follow the manufacturer’s instructions.

**WARNING**

Residual OPA on TEE transducers may cause temporary staining of the mouth and lip area and irritation or chemical burns of the mouth, throat, esophagus, and stomach.

To minimize the effects from residual OPA, or any other disinfectant, Philips recommends the following:

**WARNING**

Follow the disinfectant manufacturer’s instructions very carefully. For example, the manufacturer of Cidex OPA recommends soaking transducers three times in fresh water.

**WARNING**

Use a protective transducer cover during endocavity and TEE studies.

**WARNING**

Use a sterile protective transducer cover with sterile ultrasound transmission gel during intraoperative and biopsy studies.

**WARNING**

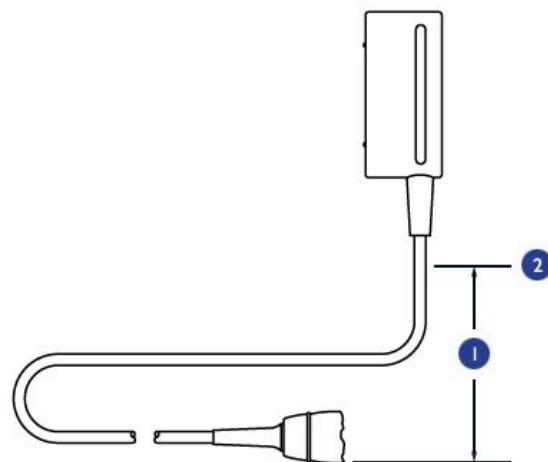
Limit the time that transducers are soaked in the disinfectant solution to the minimum time recommended by the disinfectant manufacturer (for example, the manufacturer of Cidex OPA recommends a minimum of 12 minutes).

Disinfecting Non-TEE Transducers by Immersion

Before performing this procedure, read the warnings and cautions in “[Transducer Disinfection by Immersion](#)” on page 266, “[Transducer Care Safety](#)” on page 255, and “[Minimizing the Effects of Residual Disinfectant](#)” on page 267.

Methods for disinfecting transesophageal (TEE) and non-TEE transducers differ. For TEE transducers, see “[Disinfecting TEE Transducers by Immersion](#)” on page 270 or “[Disinfecting TEE Transducers with an AER](#)” on page 273.

1. Clean the transducer and cable according to the procedures in “[Transducer, Cable, and Connector Cleaning](#)” on page 258.
2. Mix the disinfection solution compatible with your transducer (see “[Disinfectants and Cleaning Solutions Compatibility Table](#)” on page 278) according to label instructions for solution strength.
3. Immerse the transducer into the appropriate disinfectant for your transducer as shown in the illustration. Follow the instructions on the disinfectant label for the duration of transducer immersion. Do not immerse transducers longer than the minimum time needed for your level of disinfection.
4. Using the instructions on the disinfectant label, rinse the transducer up to the point of immersion, and then air dry or towel dry with a sterile cloth.
5. Examine the transducer for damage, such as cracks, splitting, fluid leaks, or sharp edges or projections. If damage is evident, discontinue use of the transducer and contact your Philips representative.



Immersing Transducers

- 1 Immerse this section only, up to 5.1 cm (2 in) from the connector's strain relief.
 - 2 Maximum allowable immersion depth; you are not required to immerse to this depth if it is unnecessary.
-

Cautions for TEE Transducer Disinfection

Obey the following safety precautions when disinfecting TEE transducers.



CAUTION

Never sterilize the transducer with autoclave, gamma-radiation, gas, steam, or heat sterilization techniques. Severe damage will result. Avoidable transducer damage is not covered by the warranty or service contract.



CAUTION

Do not bend the shaft into a circle with a diameter of less than 0.30 m (1 ft).



CAUTION

Do not use bleach on the transducer and shaft.

**CAUTION**

Do not use isopropyl alcohol-based products on the transducer and shaft.

**CAUTION**

Do not soak the transducer for extended periods of time. Limit the time that transducers are soaked in disinfectant solution to the minimum time recommended by the disinfectant manufacturer.

**CAUTION**

Do not rinse or immerse the control housing, cable, connector, or the portion of the cable near the connector.

**CAUTION**

Do not immerse or rinse the steering mechanism.

**CAUTION**

Follow the recommendations of the disinfectant manufacturer.

**CAUTION**

The transducer steering mechanism is unsealed. If disinfectant or other fluid enters the steering mechanism, it corrodes the gears and electrical connections. Avoidable transducer damage is not covered by the warranty or service contract.

Disinfecting TEE Transducers by Immersion

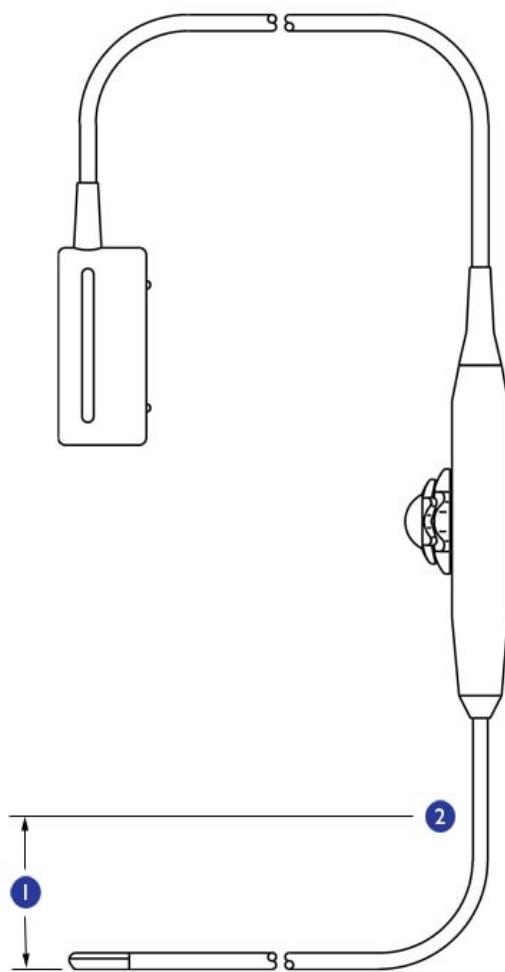
Before performing this procedure, read the cautions and warnings in “[Transducer Disinfection by Immersion](#)” on page 266, “[Transducer Care Safety](#)” on page 255, and “[Minimizing the Effects of Residual Disinfectant](#)” on page 267.

Disinfection by immersion is the accepted method of infection control for transesophageal transducers. Philips recommends that a protective transducer cover be used during studies.

Upon receiving your new transducer, disinfect it before performing the first study. Clean and disinfect the transducer immediately after each use to protect patients and personnel from a variety of pathogens. Establish and clearly post a cleaning procedure that includes the following steps.

Methods for disinfecting transesophageal (TEE) and non-TEE transducers differ. For non-TEE transducers, see “[Disinfecting Non-TEE Transducers by Immersion](#)” on page 268.

1. Disconnect the transducer from the system.
2. Clean the transducer and flexible shaft using any of the following: enzymatic cleaner, mild soap solution, or an approved wipe. Follow the manufacturer's instructions for use.
3. Use water to rinse the distal tip and flexible shaft thoroughly.
4. Immerse the distal tip and flexible shaft into the appropriate disinfectant as shown in the illustration.
5. Remove the tip and shaft from the disinfectant and thoroughly rinse with water according to the instructions from the disinfectant manufacturer.
6. Check the transducer for any residual organic material. If any is present, remove it and disinfect the transducer again.
7. Gently dry the distal tip and flexible shaft with a sterile cloth or pad, or allow it to air dry.
8. Lightly wipe only the steering mechanism and handle with a pad moistened with rubbing alcohol (70% isopropyl alcohol), or use approved cleaners as directed on the handle and steering mechanism.
9. Hang the transducer on a wall-mounted rack, and let it air dry.

*Immersing TEE Transducers*

- 1 Immerse this section only, up to 5.1 cm (2 in) from the handle's strain relief.
- 2 Maximum allowable immersion depth; you are not required to immerse to this depth if it is unnecessary.

Disinfecting TEE Transducers with an AER

Before performing this procedure, read the cautions and warnings in “[Transducer Disinfection by Immersion](#)” on page 266, “[Transducer Care Safety](#)” on page 255, “[Cautions for TEE Transducer Disinfection](#)” on page 269, and “[Minimizing the Effects of Residual Disinfectant](#)” on page 267.

The automated endoscopy reprocessor (AER) disinfecter can be used only with those transducers listed that are listed as compatible in the “[Disinfectants and Cleaning Solutions Compatibility Table](#)” on page 278 or in the results of a compatible-solution search on the Transducer Care website:

www.healthcare.philips.com/us_en/products/ultrasound/Transducers/transducer_care/index.wpd

Methods for disinfecting transesophageal (TEE) and non-TEE transducers differ. For non-TEE transducers, see “[Disinfecting Non-TEE Transducers by Immersion](#)” on page 268.

1. Disconnect the transducer from the system.
2. Follow the manufacturers' instructions for disinfection.

Transducer Sterilization

Sterilization is required if the transducer enters otherwise sterile tissue without a sterile cover. If you use a sterile cover, you should sterilize but you can disinfect (high-level disinfection). For information about disinfecting a transducer, see “[Transducer Disinfection](#)” on page 263.



WARNING

Always use protective eyewear and gloves when cleaning, disinfecting, or sterilizing any equipment.



WARNING

In intraoperative applications, sterilized transducers should be used with sterile gel and a sterile transducer cover.

**WARNING**

Sterile transducer covers are disposable and must not be reused.

**WARNING**

If a premixed solution is used, be sure to observe the solution expiration date.

**CAUTION**

Transducers must be cleaned after each use. Cleaning the transducer is an essential step before effective disinfection or sterilization. Be sure to follow the manufacturer's instructions when using disinfectants.

**CAUTION**

Use only liquid solutions to sterilize transducers. Using autoclave, gas (EtO), or other methods not approved by Philips will damage your transducer and void your warranty.

**CAUTION**

Do not allow sharp objects, such as scalpels and cauterizing knives, to touch transducers or cables.

**CAUTION**

When handling a transducer, do not bump the transducer on hard surfaces.

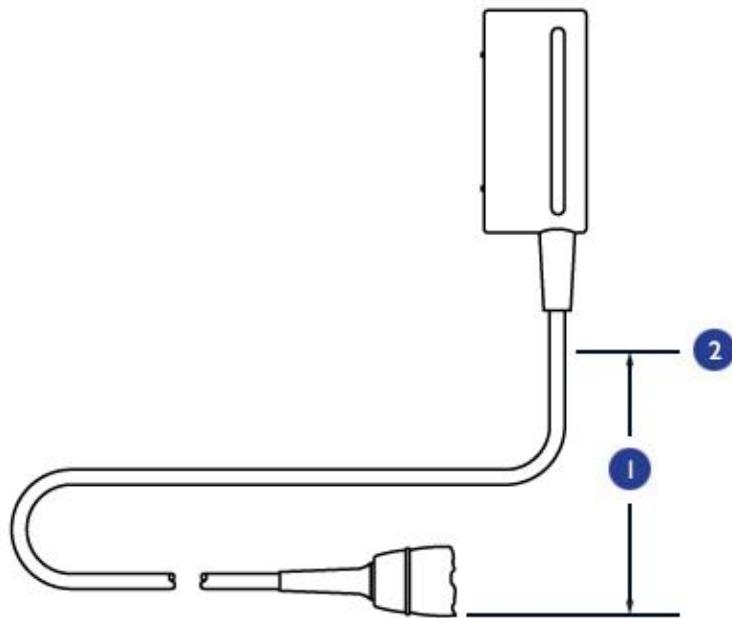
**CAUTION**

Ensure the solution strength and duration of contact are appropriate for sterilization. Be sure to follow the manufacturer's instructions.

Sterilizing Transducers by Immersion

The main difference between sterilization by immersion and disinfection by immersion is the length of time the transducer is immersed. To determine if your transducer requires sterilization or high-level disinfection, see “[Choosing the Correct Transducer-Care Method](#)” on [page 257](#).

1. Clean the transducer and cable according to the procedures in “[Transducer, Cable, and Connector Cleaning](#)” on [page 258](#).
2. Mix the sterilization solution compatible with your transducer according to label instructions for solution strength.
3. Immerse the transducer in the sterilization solution as shown in the illustration.
4. Follow the instructions on the sterilization label for the duration of transducer immersion required for sterilization.
5. Remove the transducer from the sterilization solution after the recommended sterilization time has elapsed.
6. Using the instructions on the sterilization label, rinse the transducer in sterile water up to the point of immersion, and then air dry or towel dry with a sterile cloth.
7. Examine the transducer for damage, such as cracks, splitting, fluid leaks, or sharp edges or projections. If damage is evident, discontinue use of the transducer, and contact your Philips representative.



Immersing Transducers

-
- 1 Immerse this section only, up to 5.1 cm (2 in) from the connector's strain relief.
 - 2 Maximum allowable immersion depth; you are not required to immerse to this depth if it is unnecessary.
-

Disinfectants Compatibility

Read this information before performing disinfection and sterilization procedures. It discusses recommended disinfectants and choosing an appropriate disinfectant for the required level of disinfection. You must check “[Disinfectants and Cleaning Solutions Compatibility Table](#)” on page [278](#) for the chemical compatibility of disinfectants and cleaners with specific transducers. In addition, the table indicates if a device can be sprayed or wiped only, or if it can be soaked.

**WARNING**

Not all disinfectants are effective against all types of contamination. Ensure the disinfectant type is appropriate for the type of transducer and that the solution strength and time of contact are appropriate for the intended clinical use.

**WARNING**

Disinfectants listed in this section are recommended because of their chemical compatibility with product materials, not their biological effectiveness. For the biological effectiveness of a disinfectant, see the guidelines and recommendations of the disinfectant manufacturer, the Association for Professionals in Infection Control, the U.S. Food and Drug Administration, and the U.S. Centers for Disease Control.

**WARNING**

If a premixed solution is used, be sure to observe the solution expiration date.

**WARNING**

Always use protective eyewear and gloves when cleaning and disinfecting any equipment.

**CAUTION**

Using a non-recommended disinfection solution, using an incorrect solution strength, or immersing a transducer deeper or longer than recommended can damage the device and voids the warranty.

Disinfectant Types

**WARNING**

The level of disinfection required for a device is dictated by the type of tissue it will contact during use. Ensure the disinfectant type is appropriate for the type of transducer and the transducer application. For information on the levels of disinfection requirements, see

“Choosing the Correct Transducer-Care Method” on page 257. For more information, see the disinfectant label instructions and the recommendations of the Association for Professionals in Infection Control, the U.S. Food and Drug Administration, and the U.S. Centers for Disease Control.



CAUTION

If you use an isopropyl alcohol-based product for disinfection, ensure the solution is only 70% alcohol or less. Solutions of more than 70% alcohol can cause product damage. Do not use alcohol on the transducer’s strain relief or cable, or on TEE transducers (except the handle).

See “[Disinfectants Compatibility](#)” on page 276 for standard industry recommendations on disinfection, for information that can help you choose an appropriate disinfectant for the required level of disinfection, and for transducer-specific instructions.

Factors Affecting Disinfectant Efficiency

The following factors will affect the efficiency of a disinfectant solution:

- Number and location of microorganisms
- Innate resistance of microorganisms
- Concentration and potency of disinfectants
- Physical and chemical factors
- Organic and inorganic matter
- Duration of exposure
- Biofilms

Disinfectants and Cleaning Solutions Compatibility Table

The following table lists the disinfectants and cleaning solutions that are compatible with the transducers available for your ultrasound system.



CAUTION

Do not use hydrogen-peroxide products on Doppler transducers.

**CAUTION**

Isopropyl alcohol (IPA) products are approved for use on the transducer only and only if the IPA content does not exceed 70%. Do not use IPA-based products on the connector cable and strain relief. All other product types listed here can be used on the transducer and cable.

NOTE

TEE transducers require unique methods for disinfection. See “[Disinfecting TEE Transducers by Immersion](#)” on page 270 or “[Disinfecting TEE Transducers with an AER](#)” on page 273.

Based on material compatibility testing and product use profile and active ingredients, Philips has approved for use the following types of low-level disinfectants used as a spray or wipe for surface (skin contact) and transvaginal or transrectal probes:

- Sodium hypochlorite based (for example 10% household bleach solution with active sodium hypochlorite at approximately 0.6%)
- Quaternary ammonium (QUAT) based (for example, products that contain n-alkyl (x)benzyl ammonium chloride solution where (x) can be any organic functional group such as ethyl and methyl, and so on; concentration at use should be less than 0.5% total for all QUATs listed)
- Accelerated hydrogen peroxide based, except on Doppler transducers (D2cwc, D2tcd, and D5cwc)
- Activated hydrogen peroxide based, except on Doppler transducers (D2cwc, D2tcd, and D5cwc)
- Alcohol or alcohol plus QUAT based (product alcohol content cannot exceed 70%)

Products not specifically listed in the following table but with similar active ingredients, as indicated above, and marketed for medical use may be used. Because of the large number of products available, it is impossible to have an all-inclusive list. If you are unsure of the suitability of a particular product, please contact your Philips representative for assistance.

For more information:

- Philips Ultrasound Transducer Care website (www.healthcare.philips.com/us/products/ultrasound/transducers/transducer_care/)
- In North America, call Philips at 800-722-9377.
- Outside North America, contact your local Philips representative.

Disinfectants and Cleaning Solutions Compatibility Table Legend

Origin (Country Code)	Application Definitions	Special Instructions
AU = Australia	T = Approved for use on the transducer	1. Soak or per product instructions
CA = Canada	C = Approved for use on the cable	--
DE = Germany	H =Approved for use on the handle housing	--
ES = Spain	N = Not approved for use	--
FR = France	--	--
UK = United Kingdom	--	--
US = United States	--	--

Disinfectants and Cleaning Solutions Compatibility

Solution	Origin	Qualified Use	Active Ingredients	C5-1	D2cwc	L12-3	S5-1	S7-3t	V6-2	X5-1	X6-1	X7-2t
				C8-5	D2tcd	L12-5 50	S8-3					
				C9-2	D5cwc	L15-7io	S12-4					
				C10-3v		L18-5						
				C10-4ec								
70% Isopropyl Alcohol	All	Spray/ Wipe	Alcohol	T	T	T	T	H	T	T	T	H
AbcoCide	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
AbcoCide 28	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Accel Wipes	CA	Wipe	Hydrogen Peroxide	T,C	N	T,C	T,C	N	T,C	T,C	T,C	T,C,H
Aidal	AU	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Aidal Plus	AU	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Alkaspray	FR	Spray/ Wipe	Alcohol, Alkylamine	T	T	T	H	T	T	T	T	H
Ampholysine Basique	FR	Spray/ Wipe	Biguanide/ Quat. Ammonia	T,C	T,C	T,C	T,C	T,C	T,C	T,C	T,C	T,C
Aniosept Activ	FR	Soak ¹	Peracetic Acid	T,C	N	T,C	T,C	N	T,C	T,C	T,C	T
Anioxyde 1000	FR	Soak ¹	Peracetic Acid	T,C	N	T,C	T,C	N	T,C	T,C	T,C	T
Antigermix AE1	FR	AE1 System	UV-C	N	N	N	N	N	N	N	N	T

Solution	Origin	Qualified Use	Active Ingredients	C5-1	D2cwc	L12-3	S5-1	S7-3t	V6-2	X5-1	X6-1	X7-2t
				C8-5	D2tcd	L12-5 50	S8-3					
				C9-2	D5cwc	L15-7io	S12-4					
				C10-3v		L18-5						
				C10-4ec								
Antigermix S1	FR	S1 System	UV-C	T,C	N	T,C	T,C	N	N	T,C	T,C	N
Banicide	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Bleach (10% solution of 5.25% Bleach)	All	Spray/ Wipe	Sodium Hypochlorite	T,C	T,C	T,C	T,C	C	T,C	T,C	T,C	C
CaviWipes	US	Wipe	Alcohol, Quat. Ammonia	T	T	T	H	T	T	T	T	H
Cidex	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Cidex 7	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Cidex OPA	US	Soak ¹	Ortho-phthal aldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Cidex PAE 14J	FR	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Cidex Plus	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Cleanisept Wipes	DE	Spray/ Wipe	Quat. Ammonia	T,C	T,C	T,C	T,C,H	T,C	T,C	T,C	T,C	T,C,H
Descoton Extra	DE	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Dispatch	US	Spray/ Wipe	Sodium Hypochlorite	T,C	T,C	T,C	T,C	C	T,C	T,C	T,C	C
Endo FC	FR	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Endosporine	FR	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Enzol	US	Pre- cleaner	Enzymes	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Epizyme Rapid	AU	Pre- cleaner	Enzymes	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Gigasept FF (neu)	DE	Soak ¹	Succinic dialdehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Gigasept PAA	DE	Soak ¹	Peracetic	T,C	N	T,C	T,C	N	T,C	T,C	T,C	T

Solution	Origin	Qualified Use	Active Ingredients	C5-1 C8-5 C9-2 C10-3v C10-4ec	D2cwc D2tcd D5cwc	L12-3 L12-5 50	S5-1 S8-3	S7-3t S12-4	V6-2	X5-1	X6-1	X7-2t
Incidin	DE	Spray/ Wipe	Alcohol	T	T	T	H	T	T	T	T	H
Incidur Spray	DE	Spray/ Wipe	Alcohol, Quat. Aldehyde	T	T	T	H	T	T	T	T	H
Instruzyme	FR	Pre- cleaner	Enzymes, Quat. Ammonia, Biguanide	T,C	N	T,C	N	T	T,C	N	T,C	T
Klenzyme	US	Pre- cleaner	Enzymes	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Kohrsolin	DE	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Korsolex Basic	FR	Soak ¹	Aldehyde Releasing	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Korsolex Extra	FR	Soak ¹	Aldehydes/ Quaternary Ammonium	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Korsolex PAE	FR	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
MaxiCide Plus	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
MedDis	UK	Soak ¹	Quat. Ammonia, Sulfamic Acid	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Medistel	UK	Soak ¹	Quat. Ammonia, Sulfamic Acid	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
MetriCide	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
MetriCide 28	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
MetriCide OPA Plus	US	Soak ¹	Ortho- phthalaldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
MetriCide Plus 30	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T

Solution	Origin	Qualified Use	Active Ingredients	C5-1	D2cwc	L12-3	S5-1	S7-3t	V6-2	X5-1	X6-1	X7-2t
				C8-5	D2tcd	L12-5 50	S8-3					
				C9-2	D5cwc	L15-7io	S12-4					
				C10-3v		L18-5						
				C10-4ec								
MetriZyme	US	Pre-cleaner	Enzymes	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Mikrozid PAA	DE	Wipe	Peracetic Acid	T,C	N	T,C	T,C	N	T,C	T,C	T,C	T
Mild Soap Solution	All	Pre-cleaner	Surfactants/Sap	T,C	T,C	T,C	T,C	T,C	T,C	T,C	T,C	T,C
Milton	AU	Spray/Wipe	Sodium Hypochlorite	T,C	T,C	T,C	T,C	C	T,C	T,C	T,C	C
NDP Med Concentrated Plus	SP	Soak ¹	N-Duopropenide, Alkylamine	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Omnicide 14NS	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Omnicide 28	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Opti-Cide 3	US	Spray/Wipe	Alcohol, Quat. Ammonia	T	T	T	T	H	T	T	T	H
Oxivir	US	Wipe	Hydrogen Peroxide	T,C	N	T,C	T,C	N	T,C	T,C	T,C	T,C,H
Peracetic Acid OCS	UK	Soak ¹	Peracetic Acid	T,C	N	T,C	T,C	N	T,C	T,C	T,C	T
PeraSafe Powder	UK	Soak ¹	Peracetic Acid	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Perastel (formerly Perascope)	UK	Soak ¹	Peracetic Acid	T,C	N	T,C	T,C	N	T,C	T,C	T,C	T
PerCept Wipes	CA	Wipe	Hydrogen Peroxide	T,C	N	T,C	T,C	T,C,H	T,C	T,C	T,C	T,C,H
Phagocide D	FR	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Phagozyme ND	FR	Pre-cleaner	Enzymes, Quat. Ammonium	T,C	N	T,C	N	T	T,C	N	T,C	T
Pro-Cide	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T

Solution	Origin	Qualified Use	Active Ingredients	C5-1	D2cwc	L12-3	S5-1	S7-3t	V6-2	X5-1	X6-1	X7-2t
				C8-5	D2tcd	L12-5 50	S8-3					
				C9-2	D5cwc	L15-7io	S12-4					
				C10-3v		L18-5						
				C10-4ec								
Pro-Cide 14NS	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Pro-Cide 28	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Pro-Cide NS	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Pro-Cide Plus	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Prolystica 2X	US	Pre-cleaner	Enzymes	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Protex Disinfectant Spray	US	Spray/ Wipe	Quat. ammonia	T,C	T,C	T,C	T,C	T,C,H	T,C	T,C	T,C	T,C,H
PSS Select 14 Day	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
PSS Select 28 Day	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
PSS Select Plus	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Quaternary Ammonium	All	Spray/ Wipe	Quat. Ammonia	T,C	T,C	T,C	T,C	C	T,C	T,C	T,C	C
Rapicide	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Resert XL HLD	US	Soak	Hydrogen Peroxide	T,C	N	T,C	T,C	N	T,C	T,C	T,C	N
Rivascop	FR	Spray/ Wipe	Quat. Ammonia	T,C	T,C	T,C	T,C	T,C,H	T,C	T,C	T,C	T,C,H
Salvanios pH 10	FR	Spray/ Wipe	Quat. Ammonia	T,C	T,C	T,C	T,C	T,C,H	T,C	T,C	T,C	T,C,H
Sani-Cloth Active	US	Wipe	Quat. Ammonia	T,C	T,C	T,C	T,C	T,C,H	T,C	T,C	T,C	T,C,H
Sani-Cloth AF	US	Wipe	Quat. Ammonia	T,C	T,C	T,C	T,C	T,C,H	T,C	T,C	T,C	T,C,H
Sani-Cloth AF3	US	Wipe	Quat. Ammonia	T,C	T,C	T,C	T,C	T,C,H	T,C	T,C	T,C	T,C,H

Solution	Origin	Qualified Use	Active Ingredients	C5-1	D2cwc	L12-3	S5-1	S7-3t	V6-2	X5-1	X6-1	X7-2t
				C8-5	D2tcd	L12-5 50	S8-3					
				C9-2	D5cwc	L15-7io	S12-4					
				C10-3v		L18-5						
				C10-4ec								
Sani-Cloth Bleach	US	Wipe	Sodium Hypochlorite	T,C	T,C	T,C	C	T,C	T,C	T,C	T,C	C
Sani-Cloth Plus	US	Wipe	Alcohol, Quat. Ammonia	T	T	T	H	T	T	T	T	H
SDS 14 NS	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
SDS 28	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Sekucid N	FR	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Sekusept Aktiv	DE	Soak ¹	Peracetic Acid	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Sekusept Easy	DE	Soak ¹	Peracetic Acid	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Sekusept Plus	DE	Soak ¹	Glucoprotamin	T,C	N	T,C	N	T	T,C	N	T,C	T
Steranios 2%	FR	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
TD-5	US	TD-100 Reprocessor	Glutaraldehyde	N	N	N	N	T	N	N	N	T
T-Spray	US	Spray/ Wipe	Quat. Ammonia	T,C	T,C	T,C	T,C	T,C,H	T,C	T,C	T,C	T,C,H
T-Spray II	US	Spray/ Wipe	Quat. Ammonia	T,C	T,C	T,C	T,C	T,C,H	T,C	T,C	T,C	T,C,H
Tristel Duo	UK	Foam/ Wipe	Chlorine Dioxide	T,C	N	T,C	T,C	N	N	T,C	T,C	N
Tristel Fuse for Instruments	UK	Stella System	Chlorine Dioxide	T,C	N	T,C	T,C	T	N	T,C	T,C	T
Tristel Sporicidal Wipes	UK	Wipe	Chlorine Dioxide	T,C	T,C	T,C	T,C	T	N	T,C	T,C	T
Trophon EPR	AU	Trophon EPR Reprocessor	Hydrogen Peroxide	T,C	N	T,C	T,C	N	T,C	T,C	T,C	N

Solution	Origin	Qualified Use	Active Ingredients	C5-1 C8-5 C9-2 C10-3v C10-4ec	D2cwc D2tcd D5cwc	L12-3 L12-5 50 L15-7io	S5-1 S8-3 S12-4	S7-3t L18-5	V6-2	X5-1	X6-1	X7-2t
Vaposeptol	FR	Spray/ Wipe	Alcohol, Biguanide	T	T	T	H	T	T	T	T	H
Vespore	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Virox 5 RTU	CA	Wipe	Hydrogen Peroxide	T,C	N	T,C	T,C	T,C,H	T,C	T,C	T,C	T,C,H
Wavicide -01	US	Soak ¹	Glutaraldehyde	T,C	N	T,C	T,C	T	T,C	T,C	T,C	T
Wip'Anios	FR	Wipe	Alohol, Quat. Ammonia	T	T	T	H	T	T	T	T	H

14 System Maintenance

Maintenance should be performed regularly and as needed.

Because the system is a piece of medical equipment that contains several circuit boards, extensive service diagnostics, and complex operating software, Philips recommends that only trained personnel service the system.

Cleaning and Maintaining the System

It is important to clean and maintain the ultrasound system and peripherals. Thorough cleaning is particularly important for pieces of peripheral equipment, because they contain electromechanical devices. If exposed to constant and excessive environmental dust and humidity, these devices will suffer in both performance and reliability.

It is essential to clean the transducers used with your ultrasound system. The cleaning procedures vary for the different types of transducers and their uses.

For detailed instructions on how to clean and maintain each type of transducer used with the system, including disinfectant compatibility, see the “[Transducer Care](#)” section.

Cleaning the System and ECG Equipment

Use this method to clean the system and the ECG cables, leads, and electrodes. You can use a mild soap solution. If the equipment has come in contact with blood or infectious material, clean the equipment with a 70% solution of isopropyl alcohol. For instructions on disinfecting system surfaces, see “[Disinfecting System Surfaces](#)” on page 290.



WARNING

Always use protective eyewear and gloves when cleaning and disinfecting any equipment.



CAUTION

Attempting to disinfect a cable or connector by using a method other than the one included here can damage the device and voids the warranty.

**CAUTION**

Orient the parts that must remain dry higher than the wet parts until all parts are dry.

Use the following procedure to clean the display; the system control panel; all the external surfaces of the system and the cart; and the ECG trunk cables, leads, and electrodes.

1. Before cleaning, turn off the system and unplug the power cord from the power source.
2. Wipe with a soft cloth moistened with soap and water.

**CAUTION**

Do not spill or spray liquid on the controls, into the system cabinet, or into the transducer connection receptacle.

3. Remove any solid matter around the keys or the controls with a cotton swab or toothpick to ensure that solids are not pushed into the cabinet.
4. If blood or other infectious material comes in contact with the system or any cable other than a transducer cable, wipe with a 70% solution of isopropyl alcohol.

**CAUTION**

If blood or other infectious material comes in contact with a transducer or transducer cable, do not wipe with isopropyl alcohol until you have read the “[Transducer Care](#)” section for specific cleaning guidelines. Isopropyl alcohol should not be used on some parts of the transducer and should never be used on any parts of the transducer cable. Additional cleaning agents are also available for transducers.

**CAUTION**

Do not use strong solvents, common cleaning products, or abrasive cleansers, which will damage the system surfaces.

**CAUTION**

Do not touch the displays with sharp objects or use paper towels to clean them, which may damage them.

5. Remove dust from the monitor screen and touch screen with a soft, lint-free cloth. A micro-fiber cloth is recommended. Clean the monitor screen and touch screen using a liquid screen cleaner specifically designed for LCDs. Spray the liquid onto the cleaning cloth or spray sparingly onto the displays. You can also use pre-moistened screen wipes. Dry the displays with a soft, lint-free cloth.

**CAUTION**

When cleaning the system control panel, monitor screen, touch screen, and keyboard, take care not to get any solution inside the housings. Also take care not to scratch the face of the monitor while cleaning it.

**CAUTION**

Do not use cleaners containing bleach on the touch screen. It may damage the surface.

6. Remove any residue with a cloth moistened with sterile water.
7. Be sure to dry the equipment to prevent potential corrosion.

Disinfectants for System Surfaces

The exterior surfaces of the system can be disinfected using a compatible disinfectant with a wipe method.

System surfaces include the monitor screen, the touch screens, and plastic and painted surfaces. The following products can be used on system surfaces:

- Mild soap solution
- 70% isopropyl alcohol (IPA)
- T-Spray II (quaternary ammonium-based)
- Opti-Cide 3 (quaternary ammonium/isopropyl alcohol-based)
- Sani-Cloth HB (quaternary ammonium-based)
- Sani-Cloth Plus (quaternary ammonium/isopropyl alcohol-based)
- 0.5% Accelerated hydrogen peroxide

Other products that are based on quaternary ammonium compounds (QUAT) or QUAT/isopropyl alcohol can also be used in disinfecting system surfaces.

Disinfecting System Surfaces



WARNING

Always use protective eyewear and gloves when cleaning and disinfecting any equipment.



CAUTION

Use only compatible disinfectants on system surfaces.



CAUTION

If you use an isopropyl alcohol solution for disinfection, ensure the solution is only 70% alcohol or less. Solutions of more than 70% alcohol can cause product damage.

Before performing this procedure, read “[Disinfectants for System Surfaces](#)” on page 289.

1. Turn off the system and disconnect the system power cord from the wall outlet.
2. Use a soft cloth lightly dampened in a mild soap or detergent solution to clean exterior surfaces on the system.
3. Mix the disinfection solution compatible with your system according to label instructions for solution strength.



CAUTION

Do not spray disinfectant directly on system surfaces. When wiping, do not allow disinfectant to pool or run on system surfaces. In either case, disinfectant may leak into the system, damaging the system and voiding the warranty. Wipe only with a cloth or applicator that is lightly dampened.

4. Wipe system surfaces with the disinfectant, following disinfectant label instructions for wipe durations, solution strengths, and disinfectant contact duration. Ensure the solution strength and duration of contact are appropriate for the intended clinical application.

5. Air dry or towel dry with a sterile cloth according to the instructions on the disinfectant label.
6. Because the system is a piece of medical equipment that contains several circuit boards, extensive service diagnostics, and complex operating software, Philips recommends that only trained personnel service the system.

System Control Panel Maintenance

The system control panel and other outer surfaces are most likely to be affected by liquid spills and other materials such as excessive amounts of gel. These materials may seep into electrical components under the panel and cause intermittent failures. During preventive maintenance, look for such potential problems including loose knobs and worn controls.

Regularly clean the outside of the system as described in “[Cleaning the System and ECG Equipment](#)” on page 287.

Cleaning the Trackball

Cleaning the trackball regularly prolongs its useful life and prevents service calls.

1. With your fingers, unscrew the ring around the trackball.
2. Lift the trackball out of the mounting area.
3. Clean the trackball and the mounting area with a lint-free cloth or a small brush.
4. Place the ball back on the mounting area.
5. With your fingers, screw the ring back on.

Cleaning the System Air Filter

The system air filters should be inspected every week and cleaned as needed. The air filter is located in a slot at the bottom left side of the system. If you decide to clean the air filters with soap and water, you may want to install a spare filter while the other filter is drying. Additional air filters can be ordered from Philips.



WARNING

Before performing maintenance or cleaning, always turn off the system, and then disconnect the system from the wall outlet.

**CAUTION**

Turn off power before you remove the air filter. Do not turn on power without the air filter installed.

**CAUTION**

Ensure that air filter is dry before installing it. Installing a wet or damp air filter can damage the system.

1. Locate the air filter handle at the bottom of the left side of the system.
2. Pull the air filter handle straight out, until the filter is completely removed from the system.
3. Inspect the filter. Depending on the condition of the air filter, vacuum or rinse the filter with water to clean it. If the filter is worn out, or cannot be cleaned, replace it with a spare.
4. To reinstall the filter, slide the filter into place at the bottom of the left side of the system.



Removing the System Air Filter

Specifying and Resetting the Air Filter Maintenance Status

1. Press **Support**.
2. In **Philips SupportConnect**, click **Test/Utilities**.
3. Click **Check Filter Status**.
4. To change the cleaning interval for the air filter, under **Filter Cleaning**, type the number of days in **Interval**.
5. To reset the interval after cleaning the filter, under **Filter Cleaned**, click **Done**.
6. To exit **SupportConnect**, touch **Close**.

Transducer Maintenance

Transducers require proper care, cleaning, and handling. Reasonable care includes inspection, cleaning, and disinfection or sterilization, as necessary.

Inspect the transducer cable, case, and lens before each use. Check for cracks or other damage that jeopardizes the integrity of the transducer. Report any damage to your Philips customer service representative, and discontinue use of the transducer.

For all information on transducer cleaning and disinfection, see the “[Transducer Care](#)” section. For all information about the use of acoustic coupling gels, see “[Ultrasound Transmission Gels](#)” on page 184.



CAUTION

Some ultrasound coupling gels, as well as some solutions for precleaning, disinfecting, and sterilizing can damage a transducer. Before using a gel or solution on a transducer, see “[Ultrasound Transmission Gels](#)” on page 184 or the “[Transducer Care](#)” section. You can also contact your local Philips representative. For contact information, see “[Customer Service](#)” on page 22.

If you encounter poor image quality or transducer problems, see “[Troubleshooting](#)” on page 295.

Printer and DVD Recorder Maintenance

Before performing any maintenance on a device, observe the following warnings and cautions:



WARNING

If the device is internal to the system, turn off the system and disconnect the system from the wall outlet. If the device is external to the system, disconnect the device from the wall outlet.



CAUTION

Do not scratch the roller or allow dirt and dust to contact the roller of a printer.



CAUTION

Do not use strong solvents such as thinner or acetone, or abrasive cleaners, because those will damage a device cabinet.

**CAUTION**

Do not unplug the system from the wall outlet until the system is completely off. If you unplug your system before the shutdown message appears, you will have to wait longer than usual to use your system the next time you turn it on. You may also corrupt files, which can result in an inoperative system or the loss of patient data.

Periodically clean the external surfaces of a device with a soft cloth. Difficult stains may be removed with a cloth lightly dampened with a mild detergent solution.

Troubleshooting

If you encounter difficulty in the operation of the system, use the information here to help correct the problem. If the problem is not covered here, contact your Philips representative.

The troubleshooting table contains a list of symptoms and the actions to take to correct the problems.

Troubleshooting

Symptoms	Corrective Action
The system does not power up. The monitor indicator light is off.	<ol style="list-style-type: none">Verify the power connections.Check the circuit breaker on the back of the system.
No image displays on the monitor.	<ol style="list-style-type: none">After power up, the system takes about 20 seconds to initialize. During this time the monitor is blank.After 20 seconds, adjust the monitor brightness.Check the monitor cables and connections.
No audio comes from the system speakers.	Adjust the volume to ensure that the speakers are not muted.
An error message is displayed.	Run the system test (see " Testing the System " on page 297).
An error message indicates that the system is above normal operating temperature.	<ol style="list-style-type: none">Click Continue. The system will power down automatically in 30 minutes.With power off, check for obstructed air filters (see "Cleaning the System Air Filter" on page 291).

Error Messages

The system displays error messages in response to operating or error conditions detected by the system.

The error messages must be noted and reported to your Philips representative, who may ask you to run the system test (see “[Testing the System](#)” on page 297).

Test Patterns

Two sets of test patterns are available for testing the image quality of the system, peripheral devices, review stations, or a PACS.

- The original set of test patterns (labeled **Test Patterns**) includes images intended for a variety of tests. Unlike the TG-18 test patterns, however, these test patterns are not tied to a unified standard.
- The newest set of test patterns was created by the American Association of Physicists in Medicine Task Group 18 (TG-18). The TG-18 test patterns on the system were adapted for the 1024 x 768 pixel image area of the 54.6-cm (21.5-in) system monitor. For information on using these test patterns, read IEC publication 61223-3-6 (62B/588/CD).

Transferring the Test Patterns

The test patterns are stored on a separate part of the system hard drive. You must transfer the test patterns to a different part of the hard drive before you can view them. The transferred test patterns remain unless you delete them.

1. Press **Review**.
2. Select **Test Img**s from the **Source** menu.
3. Select **TG18 Test Patterns** or **Test Patterns** from the exam selection list.
4. Click **Send To HD**. A status message indicates that the transfer is in progress.

Using the Test Patterns

1. Press **Review**.
2. On the **Source** menu, select **Hard Drive**.
3. Select **TG18 Test Patterns** or **Test Patterns** from the exam selection list.
4. Click **Display Exams** and do any of the following:

- To send a test pattern to a local printer, double-click a test pattern to display it full-screen, and touch **Alt Print**.
- To send a test pattern to a DICOM printer or archive server, click a test pattern number to select it, click **Send To**, select a device, and click **OK**.

Testing the System

The system test is a comprehensive test of the system operational status. This test includes numerous subtests. If a subtest fails, the system completes the remaining subtests. The system test displays only a pass-fail result on the system monitor. If the system test fails, notify your Philips service representative.

Run the system test any time a system error is displayed, or if you suspect problems with the system. If an error message is displayed during the test, restart the system with the  (On/Off) control.

NOTE

The system test can take several minutes to run.

1. Turn on the system.
2. Disconnect all transducers from the system.
3. Press **Support**.
4. In **Philips SupportConnect**, click the **Test/Utilities** tab.
5. Under **Navigator**, click **System Test**.
6. In the **System Test** area, click **Run**. The system displays a message when the test is complete, indicating whether the test passed or failed.
7. If the test fails, contact your Philips service representative for instructions about how to export the log files.
8. Restart the system as explained in “[Turning the System On and Off](#)” on page 113.

For Assistance

If you are unable to correct a problem, call your local Philips representative.

System Maintenance

For Assistance

15 Specifications

Philips reserves the right to change specifications contained herein or discontinue manufacture at any time without prior notice. Current specifications are supplied with each system purchased or are available from your Philips representative.

Dimensions

- Width: 59.2 cm (23.3 in)
- Height (with fully extended monitor): 188.6 cm (74.25 in)
- Height (with monitor folded down): 125.7 cm (49.5 in)
- Depth (Maximum extension): 111.8 cm (44 in)
- Depth (Minimum extension): 79.4 cm (31.25 in)
- Weight: 102 kg (225 lb)

Gray Shades

255 in 2D, M-mode, and Doppler

Scan Lines

Up to 1,024 scan lines, depending on transducer and mode

Monitor

- 54.6 cm (21.5 in) flat-panel monitor on a tilt/swivel arm
- 128 hues of color available
- 24-bit color

Input Signals

- Four transducer receptacles
- Pencil probe receptacle
- Physio pulse, phono, auxiliary 1, and auxiliary 2
- High- and low-level ECG

Output Signals

- External printer
- USB serial data
- Video: S-Video, and Digital DisplayPort
- Physio analog signal

Data Connections

- Ethernet network (Gigabit, 10Base-T, and 100Base-T)
- Wireless network (IEEE 802.11 b/g)
- USB 3.0 devices at USB 2.0 speeds
- Digital Navigation Link (DNL)

Modality Interface

DICOM standard. DICOM conformance statements for Philips products are available at this website:

www.healthcare.philips.com/us/about/connectivity/dicom_conformance_main.wpd

Physio

- ECG amplitude range between 0.15 mV and 5.0 mV
- Duration of the QRS wave between 40 ms and 120 ms
- Lower Frequency Cut-off: 0.70 Hz ±10%
- Upper Frequency Cut-off: 17 Hz ±10%
- Nominal Input Amplitude: ±5 mV peak
- Minimum QRS Wave Amplitude: 0.05 mV

Peripherals

- Black-and-white image printer
- Foot switch
- Color image printer
- DVD recorder
- Report printer
- External monitor

Electrical Parameters

AC Voltage

- AC voltage 100-240 V~
- 50 or 60 Hz
- 600 VA

Power must be available through a grounded outlet.

In the United States, power must be available through a grounded, hospital-grade outlet.

Languages

Localized user interface (including international symbols on key caps) and *Help*:

Danish	German	Spanish
Dutch	Italian	Swedish
French	Norwegian	

Localized documentation, other than *Help*:

Bulgarian	Greek	Norwegian
Chinese, Traditional and Simplified	Hungarian	Polish
Czech	Indonesian	Portuguese (Brazilian)
Danish	Italian	Romanian
Dutch	Japanese	Russian
Estonian	Kazakh	Slovak
Finnish	Korean	Spanish
French	Latvian	Swedish
German	Lithuanian	Turkish

Pressure Limits

- Operating: 525 mmHg to 795 mmHg (700 hPa to 1,060 hPa)
- Storage: 427 mmHg to 795 mmHg (570 hPa to 1,060 hPa)

Humidity Limits

- Operating: 15% to 80%
- Storage: 15% to 95%

Temperature Limits

- High operating temperature: 40°C (104°F) between 1060 hPa and 795 hPa (795 mmHg to 596 mmHg), linearly decreasing to 35°C (95°F) at 700 hPa (525 mmHg)
- Low operating temperature: 10°C (50°F) from 700 hPa to 1060 hPa (525 mmHg to 795 mmHg)
- Storage temperature range: -20°C to 60°C (-4°F to 140°F)

Safety and Regulatory Requirements

Classification

- Class I equipment with Type BF and Type CF applied parts
- Ordinary Equipment/Continuous Operation
- Non-AP/APG

Electromechanical Safety Standards Met

The system complies with the requirements of IEC 60601-1 Medical Electrical Equipment, General Requirements for Safety, including all applicable collateral and particular standards, as well as all applicable national deviations.

Compliance

Philips products comply with relevant international and national standards and laws. Information on compliance will be supplied by your local Philips representative, or the manufacturer, on request.

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