

# SONOS 7500/5500

Using 3-Dimensional and BiPlane Imaging  
And Other System Changes for Software Revision D.1



# PHILIPS

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## Using 3-Dimensional and BiPlane Imaging

And Other System Changes  
for Software Revision D.1

Philips SONOS 7500 and 5500 Systems

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### Electrical Shock Hazard

Do not remove system covers.  
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only supplied power cords and  
connect only to properly  
grounded wall (wall/mains)  
outlets.

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Do not operate the system in  
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### Safety Information

Before you use any transducer  
for the first time, be sure to  
read all applicable usage,  
patient-safety, operator-safety,  
and electrical-safety guidelines  
in the Safety-and-Standards  
and Transducer documentation  
for your system.

Pay special attention to the  
“Warnings” and “Cautions.”

The warnings explain the dan-  
gers of electrical shock and ex-  
plosion hazard, the safety of  
ultrasound, applications,  
guidelines for fetal use, and  
guidelines for setting controls  
that affect acoustic output and  
accuracy of clinical measure-  
ments. The cautions explain po-  
tential dangers to equipment.

### Warning Symbol Used in the Text:

## WARNING

### Caution Symbol Used in the Text:

## CAUTION

### Warning Symbols Used on the System:



Instruction manual symbol: the  
product will be marked with  
this symbol when it is neces-  
sary for the user to refer to the  
instruction manual in order to  
protect the product against  
damage.



Dangerous voltages symbol:  
Indicates potential for electri-  
cal shock.

### Monitor Radiation

The monitor used in this sys-  
tem complies with the FDA  
regulations that were applica-  
ble at the date of manufacture  
(21 CFR Subcategory J).

### Prescription Device

The United States Food and  
Drug Administration requires  
the following labeling state-  
ment:

Caution—Federal Law  
restricts this device to use by or  
on the order of a physician.

### Important

**CE**<sub>0123</sub> marking is for  
Council Directive  
93/42/EEC.

This system complies with the  
Medical Device Directive.

Authorized EU  
Representative:

Philips Medical Systems  
Nederland B.V.  
Corporate Quality and  
Regulatory Group  
Veenpluis 4  
5684 PC Best,  
The Netherlands  
PMS.Incident@philips.com

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## Preface

This guide describes the 3-Dimensional and BiPlane imaging procedures for the Philips SONOS ultrasound imaging systems. It also includes an appendix describing other system changes implemented in Software Revision D.1.

Use this guide in conjunction with the following user's guides:

- *System Basics*—Describes the basic operation of the Philips SONOS systems.
- *Controls Reference*—Provides a detailed description of all system controls.
- *Safety and Standards Guide*—Provides information on safety issues.
- *Measurements and Calculations Reference*—Provides information on measurements and calculations that you can perform on your ultrasound system.
- *Transducer Reference*—Provides information on the operation, care, and cleaning of transducers.

Additionally, several specialty guides and multimedia products describe SONOS imaging applications and optional packages:

- *Using Integrated Digital Interface (IDI)*
- *Using Stress Echocardiography*
- *Using Acoustic Quantification*
- *Using Acoustic Densitometry*
- *Using Contrast Imaging*
- *SONOS Live 3D Cardiac Echo: Features and Fundamentals* (a CD guide to Live-3D cardiac imaging)
- *SONOS BiPlane Imaging* (a CD guide)
- *LVO and Contrast CK: A Practical Approach* (a video guide to SONOS contrast echocardiography detection techniques)
- *Stress Audio CD* (a spoken guide to performing SONOS stress echocardiography studies)

## Conventions Used in This Guide

The following conventions are used in this guide:

- Touch control and rotary control names appear in bold text. For example, **Acquire Loop**.
- The names of the function keys on the system keyboard appear in a box. For example, **Enter**.

## Foot Switch Warning

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**WARNING**

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The SONOS foot switch is not approved for use in operating-room environments.

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## Some SONOS System Changes for Software Revision D.1

This section describes some changes that were made to the SONOS 7500 system for software Revision D.1 (other than the changes made to Live 3D, Full Volume, 3D Color, and BiPlane functions). Changes to the Live-3D, Full Volume, 3D Color, and BiPlane functions are described elsewhere in this manual.

The following material is covered in this section:

- Maximum Live 3D frame rate
- **Report to Serial Pt** control
- **Disk Space** control
- IDI beeps
- Password access to full test mode
- Network utilities access through full test mode

### Maximum Live 3D frame rate

The maximum Live 3D frame rate increased from 21 Hz to 28 Hz. This improved frame rate can be observed at depths of 10 cm or less.

### Report to Serial Pt control

When set to **On**, the **Report to Serial Port** touch control sends analysis reports to a device connected to the system's serial port. When set to **Off**, the control sends analysis reports to a selected printer.

Type: Touch control toggle

Location: **Setup** > **System** > **Report to Serial Pt** control on right primary touch panel

Values: **On/Off**

---

#### NOTE

In prior software revisions, this functionality was accessed through the **Analysis** > **Serial Output** control.



## Disk Space control

The **Disk Space** touch control displays the amount of space available on the disk and the approximate number of 1-beat loops that may be stored in the remaining space.

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### NOTE

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This control is not available for the Live-3D disk drive, which uses different storage displays.

Type: Touch control

Location: **Disk** > **Disk Space** control on left touch panel

## IDI beeps

During IDI processes, the system beeps to indicate that

- IDI processes are running.
- Image files are stored.
- Study transfers are complete.

## Password access to full test mode

Access to system information, such as serial number, configuration, and software revision, is available without entering a password. However, access to full test and configuration modes requires a valid user name and password in the Test Mode Login screen. This opens access to the full SONOS test menu.

Single-day passwords may be obtained at the discretion of the Philips customer-service representative. One can also obtain permanent access by purchasing a separate software option.

## Network utilities access through test mode

The Test Mode Login screen now permits access to SONOS network utilities. To access these utilities, select **Network Utility** in the Login Dialog box.

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### NOTE

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In prior software revisions, network utilities were accessed through **TEST** > **Other Tests & Utilities**.

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# Chapter 1 Introduction

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## 3-Dimensional and BiPlane Imaging Overview

This guide includes information on 3-Dimensional (3D) and BiPlane imaging. Live 3D imaging is the real-time acquisition and rendering of ultrasound data. Full Volume, 3D Color, and 3D Zoom further enhance your ability to investigate 3D anatomy and function. BiPlane imaging allows the display of two views simultaneously. You can use previously existing controls as they are used during 2D imaging.

The acoustic data for the imaging methods described in chapters 1, 2, 3, and 4 is obtained using the x4 Matrix array transducer.

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### NOTE

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If ECG leads are attached to the patient, ECG waveforms may be displayed and stored with forward-acquired ECG loops. These loops include Live 3D, 3D Zoom, Full Volume, and 3D Color.

The ECG is not displayed during Live 3D modes or during acoustic replay (freeze and replay) for Live 3D.

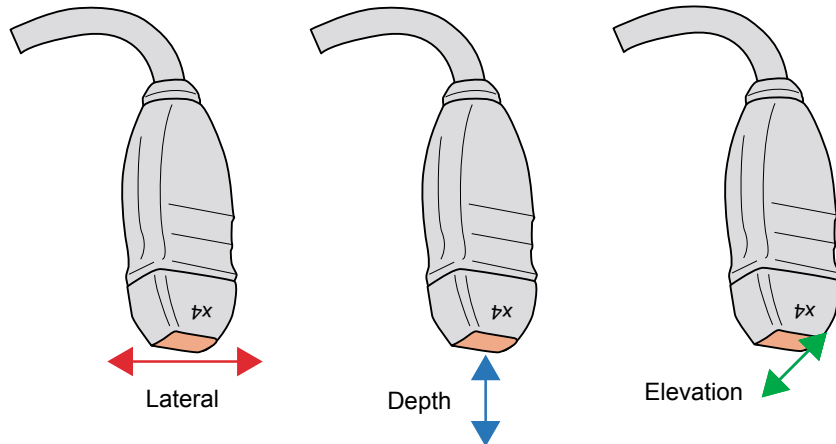
For more information about setting up and collecting ECG waveforms, see the *System Basics* chapter “Physios.”

---

## Introducing the x4 Matrix Array Transducer

The x4 Matrix array transducer technology enables Live 3D and BiPlane imaging by allowing the ultrasound beam to be steered in both the lateral direction (left or right like a sector transducer) and the elevation direction (front to back). This allows rapid acquisition of BiPlane or volume data without moving the transducer. The x4 transducer is optimized for the high frame rates typically used in cardiac ultrasound.

The following illustration shows the three axes in which the x4 transducer sends and receives acoustic data.

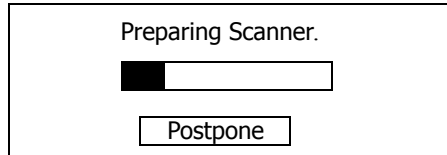


The matrix transducer has several coefficient tables for transmit and receive parameters. These coefficient tables use large amounts of memory and may be loaded when:

- The system is powered up and the x4 transducer is activated
- The density is changed

The tables also may be recalculated after a software upgrade.

The following dialog box is displayed whenever loading is necessary, showing the progress of the calculation.

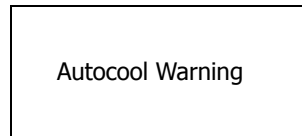


If you press **Postpone**, the loading of coefficients is canceled, but can be done later when modes requiring those coefficients are used.

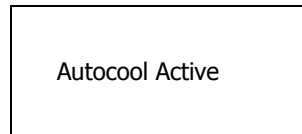
For more information about x4 transducer technology, see the *Reference Manual, Transducer Reference*.

## x4 Matrix Transducer Autocool

If the x4 Matrix transducer reaches a computed temperature of 42.0° C (107.6° F) during imaging, imaging continues, but the following message appears:



If the x4 Matrix transducer reaches a computed temperature of 42.5° C (108.5° F) during imaging, imaging stops and the following message appears.



When the x4 Matrix transducer temperature drops below 40.5° C (104.9° F), the system resumes imaging.



At temperatures above 47.7° C, if autocool detection fails, or if the transducer connector is not seated properly, the following message appears.

Reconnect the Transducer, then  
press Reset. If problem  
persists, contact your Philips  
service representative.

---

## Introducing Live 3D Echo Imaging

Live 3D Echo is an integrated feature that acquires and renders 3-dimensional acoustic data in real time. Because a Live 3D image is a volume of data, more information is obtained than in a typical 2D image. You can rotate the volume by using the trackball, and enhance the image with the traditional 2D controls as well as the new 3D controls. Harmonic imaging is also available.

---

### NOTE

If ECG leads are attached to the patient, ECG waveforms may be displayed and stored with forward-acquired ECG loops. These loops include Live 3D, 3D Zoom, Full Volume, and 3D Color.

The ECG is not displayed during Live 3D modes or during acoustic replay (freeze and replay) for Live 3D.

For more information about setting up and collecting ECG waveforms, see the *System Basics* chapter “Physios.”

### 3D Zoom

The 3D Zoom Preview **Size** and **Position** keys and the 3D Zoom display modes operate similarly to 2D zoom modes. You can use 3D Zoom to view a smaller volume of interest in greater detail. The preview box moves in the lateral and depth dimensions. You can change the size of the zoom box in the depth dimension.

---

### NOTE

The elevation and lateral dimensions of the zoom box are fixed, but can be changed indirectly using the High Density control in the secondary touch panel.

In Zoom mode, two reference images are available to maintain orientation and perspective:

- The left reference image is the lateral plane and is fixed in elevation. This displays the transducer’s current imaging plane.
- The right image displays the elevation plane and is fixed in the lateral dimension.

---

### NOTE

The Reference Image data is not calibrated. Do not make measurements from the Reference Images.

For more information, see [Chapter 2, “Live 3D Echo Imaging.”](#)

---

## Introducing Full Volume Acquisition

Full Volume is a mode in which four subvolumes are compiled to create a larger volume of 3-dimensional information. The system uses either ECG triggering or no triggering for the Full Volume acquisition cycle. Triggered acquisition is used for non-static anatomy. In triggering mode, the system gathers four different subvolumes and combines them into one volume. Nontriggered acquisition is used to acquire images of static objects, and one frame per subvolume is acquired.

---

### NOTE

Any triggered acquisition mode has the potential for temporal artifacts. Due to the triggered nature of a Full Volume acquisition, temporal artifacts might occur due to fast moving structures, rapidly changing flow patterns, respiration, or probe movement.

---

### NOTE

If ECG leads are attached to the patient, ECG waveforms may be displayed and stored with forward-acquired ECG loops. These loops include Live 3D, 3D Zoom, Full Volume, and 3D Color.

The ECG is not displayed during Live 3D modes or during acoustic replay (Freeze and Replay) for Live 3D.

For more information about setting up and collecting ECG waveforms, see the *System Basics* chapter “Physios.”

For more information, see [Chapter 2, “Live 3D Echo Imaging.”](#)

---

## Introducing 3D Color Imaging

3D Color mode uses the Doppler shift to detect velocities in a 3-dimensional anatomical volume. As in 2D color-flow imaging, this additional information helps to assess general blood flow properties.

3D Color combines seven triggered subvolumes into a larger volume color image. This volume can be rotated and cropped along multiple planes, allowing you to see blood flow from several perspectives, as well as relative to tissue and walls. In cardiac applications, the acquisition is synchronized with the R-wave so that the subvolumes are time-aligned for the final rendered image.

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### NOTE

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- No velocity or geometry measurements are available in 3D Color mode. Velocities displayed are average projected velocities, and are not necessarily indicative of flow velocities displayed in 2D color-flow imaging. 3D Color velocities, therefore, differ from what you might see in 2D Color images.
- Any triggered acquisition mode has the potential for temporal artifacts. In triggered 3D Color acquisition, temporal artifacts might occur due to fast moving structures, rapidly changing flow patterns, respiration, or probe movement.

---

## Introducing BiPlane Imaging

BiPlane imaging allows for simultaneous side-by-side viewing of two separate live 2D images and takes advantage of the 2-dimensional array in the x4 Matrix transducer. This allows you to see cardiac function from two simultaneous live image planes.

The default view is two images perpendicular to each other. The left image is the lateral plane and displays the current 2D transducer image plane (conventional orientation). The left image is fixed and cannot be adjusted for rotation or tilt. The right image is the elevation plane and is initially perpendicular to the left image. You can rotate and tilt the right image in reference to the left image as follows:

- 360° rotation of right image (during rotation, all tilts are zeroed)
- Lateral tilt at 90° rotation
- Elevation tilt at 0° rotation

BiPlane mode also supports Zoom, which allows for detailed investigation of anatomy. For more information on Zoom mode, see [Chapter 3, “Live BiPlane Imaging.”](#)

### BiPlane Color

Color flow imaging is supported in BiPlane mode. BiPlane color flow imaging appears in the color box on each of the two images. The behavior of the color box on the left image is the same as in 2D Color mode. In most imaging modes, you use the **Size** and **Position** keys in conjunction with the trackball to resize or reposition the color box on the image. Except in elevation tilt, the box on the right image tracks the left color box vertically, but does not move left or right because the color boxes together define a contiguous color volume. In elevation tilt, however, the boxes in both images move together.

For more information see [Chapter 3, “Live BiPlane Imaging.”](#)

## Using Dual Triggering

Dual triggering lets you set two triggered acquisition points anywhere in the cardiac cycle. Dual triggering can be used in Full Volume and 3D LVO imaging modes. In these modes, two individual frames are captured and processed for each subvolume of the image.

For more information about dual triggering, see the *SONOS 7500/5500 Controls Reference*.

---

## Shutting Down the System


When you turn off the main power switch on the SONOS system, there is a short delay while the 3D PC shuts down. After the 3D PC shuts down, the system shuts down.

---

### CAUTION

If you disconnect the power cord before the system shutdown is complete, the PC may not shut down properly.

To shut down the system:

- Turn the main power switch off  and leave it in the off position for more than three seconds.

The following message appears:

#### **PLEASE WAIT WHILE THE SYSTEM SHUTS DOWN**

After approximately 25 seconds, the 3D PC shuts down. Approximately 15 seconds later, the SONOS system completes shutdown.

---

### WARNING

Do not unplug the system before shutdown ends. Doing so may cause data loss or corrupt the hard disk, damages that may not be covered by the system warranty.

---

### NOTE

If you turn the main power switch back on  within three seconds after turning it off, the shutdown stops. The system and 3D PC remain on.

---

### NOTE

While the SONOS system displays the shutdown message, it ignores further changes to the main power switch, and shutdown completes. If you set the power switch to on while the shutdown message is displayed, both the system and PC power up immediately after shutdown completes.

For detailed information about system power, see the Reference Manual, System Basics and Safety and Standards.

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## Foot Switch Warning

In image preview mode, the **Acquire** function key and Acquire foot switch behave the same as the **Acquire** touch control.

---

### **WARNING**

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The SONOS foot switch is not approved for use in operating-room environments.



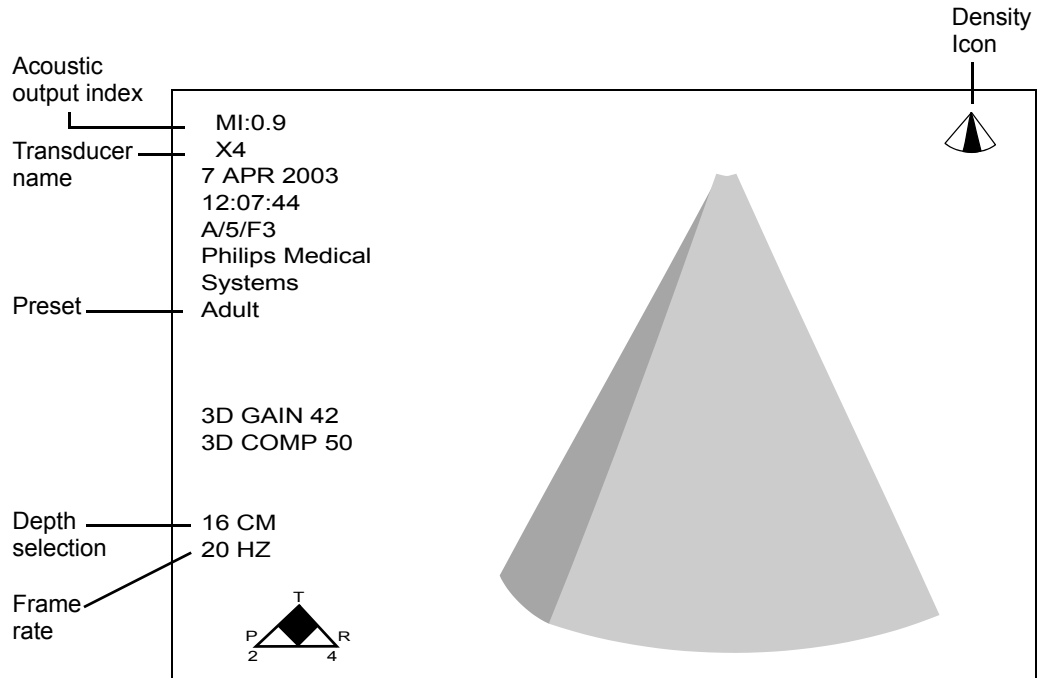


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# Chapter 2 Live 3D Echo Imaging

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## Live 3D Imaging at a Glance



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## Live 3D Echo Imaging Overview

Live 3D Echo imaging enables the capture of 3D images and volume rendering on the SONOS system. Using the x4 matrix transducer, Live 3D Echo images are acquired and displayed. After acquiring the images, you can optimize and manipulate them to view the anatomy of interest. You can then store the acquired images to the 3D hard disk.

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### NOTE

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If ECG leads are attached to the patient, ECG waveforms may be displayed and stored with forward-acquired ECG loops. These loops include Live 3D, 3D Zoom, Full Volume, and 3D Color.

The ECG is not displayed during Live 3D modes or during acoustic replay (freeze and replay) for Live 3D.

For more information about setting up and collecting ECG waveforms, see the *System Basics* chapter “Physios.”

Live 3D Echo imaging display modes include:

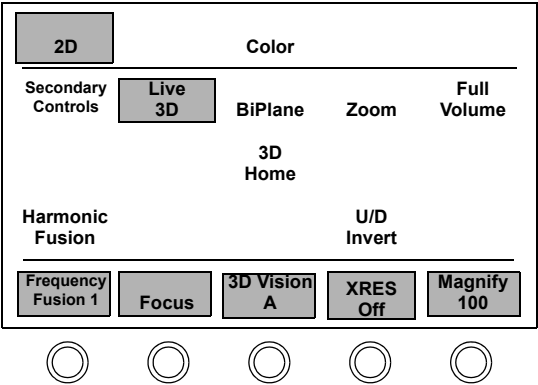
- Live 3D
- 3D Zoom
- Full Volume
- 3D Color

# Live 3D Controls

To activate Live 3D imaging:

- Touch **Live 3D** on the right touch panel.

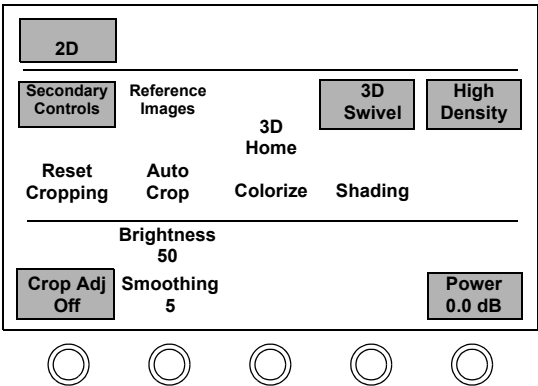
The Live 3D primary touch controls appear.



To display additional 3D controls:

- Touch **Secondary Controls** on the right touch panel.

The 3D secondary controls appear:



The **Gain** and **Compress** dedicated rotary controls on the SONOS keyboard are also important for optimizing Live 3D images.

## NOTE

Many Live 3D controls are named the same as 2D imaging controls. But Live 3D controls may be used slightly differently, as described in the following tables.

## Live 3D Control Descriptions

The following table describes the Live 3D controls:

Control Name	Description
3D Color	Turns on 3D Color preview.
3D Home	Sets the volume viewing angle to Home—the original transducer orientation.
3D Swivel	<p>When 3D Swivel is toggled on, it oscillates the rendered volume to improve 3D visualization. The volume stops oscillating if you use the trackball to rotate or tilt it, but then resumes oscillating from its new position.</p> <p>To access this control, use the Live 3D secondary controls. The control is also available in <b>Loop Display</b> on the right touch panel.</p> <p>NOTE: AVI images can be stored with 3D Swivel activated in the images.</p>
3D Vision	Controls predefined combinations of contrast, transparency, lighting, and compositing algorithms in the rendered 3D image.
Acquire	<p>Starts image acquisition.</p> <p>When you are in Preview mode, the Acquire function key and Acquire foot switch behave the same as the touch control.</p> <p><b>WARNING:</b> The SONOS foot switch is not approved for use in operating-room environments.</p>
Auto Crop	Activates the crop box controls and suppresses the front part of the 3D image.
Brightness	Adjusts the overall brightness of the rendered image.
Cancel	Allows you to cancel a Full Volume acquire. The Cancel key appears after you press the Acquire key.
Colorize	Optimizes contrast resolution by activating a colorization map that overlays the grayscale image.

**Live 3D Controls**

<b>Control Name</b>	<b>Description</b>
Compress (dedicated rotary control)	<p>In all 3D modes, Compress mimics the 2D effect. At low Compress settings, the 3D grayscale image has more contrast, with increased delineation between myocardial surfaces and the blood pool. At high Compress settings, the 3D grayscale image takes on a softer look (more grays), and the delineation between tissue and blood is not as abrupt.</p> <p>NOTE: Unlike in 2D imaging, this control continues to operate after acquisition (in 3D Loop Review).</p>
Crop Adj	Selects the type of tool ( <b>Box</b> , <b>Plane</b> , or <b>Off</b> ) used for cropping.
Delay	Sets the amount of time between the R-wave trigger and the start of each sub-volume acquisition in Full Volume and 3D Color modes. Delay is in 5 millisecond intervals.
ECG Trigger	<p>Selects whether to use ECG triggering (on) or nontriggered (off) acquisition in Full Volume and 3D Color modes. Works in conjunction with the Delay control.</p> <p>NOTE: If ECG Trigger is Off, then an ECG is not required for an acquisition.</p>
Focus	Repositions the acoustic depth of the focal zone, which is indicated by a caret.
Frequency Fusion	Optimizes frequencies for penetration, texture, or resolution.
Full Cycle	<p>When Full Cycle is toggled on, data is acquired over the entire R-R interval in Full Volume and 3D Color modes. After acquisition of the subvolume is complete, preparation is made for the next subvolume acquisition. This results in a non-consecutive beat acquisition cycle.</p> <p>When Full Cycle is toggled off, data is acquired in consecutive R-wave triggered beats. Variations may result in skipped beats.</p> <p>NOTE: Full Cycle trades off acquisition time (number of beats) versus number of frames captured.</p> <p>NOTE: The SONOS system automatically switches to Full Cycle mode when the patient's heart rate reaches or exceeds 80 bpm.</p>

Control Name	Description
Full Volume	Turns Full Volume Preview mode on or off.
Gain (dedicated rotary control)	<p>In Live 3D imaging, Gain should be set to show both valvular structures and surrounding tissue.</p> <ul style="list-style-type: none"> <li>• If Gain is set too high, tissue in front becomes too bright to see inside the chamber.</li> <li>• If Gain is set too low, the image becomes more black-and-white, loses detail, and contains imaging holes.</li> </ul> <p>A good way to set Gain is to set it slightly high and lower it until you see both valves and surrounding tissue.</p> <p>NOTE: Unlike in 2D imaging, this control continues to operate after acquisition (in 3D Loop Review).</p>
High Density	Sets the size of the volume to be displayed by adjusting the line density. Size is set separately for Live 3D, Live 3D Zoom, Full Volume, and 3D Color.
Live 3D	Activates Live 3D mode.
Magnify	Adjusts the size of the rendered image by percentage of the default display size.
Power	Sets acoustic output power.
Reference Images	Displays a pair of fixed 2D reference images derived from the center of the volume. The left image orientation is the same as the conventional 2D imaging plane. The right image is on a plane that is orthogonal to both the left image and the transducer face.
Reset Cropping	Redisplays the original uncropped volume and turns off the cropping controls.
Rotate Volume	When on, allows you to use the trackball to rotate volume images. When off, in cine loop display mode, allows you to scroll through the cine loop image or adjust loop speed.
Shading	Adjusts the shading recipe applied to the rendered image to improve the depth perception.
Smoothing	Averages voxels (volume pixels) to adjust the smoothing or filtering recipe that is applied to the rendered image.

Control Name	Description
U/D Invert	Controls the up-down orientation of the 3D rendered image. When ON (inverted orientation) 3D Home maintains the inverted orientation. The volume is rotated 180° around the elevation axis.
XRES	Improves tissue texture and better defines margins and borders.
Zoom	Magnifies an area of interest within the zoom volume.

## Understanding Line Density

The size of the image is related to its resolution on the screen. The smaller the image size, the greater the resolution of the image. The line density state (high, medium, or low) determines the volume of the image displayed. The higher the density, the smaller the image volume.

The line density resulting from each combination of **Low Density** and **High Density** control settings is as follows:

		High Density setting	
		Off	On
Low Density setting	Off	medium	high
	On	low	high




Live 3D mode does not support “low” line density. Full Volume, 3D Zoom, and 3D Color modes do support “low” line density. Setting the density in Live 3D does not change the density setting in Full Volume, 3D Zoom, or 3D Color modes. Whatever density you choose for 3D Zoom is also set for Full Volume, 2D Color, and vice versa.

**NOTE**

- The **Low Density** control is activated through **Setup** and controls the line density used when the **High Density** control is off.
- Lower line densities may compromise color sensitivity.



The following table shows the meaning of the density icons that appear on the SONOS screen.

Icon	Description
	When High Density is on, a smaller volume size with higher resolution is displayed. This is the density setting when the High Density touch control is highlighted.
	When High Density is off, a larger volume size with lower resolution is displayed. This density is in effect when the High Density touch control is not highlighted and Low Density is off.
	When High Density is off and Low Density is on, the largest volume available and the lowest resolution is displayed.

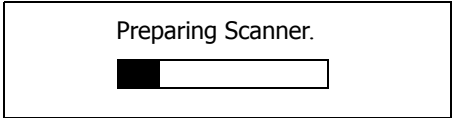
### Setting the line density

The matrix transducer has several coefficient tables for transmit and receive parameters. These coefficient tables use large amounts of memory and must be loaded when you change the line density setting.

To change the density from “medium” to “high” in Live 3D:

- Touch **High Density** on the right touch panel.

The following message appears while the system changes settings:



---

**NOTE**

The “Preparing Scanner” message may not appear immediately, but will appear later when you access a mode that requires the scanner to prepare.

To set low density for Full Volume or 3D Zoom modes:

- 1 Press **Setup**.
- 2 Touch **Live 3D** on the right touch panel.
- 3 Touch **Low Density** on the right touch panel.

If **High Density** is already turned off, the “Preparing Scanner” message appears while the system changes to low density.

---

## Using Live 3D

Before you begin acquiring Live 3D images, you may want to create a preset to use when acquiring. For details on creating and saving presets, see the *Reference Manual, System Basics*. After you have created your preset, you can use it to acquire Live 3D images.

### Creating a Live 3D Preset

Philips recommends that you create a Live 3D preset with the following settings in the **Comment** system menus:

- **Disk Autostore** off—To control how studies are stored on the 3D hard disk and to avoid filling the disk too quickly.
- **Auto Comment** off—For flexibility in writing comments for stored studies.
- Comment Options set to **Manual Entry**—For flexibility in writing comments for stored studies.

---

#### NOTE

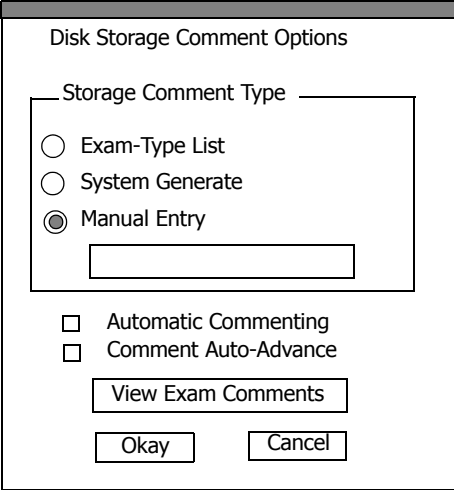
Since protocols vary between labs, check with your lab administrator before creating or customizing the Live 3D preset.

To create a Live 3D preset:

- 1 Select the **Adult** and **Cardiac** presets.
- 2 On the left touch panel, touch **Loop** and deselect **Disk Autostore** to turn it off.
- 3 Touch **Disk** and press **Setup**.

4 Touch **Comment Options**.

The Disk Storage Comment Options screen appears.

A dialog box titled "Disk Storage Comment Options". It contains a section "Storage Comment Type" with three radio button options: "Exam-Type List", "System Generate", and "Manual Entry". The "Manual Entry" option is selected. Below these options is a text input field. At the bottom of the dialog, there are two checkboxes: "Automatic Commenting" and "Comment Auto-Advance", both of which are unchecked. Below the checkboxes are three buttons: "View Exam Comments", "Okay", and "Cancel".

Disk Storage Comment Options

Storage Comment Type

☐ Exam-Type List

☐ System Generate

☒ Manual Entry

☐ Automatic Commenting

☐ Comment Auto-Advance

View Exam Comments

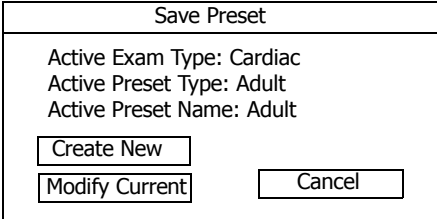
Okay Cancel

- Select **Manual Entry** for the Storage Comment Type.
- Deselect **Automatic Commenting**.
- Select **OK** and press **Enter**.

5 Press **Setup** and touch **Preset** on the left touch panel.

6 Touch **Save Preset**.

The Save Preset screen appears.

A dialog box titled "Save Preset". It displays the following information: "Active Exam Type: Cardiac", "Active Preset Type: Adult", and "Active Preset Name: Adult". Below this information are three buttons: "Create New", "Modify Current", and "Cancel".

Save Preset

Active Exam Type: Cardiac

Active Preset Type: Adult

Active Preset Name: Adult

Create New

Modify Current Cancel

- Select **Create New** and press **Enter**.
- In the screen that appears, type a name for the preset, select **Okay**, and then press **Enter**.

## Acquiring a Live 3D Image

Before you begin to acquire a Live 3D image:

- 1 Select the x4 transducer.
- 2 Attach ECG leads to the patient (to add ECG waveforms to acquired image files).
- 3 Set the system to the correct preset.

For more information about setting up the system, see the *Reference Manual, System Basics*.

NOTE

Creating a 3D image requires many steps. Finding the best settings will take experience in your imaging environment. Use the following procedure as a guideline to help optimize image quality.

- 1 Obtain an optimal 2D image.
- 2 Touch **Live 3D**.
- 3 Use the trackball to rotate the image to the view you want.
- 4 Beginning with the defaults, use the 3D touch controls to optimize the image as needed:

If you want to ...	Then ...
adjust image grays	adjust the <b>Compress</b>
improve the visualization of the tissue or adjust the 3-dimensional appearance of the image	adjust the <b>Gain</b>
use predefined combinations of settings to obtain an optimal image	choose a <b>3D Vision</b> setting
improve the depth perception	turn <b>Shading</b> on or off
decrease or increase the overall brightness of the image	adjust <b>Brightness</b>
increase or decrease the image size	adjust <b>Magnify</b>
make the texture of the image appear smoother	adjust <b>Smoothing</b>

If you want to ...	Then ...
improve tissue texture and better define margins and borders	adjust <b>XRES</b>
after adjustments, return to the original rotation	touch <b>3D Home</b>
use color to optimize contrast resolution	touch <b>Colorize</b>
suppress portions of the image to view inner anatomy	crop the image. For details, see <a href="#">page 2-36</a> .

5 To acquire an image, do one of the following:

- Touch **Acquire Loop**.
- Press **Acquire**.
- Press **Freeze**, touch **Replay**, and then press **Acquire**.

## Storing Live 3D Images to Disk

To guarantee being able to recapture what you are seeing in the Live 3D image, store it to the 3D hard disk as follows:

- 1 Touch **Create Subpage** on the right touch panel.
- 2 Touch **Disk Store** on the left touch panel.

NOTE

If **Disk Autostore** is on, the image is automatically stored to the 3D hard disk when the acquire is accepted.

For more information about creating subpages, see “[Subpages](#)” on [page 2-48](#). For more information on storing images, see [Chapter 4, “Managing Images.”](#)

## Using 3D Zoom

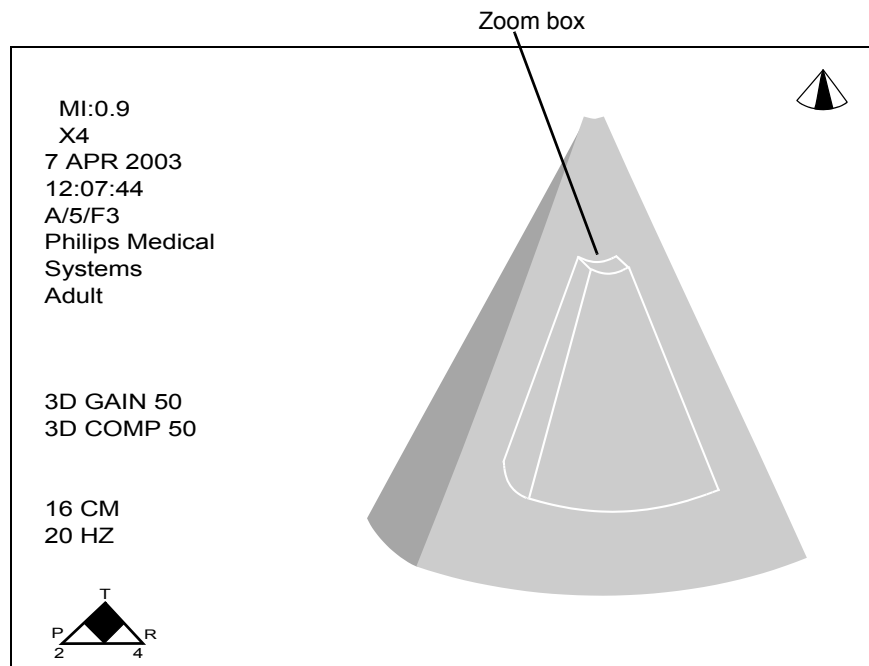
You can access 3D Zoom in two ways:

- In Live 3D mode, touch **Zoom**.
- In 2D zoom, touch **Live 3D**. When you access 3D Zoom this way, the zoom size is locked and the size of the 2D zoom image may differ from the size of the Live 3D zoom image.

After you obtain an optimal Live 3D image, use 3D Zoom as follows:

- 1 In Live 3D mode, touch **Zoom**.

You are now in Zoom Preview mode. The 3D Zoom box appears on the image and the Zoom touch control outline is highlighted on the touch panel.



- 2 On entering 3D Preview mode, the **Position** control is highlighted, and you can use the trackball to move the zoom box to the region of interest by moving it up and down or side to side.

- 3 To adjust the size of the volume of interest, press **Size** and resize the zoom box vertically. You cannot resize it laterally.
- 4 Touch **Zoom** again or press **Enter**.

As shown in the following illustration, the 3D Zoom volume of interest is displayed with two smaller reference images. The colored lines represent the following:

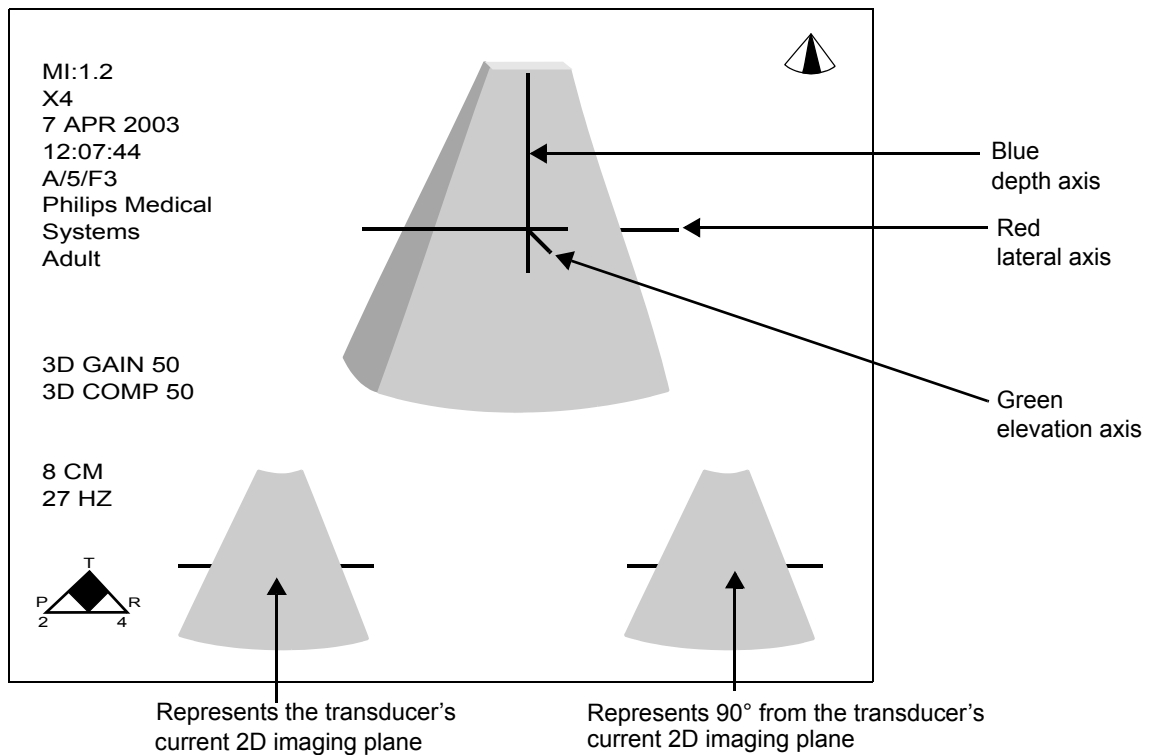
- Red—lateral axis
- Green—elevation axis
- Blue—depth axis

---

**CAUTION**

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The reference images are not calibrated. Do not make measurements from them.





- 5 Use the trackball to rotate the image to the anatomy of interest.
- 6 Touch **Reference Images** to remove them from the screen.
- 7 Crop the image as needed. For more information on cropping, see [page 2-36](#).
- 8 Turn the **Magnify** control to adjust the magnification as needed.
- 9 To acquire an image, do one of the following:
  - Touch **Acquire Loop**.
  - Press **Acquire**.
  - Press **Freeze**, touch **Replay**, and then press **Acquire**.
- 10 To capture a cropped image, touch **Create Subpage** on the right touch panel.
- 11 To store the images to hard disk, touch **Disk Store** on the left touch panel.

---

NOTE

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If Disk Autostore is on, the image is automatically stored to the 3D hard disk when **Acquire** is pressed.

For more information about creating subpages, see “[Subpages](#)” on [page 2-48](#). For more information about storing images, see [Chapter 4, “Managing Images.”](#)

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## Full Volume Overview

Full Volume is an acquisition mode that captures acoustic data in subvolumes and combines them to create a larger rendered volume.

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### NOTE

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If ECG leads are attached to the patient, ECG waveforms may be displayed and stored with forward-acquired ECG loops. These loops include Live 3D, 3D Zoom, Full Volume, and 3D Color.

The ECG is not displayed during Live 3D modes or during acoustic replay (freeze and replay) for Live 3D.

For more information about setting up and collecting ECG waveforms, see the *System Basics* chapter “Physios.”

There are two Full Volume acquisition modes:

- ECG triggered
- Nontriggered

In the ECG triggered mode, a series of four subvolumes is acquired. The acquisition is synchronized with the R-wave so that the subvolumes are time-aligned for the final rendered Full Volume. Because of the short acquisition times, you can use a breath-hold technique with most patients for a comprehensive image with minimal spatial or temporal artifacts.

You use the nontriggered mode to image static objects. In the nontriggered mode, a single frame of each subvolume is acquired when you acquire an image.

Full Volume Preview shows fixed BiPlane images to allow for transducer and volume positioning. After Full Volume acquisition is complete, the system automatically enters Loop Display mode and displays the Full Volume image if Auto Display has been turned on in **Setup**.

For cardiac applications, the acquisition is triggered on the ECG, and the image should be acquired while the patient suspends breathing. The system automatically determines how many frames are needed to acquire the image from R-wave to R-wave.

NOTE

You can store a Full Volume loop as a single page or as subpages, with one or more subpages having different image optimizations.

NOTE

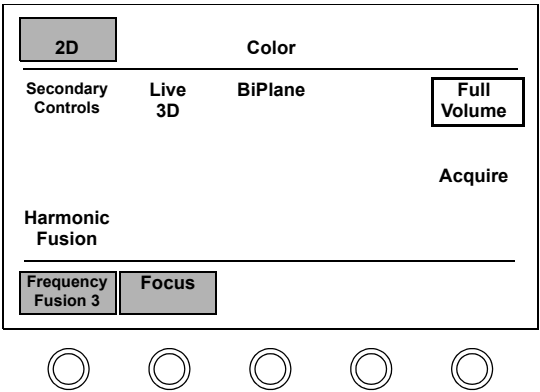
Any triggered acquisition mode has the potential for temporal artifacts. In triggered Full Volume acquisition, temporal artifacts might occur due to fast moving structures, rapidly changing flow patterns, respiration, or probe movement.

## Full Volume Controls

To activate Full Volume imaging:

- Touch **Full Volume** on the right touch panel.

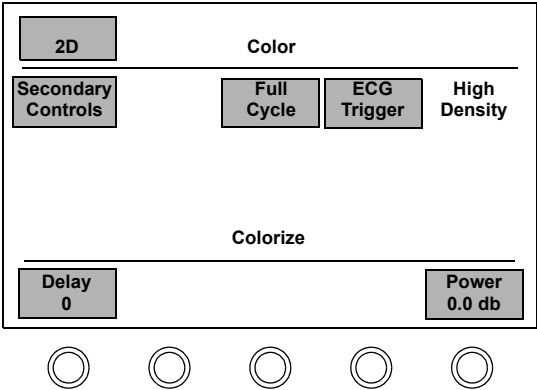
The Full Volume Preview mode is displayed and the Full Volume primary controls appear on the right touch panel.



To access additional Full Volume controls:

- Touch **Secondary Controls** on the right touch panel.

The Full Volume secondary controls appear:



The following table describes the Full Volume controls:

Control Name	Description
Acquire	Starts image acquisition.  When you are in Preview mode, the Acquire function key and Acquire foot switch behave the same as the touch control.  <b>WARNING:</b> The SONOS foot switch is not approved for use in operating-room environments.
Cancel	Allows you to cancel a Full Volume acquire. The Cancel key appears after you press the Acquire key.
Delay	Sets the amount of time between the R-wave trigger and the start of each sub-volume acquisition in Full Volume and 3D Color modes. Delay is in 5 millisecond intervals.

<b>Control Name</b>	<b>Description</b>
ECG Trigger	<p>Selects whether to use ECG triggering (on) or nontriggered (off) acquisition in Full Volume and 3D Color modes. Works in conjunction with the Delay control.</p> <p>NOTE: If ECG Trigger is Off, then an ECG is not required for an acquisition.</p>
Full Cycle	<p>When Full Cycle is toggled on, data is acquired over the entire R-R interval in Full Volume and 3D Color modes. After acquisition of the subvolume is complete, preparation is made for the next subvolume acquisition. This results in a non-consecutive beat acquisition cycle.</p> <p>When Full Cycle is toggled off, data is acquired in consecutive R-wave triggered beats. Variations or very high pulse rates may result in skipped beats.</p> <p>NOTE: Full Cycle trades off acquisition time (number of beats) versus number of frames captured.</p> <p>NOTE: The SONOS system automatically switches to Full Cycle mode when the patient's heart rate reaches or exceeds 80 bpm.</p>
Full Volume	Turns Full Volume Preview mode on or off.
Power	Sets acoustic output power.

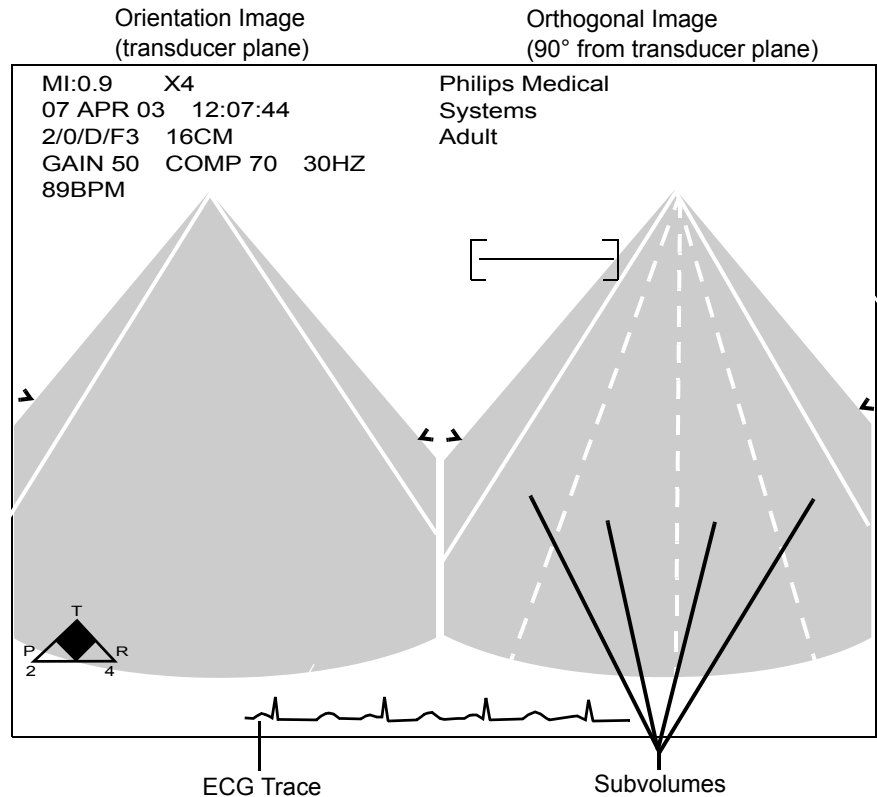
## Acquiring a Triggered Full Volume Image

Before acquiring, obtain an optimal 2D image with a stable ECG baseline and prominent R-wave. Acquire the image while the patient is suspending respiration. For details about triggered acquisition, see [“Full Volume Overview” on page 2-17](#).

To acquire a triggered Full Volume image:

### 1 Touch **Full Volume**.

The Full Volume Preview mode is activated. The blue dashed lines on the right image show the edges of each subvolume in the Full Volume image. Due to the triggered acquisition, a spatial artifact may appear where the subvolumes are joined for the Full Volume display. Therefore, it is crucial to line up the anatomy of interest between the dashed lines. For example, if you want to view the papillary muscle, position the papillary muscle between the dashed lines.



- 2 Make sure **ECG Trigger** is selected on the right secondary touch panel.
  - Turn **Delay** to select a time delay from trigger to acquisition start.
  - Touch **Full Cycle** to select whether the acquisition duration is Full Cycle or truncated to obtain consecutive beats.
- 3 Use the standard 2D or Full Volume Preview controls to optimize the image.
- 4 While the patient suspends breathing, press **Acquire**.

An indicator shows the progress of the acquisition.

Acquiring 25%

To cancel the acquisition, touch **Cancel** on the right touch panel.

After the subvolumes are acquired, the Full Volume is displayed in cine memory.

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**CAUTION**

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When you image fast-moving structures, such as valves, you may experience temporal artifacts in the rendered image. If you see such an artifact, acquire the same image in 3D Zoom mode to determine if it is actually an artifact.

- 5 To activate the crop box controls and suppress the front part of the 3D image, touch **Auto Crop**.
- 6 To return to the original acquired image, touch **Reset Cropping**.
- 7 Rotate the volume with the trackball as needed.
- 8 Use the cropping controls to view the anatomy of interest. For more information about cropping controls, see [page 2-36](#).
- 9 After you obtain the optimal cropped image, touch **Create Subpage** on the right touch panel.

The cropped image is stored in cine memory.
- 10 To store the image to the 3D hard disk, touch **Disk Store** on the left touch panel.

---

**NOTE**

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If Disk Autostore is on, the image is automatically stored to the 3D hard disk when the acquire is accepted.

For more information about creating subpages, see [“Subpages” on page 2-48](#). For more information on storing images, see [Chapter 4, “Managing Images.”](#)

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**NOTE**

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If you videotape an image, include the Full Volume Preview image. This can help identify whether an apparent abnormality is an artifact.

## Acquiring a Nontriggered Full Volume Image

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**NOTE**

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For additional details about nontriggered acquisition, see [“Full Volume Overview” on page 2-17](#).

To acquire a nontriggered Full Volume image:

**1** Touch **Full Volume**.

The image appears in Full Volume Preview mode. Make sure the part of the image you want to acquire appears between the blue guide lines.

**2** If **ECG Trigger** is selected on the right secondary touch panel, touch it to turn it off.

**3** Touch **Secondary Controls** to return the display to the primary controls on the right touch panel.

**4** Use the Live 3D controls to optimize the image.

**5** While the patient suspends breathing, press **Acquire**.

An indicator shows the progress of the acquisition.

Acquiring 25%

To cancel the acquisition, touch **Cancel** on the right touch panel.

After the subvolumes are acquired, the Full Volume is displayed in cine memory.

**6** To activate the crop box controls and suppress the front part of the 3D image, touch **Auto Crop**.

**7** To return to the original acquired image, touch **Reset Cropping**.



- 8 Use the cropping controls to view the anatomy of interest. For more information on cropping controls, see [page 2-36](#).
- 9 After you obtain the optimal cropped image, touch **Create Subpage** on the right touch panel.

The cropped image is stored in cine memory.

- 10 To store the image to the 3D hard disk, touch **Disk Store** on the left touch panel.

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**NOTE**

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If Disk Autostore is on, the image is automatically stored to the 3D hard disk when the acquire is accepted.

For more information about creating subpages, see “[Subpages](#)” on [page 2-48](#). For more information about storing images, see [Chapter 4, “Managing Images.”](#)

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## 3D Color Overview

3D Color mode uses the Doppler shift to detect velocities in a 3-dimensional anatomical volume. As in 2D color-flow imaging, this additional information helps to assess general blood flow properties.

3D Color combines seven triggered subvolumes into a larger volume color image. This volume can be rotated and cropped along multiple planes, allowing you to see blood flow from several perspectives, as well as relative to tissue and walls.

In cardiac applications, the acquisition is synchronized with the R-wave so that the subvolumes are time-aligned for the final rendered image. You can use a breath-hold technique with most patients for a comprehensive image with minimal spatial or temporal artifacts. The system automatically determines how many frames are needed to acquire the image from R-wave to R-wave.

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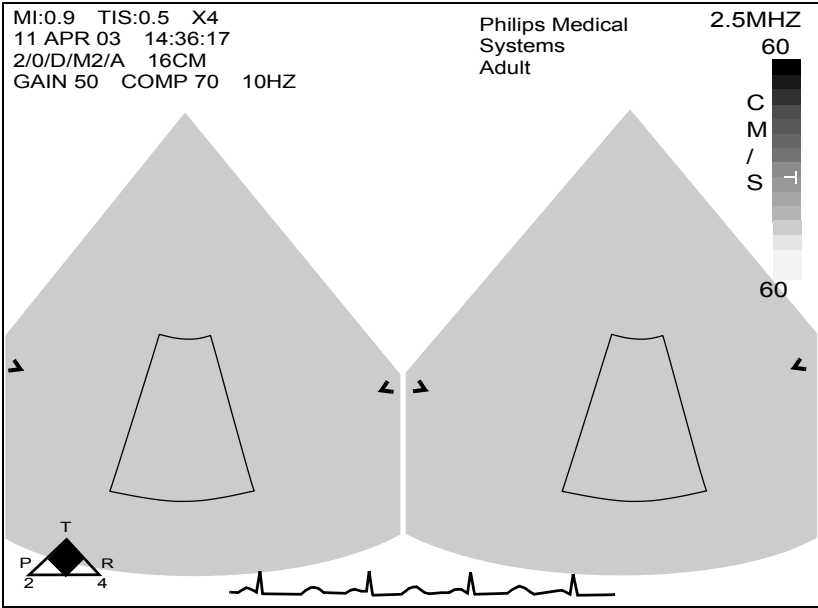
### NOTE

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- No velocity or geometry measurements are available in 3D Color mode. Velocities displayed are average projected velocities, and are not necessarily indicative of flow velocities displayed in 2D color-flow imaging. 3D Color velocities, therefore, differ from what you might see in 2D Color images.
- You can store a 3D Color loop as a single page or as subpages, with one or more subpages having different image optimizations.
- Any triggered acquisition mode has the potential for temporal artifacts. In triggered 3D Color acquisition, temporal artifacts might occur due to fast moving structures, rapidly changing flow patterns, respiration, or probe movement.

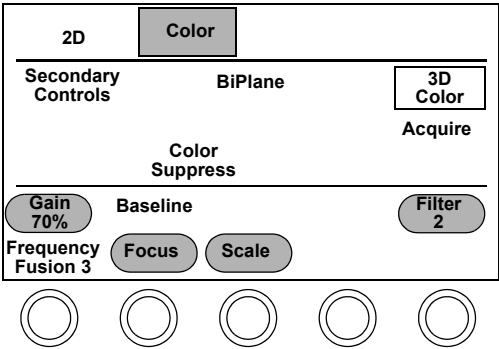
3D Color Image Preview

Sample screen and touch panels

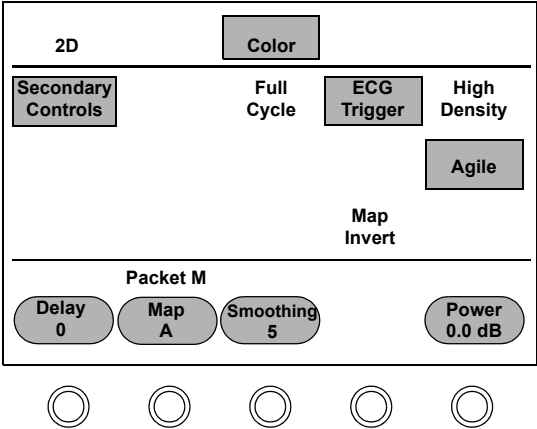


In the 3D Color preview mode, you manipulate pre-acquisition images using the following controls.

Primary touch panel



Secondary touch panel



Control descriptions

Control Name	Description
Agile (secondary control)	Adjusts the frequency used for color flow imaging.
Baseline	Adjusts the baseline level of the color bar.
Color Gain	Controls color gain. It is important to adjust 2D Color gain in preview mode where it can improve Signal-to-Noise ratios and Dynamic Range.  NOTE: Use the <b>Gain</b> dedicated rotary control on the SONOS keyboard to adjust only the grayscale image gain.
Delay (secondary control)	Sets the amount of time between the R-wave trigger and the start of each sub-volume acquisition in Full Volume and 3D Color modes. Delay is in 5 millisecond intervals.

<b>Control Name</b>	<b>Description</b>
ECG Trigger (secondary control)	<p>Selects whether to use ECG triggering (on) or nontriggered (off) acquisition in Full Volume and 3D Color modes. Works in conjunction with the Delay control.</p> <p>NOTE: If ECG Trigger is Off, then an ECG is not required for an acquisition.</p>
Filter	Removes low-level signals (such as flash) and reduces noise in the image.
Focus	Repositions the acoustic depth of the focal zone, which is indicated by a caret. The focus tracks the region of interest and affects both grayscale and color components of 2D and 3D images.
Frequency Fusion	This frequency fusion rotary control optimizes transmit frequencies for penetration, texture, or resolution. It also affects 3D grayscale images.
Full Cycle (secondary control)	<p>When Full Cycle is toggled on, data is acquired over the entire R-R interval in Full Volume and 3D Color modes. After acquisition of the subvolume is complete, preparation is made for the next subvolume acquisition. This results in a non-consecutive beat acquisition cycle.</p> <p>When Full Cycle is toggled off, data is acquired in consecutive R-wave triggered beats. Variations or very high pulse rates may result in skipped beats.</p> <p>NOTE: Full Cycle trades off acquisition time (number of beats) versus number of frames captured.</p> <p>NOTE: The SONOS system automatically switches to Full Cycle mode when the patient's heart rate reaches or exceeds 80 bpm.</p>
High Density (secondary control)	<p>Sets the size of the 3D Color volume to be displayed by adjusting the line density.</p> <p>NOTE: Trades off volume size versus resolution and sensitivity.</p>

Control Name	Description
Packet (secondary control)	Selects the color-flow packet size (small, medium, or large), which determines how the system samples and processes color-flow information.  NOTE: Packet size determines the number of acoustic lines in each packet. Increasing the packet size increases the number of lines in each packet. Decreasing the packet size decreases the number of lines in each packet. Packet size trades off color sensitivity versus frame rate.
Power (secondary control)	Sets acoustic output power.  NOTE: Since power can negatively affect sensitivity, it should normally be set at 0.0 dB.
Scale	In both 2D and 3D imaging, this control trades off the Pulse Repetition Frequency (PRF), low-velocity sensitivity, frame rate, and aliasing.

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**NOTE**

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- Some 3D Color controls seem similar to those for 2D color, but the two sets of controls function independently. Use both sets of controls to optimize images in their respective imaging modes.
- The following controls are also available and can be used during 3D Color image preview. However, their effect on the preview image does not necessarily translate to the acquired Color 3D image:
  - **Color Suppress**
  - **Map**
  - **Map Invert**
  - **Smoothing**

## Using 3D Color preview

To enhance a 3D Color preview image:

- 1 Once you obtain an optimized 2D Color image, touch **3D Color** on the right touch panel to display the 3D Color preview screen.

As in Full Volume, the image on the left represents the active transducer plane, and the image on the right is at right angles to this active plane.

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### NOTE

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You can also access 3D Color preview mode from Full Volume, Live 3D, or Live 3D Zoom modes by touching **Color** in the right touch panel. The **Full Volume** control then becomes **3D Color**.

- 2 Use the **Size** and **Position** keys, along with the trackball, to position the 3D Color preview boxes around the anatomy of interest.

You can size the boxes vertically, but not horizontally.

- 3 Apply the 3D Color preview controls to enhance the image.

## 3D Color Image Acquisition

When you obtain an optimized 3D Color preview image, you can acquire the 3D Color image in any of the following ways:

- Touch **Acquire** on the right touch panel.
- Press the **Acquire** key on the keyboard.
- Push down on the Acquire foot switch.

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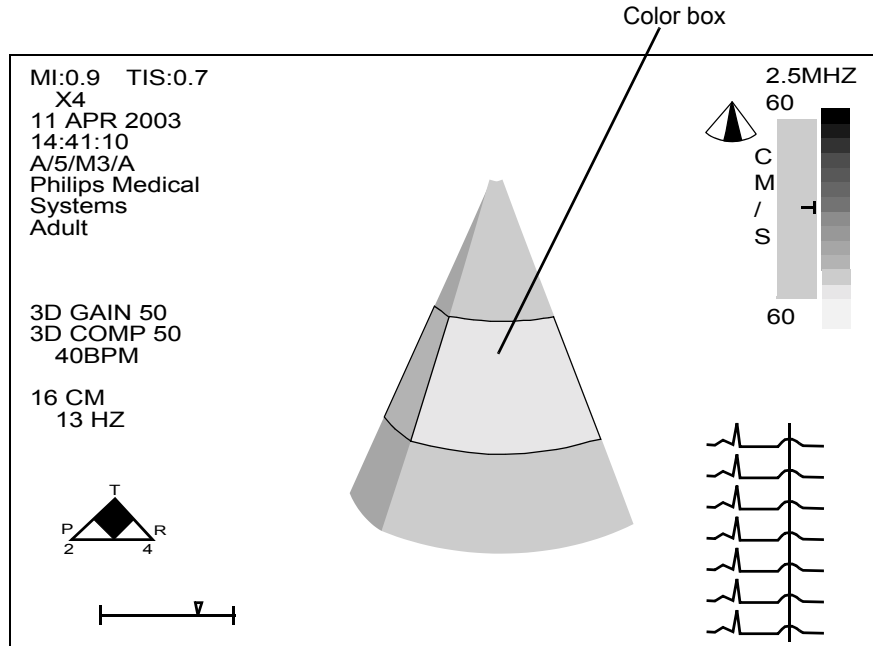
### WARNING

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The SONOS foot switch is not approved for use in operating-room environments.

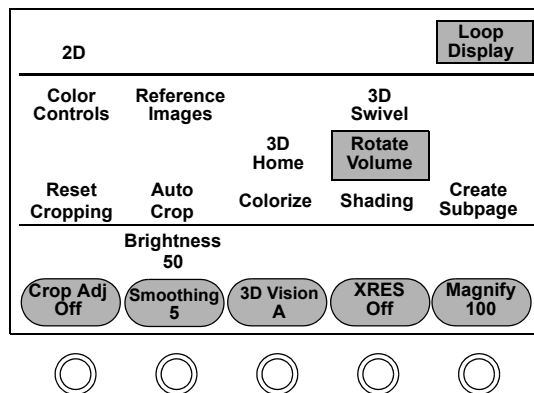
## 3D Color Image Review

### Sample screen and touch panels



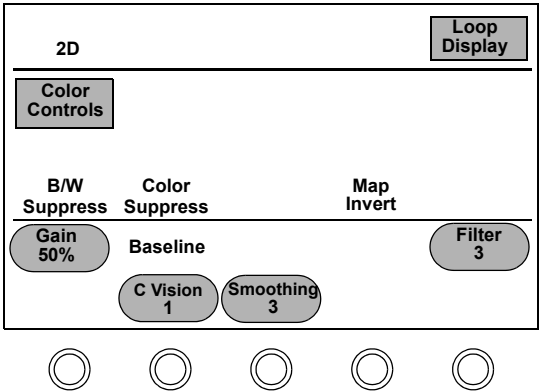
In the 3D Color loop display mode, you can manipulate or edit one or more pages of acquired images using the following controls, and then crop and save the images as described in following sections.

### Primary touch panel





Color Controls touch panel



Control descriptions

Control Name	Description
3D Swivel	When 3D Swivel is toggled on, it oscillates the rendered volume to improve 3D visualization. The volume stops oscillating if you use the trackball to rotate or tilt it, but then resumes oscillating from its new position.  NOTE: AVI images can be stored with 3D Swivel activated in the images.

**3D Color Overview**

<b>Control Name</b>	<b>Description</b>
3D Vision	<p>The following 3D Vision settings may be used to adjust Live 3D, Zoom, or Full Volume images based on the echogenicity of the patient. These settings should be used in addition to other 3D optimization controls and are not meant to replace them:</p> <p><b>A</b>—Optimized for echogenic patients. Has lots of grays.</p> <p><b>B</b>—Optimized for average patients, with more emphasis on penetrating through ventricular clutter. The image is more black and white, with less grays and more smoothing.</p> <p><b>C</b>—Optimized for difficult-to-image patients, with many of the visual attributes of 3D Vision setting <b>B</b>.</p> <p><b>D</b>—Traditional volume rendering with relatively softer images.</p> <p>NOTE: 3D Vision setting <b>D</b> is not optimized for use in 3D Color applications.</p> <p><b>E</b>—Optimized for interventional structures such as catheters. This setting has poor 3D effect because there is no foreground occlusion, but it is good for penetrating through clutter. This setting may be useful for viewing the aortic valve.</p> <p><b>F</b>—Provides the best 3D image quality for more echogenic images. It is a high-resolution version of 3D Vision setting <b>A</b>.</p>
Baseline (Color Controls)	<p>Adjusts the baseline level of the color bar just as in 2D color-flow imaging.</p> <p>NOTE: 3D Color baseline shift is intended for use with the <b>C Vision</b> setting <b>1</b> and is not optimized for use with the <b>C Vision</b> settings <b>2, 3,</b> and <b>4</b>.</p>

Control Name	Description
C Vision (Color Controls)	<p>The following settings provide customized color map and visualization controls. To accommodate 3D depth, velocities are average projected velocities, which may result in display colors that are not shown in the color bar:</p> <p><b>1</b>—Uses traditional color-flow mapping to represent blood flow direction and velocity.</p> <p><b>2</b>—Enhances visualization of flow direction by overlaying forward and reverse flows. As a result, colors can be produced that are not visible in the color bar. For example, overlapped forward and reverse flows are represented by the color purple.</p> <p><b>3</b>—Uses enhanced color mapping for better visualization of depth cues. The color bar represents flow velocity in the blood flow nearest to the viewer. Lighter colors in the image also represent blood flow that is closer to the person viewing the image. Darker (more saturated) colors that are not included in the color bar represent blood flow that is farthest from the person viewing the image.</p> <p><b>4</b>—Similar to 2D Power Angio. Uses absolute velocity to represent the structure, size, and position of flow pathologies.</p> <p>NOTE: This setting mimics the 2D Color Map <b>X</b> and is best used when flow direction is not critical.</p>
Color Controls	Toggles between the black-and-white 3D controls and a set of secondary 3D Color cine-loop-display controls.
Color Gain (Color Controls)	<p>Affects color opacity.</p> <p>NOTE: Use the <b>Gain</b> dedicated rotary control on the SONOS keyboard to adjust only the grayscale image gain.</p>
Compress (Dedicated keyboard rotary)	<p>In all 3D modes, Compress mimics the 2D effect. At low Compress settings, the 3D grayscale image has more contrast, with increased delineation between myocardial surfaces and the blood pool. At high Compress settings, the 3D grayscale image takes on a softer look (more grays), and the delineation between tissue and blood is not as abrupt.</p> <p>NOTE: Unlike in 2D imaging, this control continues to operate after acquisition (in 3D Loop Review).</p>

Control Name	Description
Filter (Color Controls)	This wall-filter control trades off low-velocity sensitivity versus Flash suppression during 3D Color review. This control can be used to better isolate high-velocity pathologic flows from normal flows.
Gain (Dedicated keyboard rotary)	Adjusts the amplification of received acoustic signals to adjust the grayscale image gain.
Smoothing (Color Controls)	Averages just the 3D Color voxels (volume pixels) in the image to make its texture appear smoother and its surfaces more uniform.

- NOTE

- Some 3D Color controls seem similar to those for 2D color, but the two sets of controls function independently. Use both sets of controls to optimize images in their respective imaging modes.
  - The following controls are also available, and can be used during 3D Color image review:
    - Brightness**
    - B/W Suppress**
    - Color Suppress**
    - Colorize**
    - Magnify**
    - Map Invert**
    - Reference Images**
    - Rotate Volume**
    - Shading**
    - XRES**

---

## Cropping 3D Images

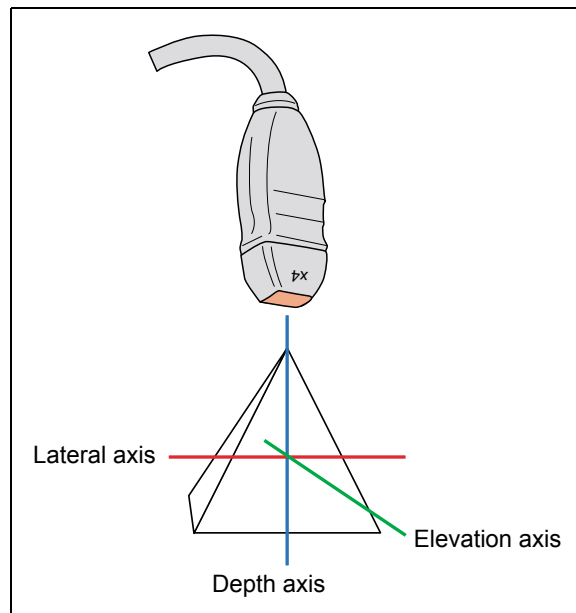
The SONOS system offers two types of 3-dimensional cropping tools:

- Crop box ([page 2-36](#))
- Arbitrary crop plane ([page 2-40](#))

### Crop Box

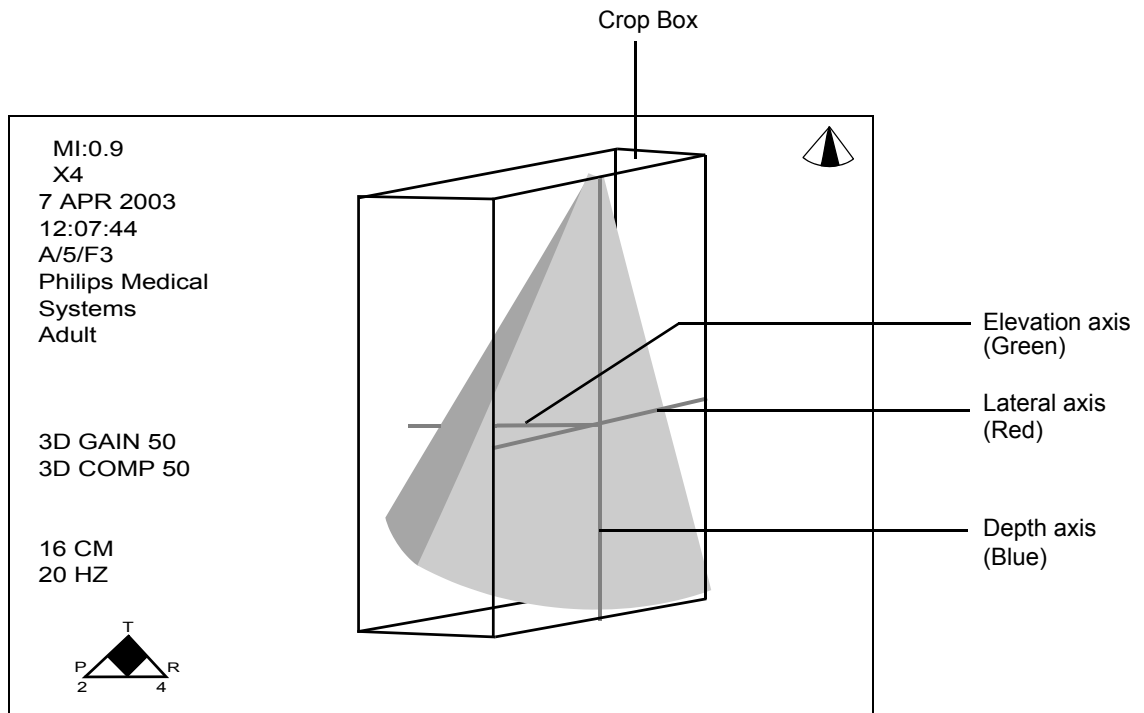
The crop box allows you to suppress the surface of an image along the six planes of the crop box to better visualize structures of interest. You can crop a live image or an acquired image in loop display.

The cropping lines correspond to the three axes in which the x4 transducer transmits and receives acoustic data as shown in the following illustration. For more details about the x4 transducer, see “[Introducing the x4 Matrix Array Transducer](#)” on [page 1-2](#).



When the crop box is on, the active cropping plane is displayed in purple. When the crop box is off, the active cropping plane is displayed in the color of the axis along which it moves, as follows:

- Red—lateral axis
- Green—elevation axis
- Blue—depth axis



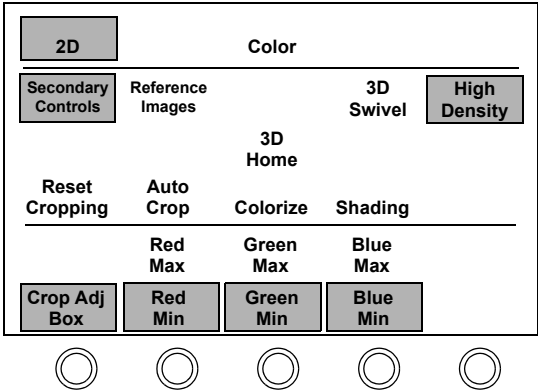
**NOTE**

Turn the crop box display on and off in **Setup**.

### Accessing the crop box

- Turn **Crop Adj** to **Box** on the right secondary touch panel.

The following illustration shows the crop box controls:



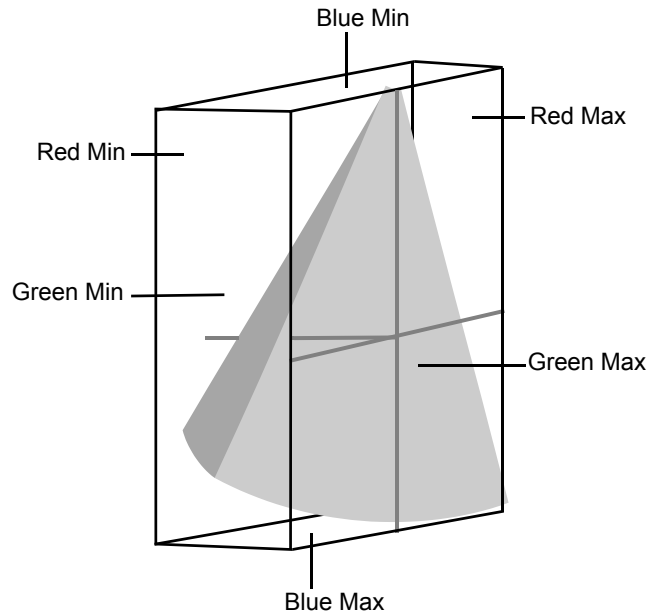
The following table describes the crop box controls:

Control Name	Description
Auto Crop	Activates the crop box controls and suppresses the front part of the 3D image.
Crop Adj	Selects the type of cropping tool ( <b>Box</b> , <b>Plane</b> , or <b>Off</b> ).
Reset Cropping	Redisplays the original uncropped volume and turns off the cropping controls.
Red Min, Red Max	From the original acquisition, adjusts cropping along the lateral axis of the rendered image.
Green Min, Green Max	From the original acquisition, adjusts cropping along the elevation axis of the rendered image.
Blue Min, Blue Max	From the original acquisition, adjusts cropping along the depth axis of the rendered image. (That is, increasing depths away from the probe's face.)

## Using the crop box

- 1 Turn **Crop Adj** to **Box**.

The crop box appears if the **Crop Box** is enabled in **Setup**.



- 2 In the right secondary touch panel, touch the control for the axis along which you want to crop (**Red Min**, **Green Max**, and so on).
- 3 Turn the corresponding rotary control to move the active cropping plane.

When the crop box is on, the active cropping plane is displayed in purple. When the crop box is off, the active cropping plane is displayed in the color of the axis along which it moves.

- 4 Use the trackball to rotate the image to better see the anatomy of interest.

---

### NOTE

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If Disk Autostore is on, the image is automatically stored to the 3D hard disk when the acquire is accepted.

- 5 Touch **Reset Cropping** to return to the original image.



## Arbitrary Crop Plane

The Live-3D crop box described earlier allows you to crop images along lateral, depth, and elevation axes. But the anatomy of interest may not be parallel to these axes. In such cases, the arbitrary crop plane allows you to transcend the 3D crop axes, to freely crop a 3D volume from any angle. The arbitrary crop plane is freely rotated around the volume by using the trackball.

If you use the **Retain Crop** control to save this cropped image, you can then apply another arbitrary crop plane to it. In this way, you can apply multiple freely positioned crop planes to a single rendered volume, before saving it as a subpage.

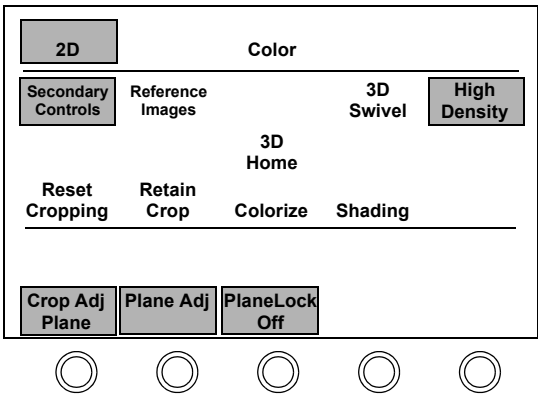
NOTE

You can use any combination of crop box and crop-plane cropping in the same volume, as long as you touch **Retain Crop** to retain results from the arbitrary crop plane. Crop box results are automatically retained in the displayed image.

## Accessing the arbitrary crop plane

- Turn **Crop Adj** to **Plane** on the right secondary touch panel.

The following illustration shows the arbitrary crop plane controls:



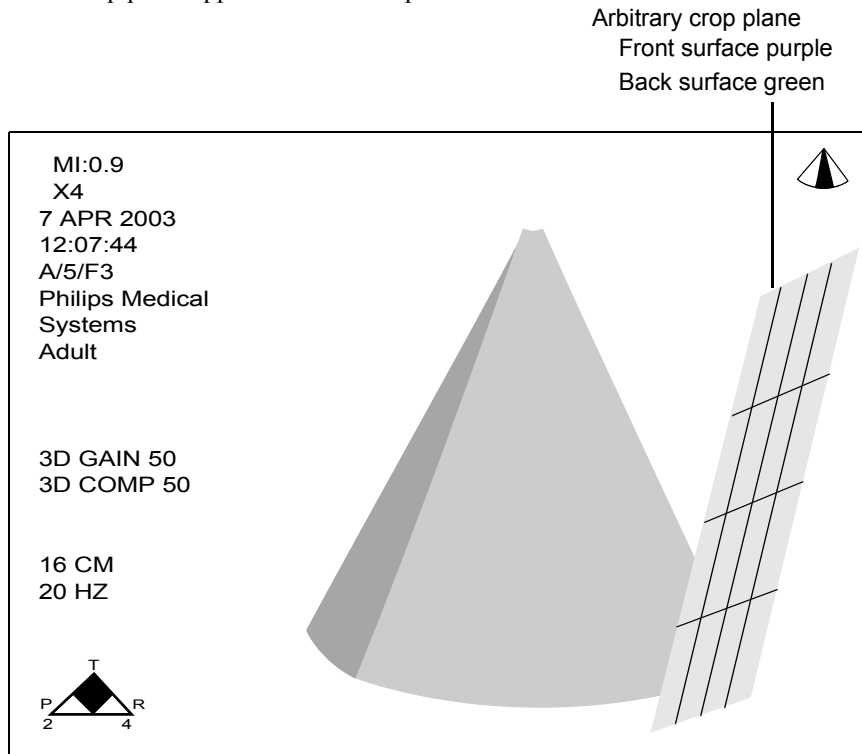
The following table describes the arbitrary crop plane controls:

<b>Control Name</b>	<b>Description</b>
Crop Adj	Selects the type of cropping tool ( <b>Box</b> , <b>Plane</b> , or <b>Off</b> ).
Plane Adj	From its home position, moves the crop plane toward or away from the rendered image.
PlaneLock	When turned on, locks the crop plane and the rendered image in their relative positions. They can be rotated and tilted as a unit to view the cropped anatomy.  When turned off, frees the crop plane to be moved to another position.
Reset Cropping	Redisplays the original uncropped volume and turns off the cropping controls.
Retain Crop	Retains the cropped image and returns the crop plane to its home position for further cropping.

## Using the arbitrary crop plane

- 1 Turn **Crop Adj** to **Plane** on the right secondary touch panel.

The crop plane appears in its home position.



- 2 Using the trackball, move the crop plane vertically and horizontally around the rendered image.

### NOTE

If the crop plane motion is uncomfortable to watch, turn swivel off, freeze the image, and then move the crop plane more slowly.

- 3 Turn the **Plane Adj** rotary control to move the crop plane into or away from the rendered image.

- 4** Turn the **Plane Lock** rotary control to **On** to lock the crop plane and the rendered image in their current relative position so that you can move them together as a unit.
- 5** Use the trackball to rotate the combined image for a better view of the cropped anatomy.
- 6** Turn the **Plane Lock** rotary control to **Off** to release the crop plane for further positioning.
- 7** Repeat steps 2 through 6 until you obtain the best view of the anatomy of interest.
- 8** Touch **Retain Crop** to retain the current cropped image and return the crop plane to its home position for further cropping.

---

## Saving Images

- 1 In 3D loop display mode, touch **Create Subpage** on the right touch panel to add a subpage with the current cropping settings to the existing loop.
- 2 In 3D loop display mode, touch **Disk Store** on the left touch panel to save the image, with all subpages, to the 3D hard disk.

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### NOTE

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- Subpages are temporarily held in SONOS system RAM and will be lost unless stored to the 3D hard disk.
- If **Disk Autostore** is on, the image is automatically stored to the 3D hard disk when the acquire is accepted.

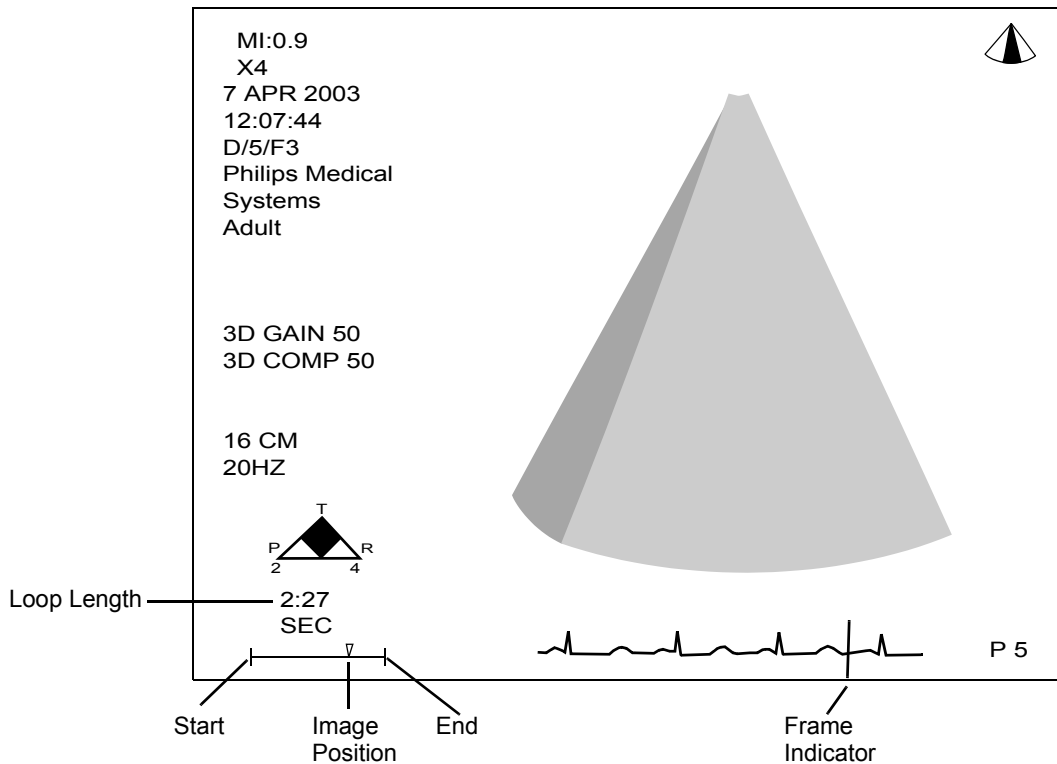
For more information about creating subpages, see [“Subpages” on page 2-48](#). For more information on storing images, see [Chapter 4, “Managing Images.”](#)

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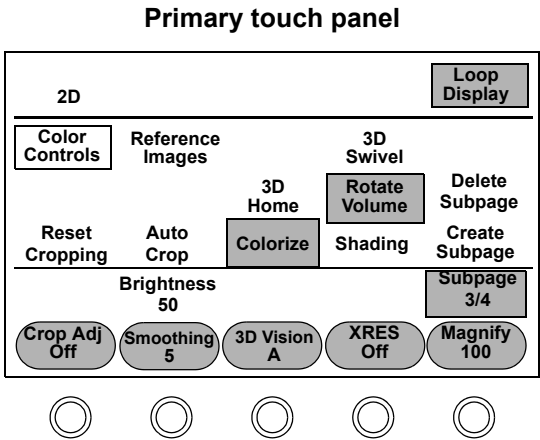
## 3D Loop Display

In 3D Loop Display mode, you can manipulate or edit one or more pages of acquired images

### Sample Screen and Touch Panels



The following illustration shows the controls that are used in Live 3D Loop Display mode.



## Control Descriptions

Control Name	Description
3D Home	Sets the volume viewing angle to Home—the original transducer orientation.
3D Swivel	When 3D Swivel is toggled on, it oscillates the rendered volume to improve 3D visualization. The volume stops oscillating if you use the trackball to rotate or tilt it, but then resumes oscillating from its new position.  NOTE: AVI images can be stored with 3D Swivel activated in the images.
3D Vision	Controls predefined combinations of contrast, transparency, lighting, and compositing algorithms in the rendered 3D image.
Auto Crop	Activates the crop box controls and suppresses the front part of the 3D image.
Brightness	Adjusts the overall brightness of the rendered image.

Control Name	Description
Color Controls	Toggles between the black-and-white 3D controls and a set of secondary 3D Color cine-loop-display controls.
Colorize	Optimizes contrast resolution by activating a colorization map that overlays the grayscale image.
Compress (dedicated rotary control)	Adjusts the dynamic range of returning echoes, thereby affecting the grayscale displayed within the image. The amount of compression used is displayed on the screen.
Create Subpage	Saves Live 3D images and optimization settings to loop memory. The <b>Subpage</b> rotary control then automatically increments the working page number.
Crop Adj	Selects the type of tool ( <b>Box</b> , <b>Plane</b> , or <b>Off</b> ) used for cropping.
Delete Subpage	Immediately deletes the current subpage.
Gain (dedicated rotary control)	<p>In Live 3D imaging, Gain should be set to show both valvular structures and surrounding tissue.</p> <ul style="list-style-type: none"><li>• If Gain is set too high, tissue in front becomes too bright to see inside the chamber.</li><li>• If Gain is set too low, the image becomes more black-and-white, loses detail, and contains imaging holes.</li></ul> <p>A good way to set Gain is to set it slightly high and lower it until you see both valves and surrounding tissue.</p>
Magnify	Adjusts the size of the rendered image by percentage of the default display size.
Reference Images	Displays a pair of fixed 2D reference images derived from the center of the volume. The left image orientation is the same as the conventional 2D imaging plane. The right image is on a plane that is orthogonal to both the left image and the transducer face.
Reset Cropping	Redisplays the original uncropped volume and turns off the cropping controls.
Rotate Volume	When on, allows you to use the trackball to rotate volume images. When off, in cine loop display mode, allows you to scroll through the cine loop image or adjust loop speed.



Control Name	Description
Shading	Adjusts the shading recipe applied to the rendered image to improve the depth perception.
Smoothing	Averages voxels (volume pixels) to adjust the smoothing or filtering recipe that is applied to the rendered image.
Subpage	Selects Live 3D loop subpages for viewing and storing.

NOTE	If you record Live 3D images on videotape, they appear larger when played back on a review station than they do on the SONOS system.
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## Subpages

Each 3D subpage displays one independent set of rendered settings for the current loop. You can store multiple versions of optimized 3D images on subpages. For example, each 3D image may have subpages that use the same data set. However, each subpage may have different rotation, cropping, lighting, smoothing, magnification, shading, gain, compression, 3D Vision, XRES, and colorization settings applied to it.

When you store a Live 3D loop to disk, all subpages associated with that loop are also stored.

To view the subpages, use the **Subpage** rotary control on the right touch panel.

---

## Setup Controls for Live 3D Imaging

You configure several important 3D imaging features using **Setup** controls, as follows:

- 1 Press **Setup** and touch **Live 3D** on the right primary touch panel.
- 2 Configure the following options on the right primary touch panel:

Control Name	Description
3D Cursor	Controls visibility of the red, green, and blue crop axis indicators that are centered in the 3D volume. This control is applicable in crop box mode and with 3D Zoom images. It has no effect when using the arbitrary crop plane.
3D Low Density	Displays the largest possible volume using the lowest line density when High Density is off. You can access the control in 3D Zoom or Full Volume Preview modes.
Crop Box	Enables the crop box, if you would like to use it around the 3D volume. This control can be used with zoomed images.
ECG Color	Displays each of the Full Volume or 3D Color subvolume ECG cycles as a different color (7 cycles for 3D Color images or 4 cycles for Full Volume images).
ECG Overlay	Superimposes the displayed ECG cycles on top of each other (7 cycles for 3D Color images or 4 cycles for Full Volume images). This display is useful for seeing differences between the individual ECG segments in triggered imaging modes.

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**NOTE**

The above settings are presettable. Once you create a configuration you like, save them as a preset.

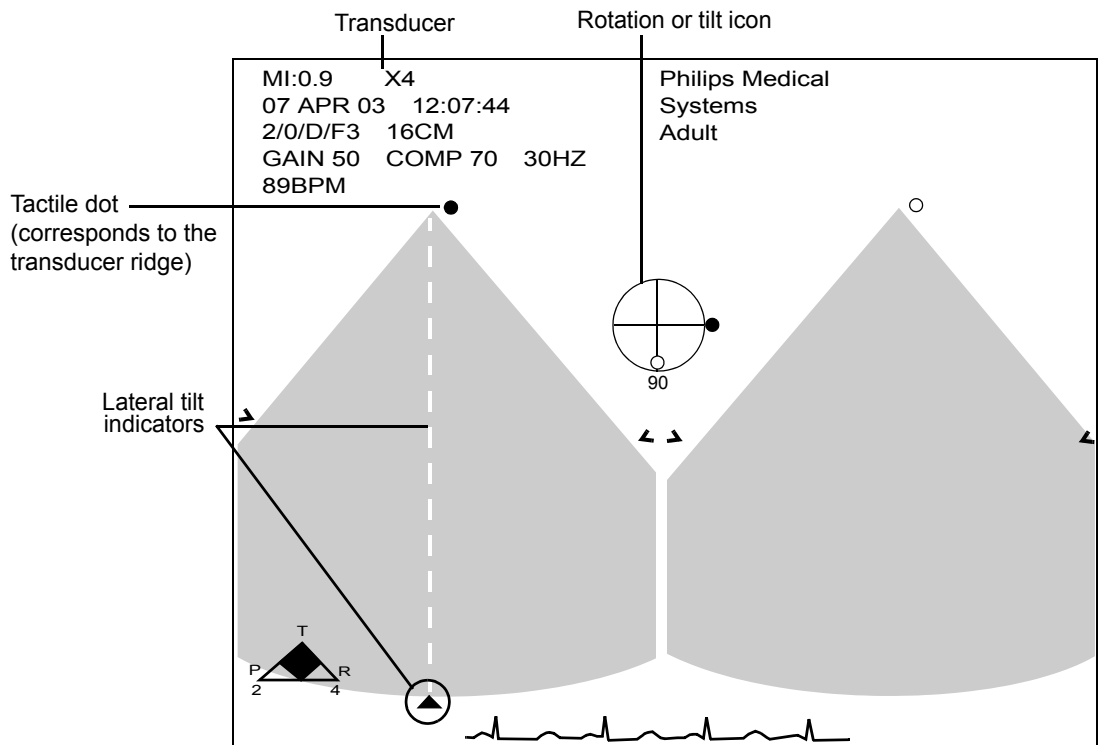
- 3 Press **Setup** again to return to imaging mode.



## Chapter 3 Live BiPlane Imaging

### Live BiPlane Imaging at a Glance

The following illustration shows an example BiPlane image. The left sector represents the fixed reference scan plane, which always has the same orientation as in 2D mode. The right sector represents the rotated or tilted scan plane. The icon between the two sectors represents how the two planes relate to each other in a top-down view from the x4 probe.

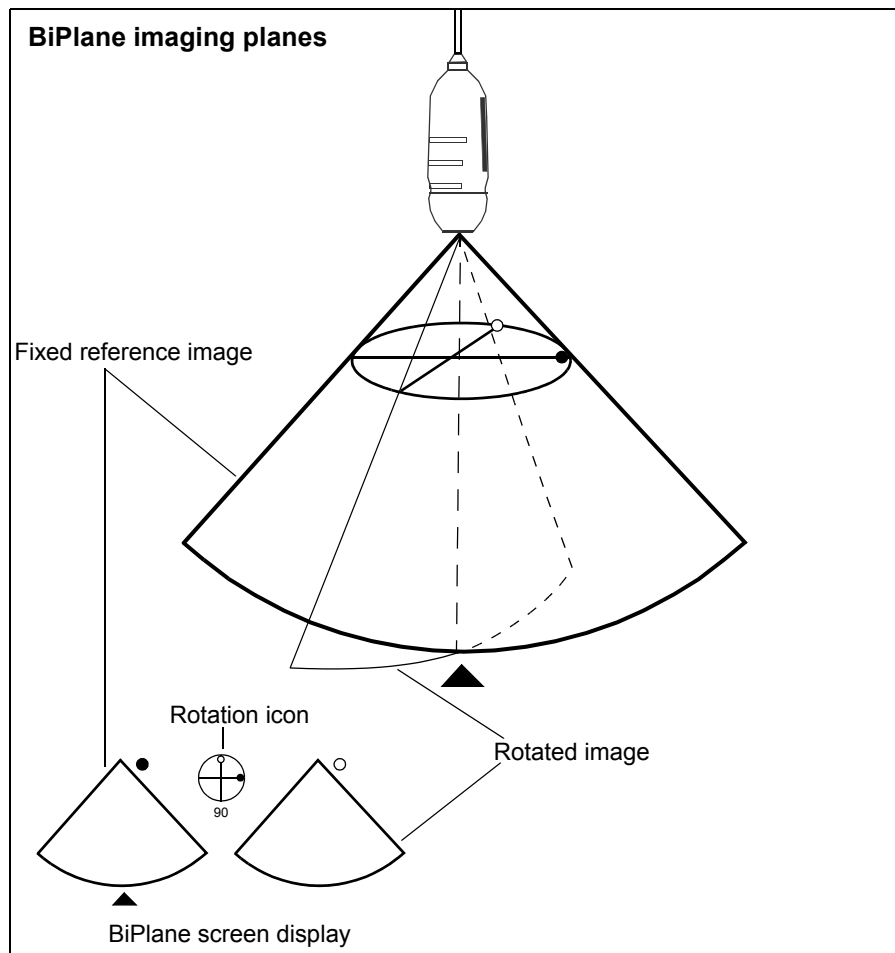


#### NOTE

When using BiPlane from an Apical approach, use Right Invert to make the right-side image an ASE recommended view.

## Live BiPlane Overview

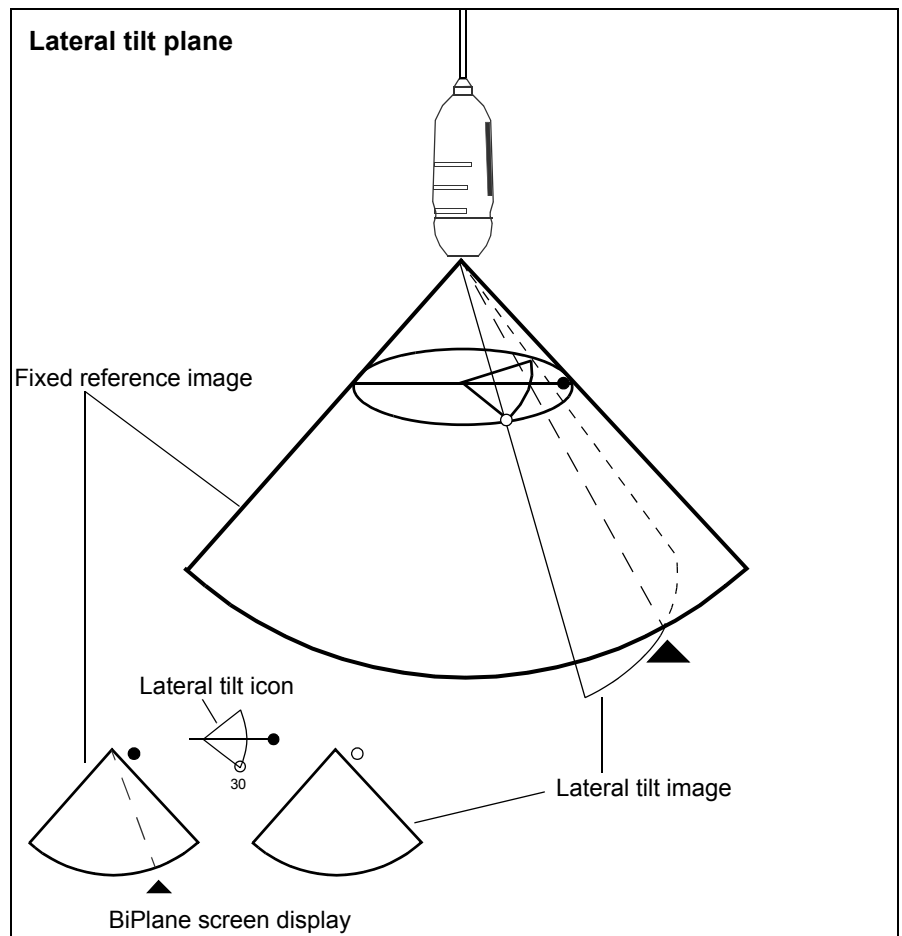
BiPlane imaging mode uses xMatrix transducer technology to display two simultaneous live images. The following illustration shows the relation of these two image planes to the BiPlane rotation icon and to the x4 transducer head. The default images are orthogonal. You can rotate this right image plane through a full 360 degrees or you can tilt it laterally or in elevation.



## Lateral Tilt

You can apply lateral tilt to the right image when its rotation is  $90^\circ$  or  $270^\circ$ . The right image remains at  $90^\circ$  or  $270^\circ$  rotation to the left image. In lateral tilt, the trackball sweeps the elevation plane of the right image across the lateral plane that provides the left image, without having to move the transducer.

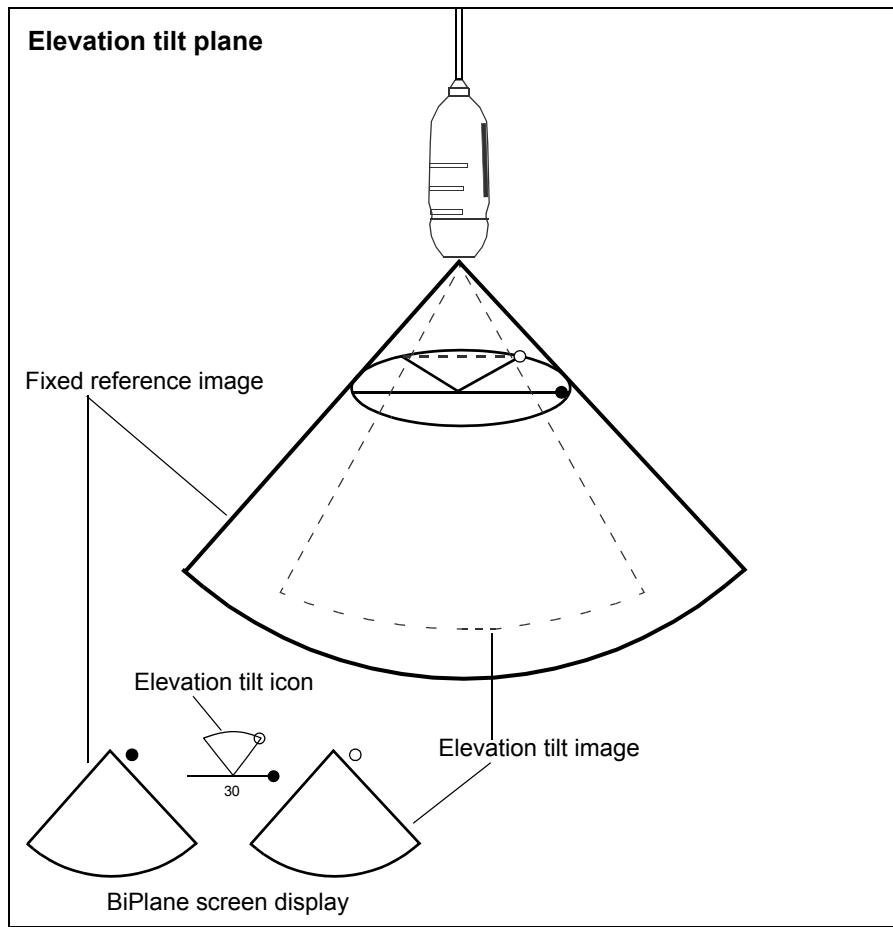
The following illustration shows the relation of these two image planes to the lateral tilt icon and to the x4 transducer head. The default tilt angle is  $0^\circ$ .



## Elevation Tilt

You can also apply elevation tilt to the right image when the rotation is  $0^\circ$ . In elevation tilt, the trackball sweeps the plane of the right image forward and backward in elevation. The right image remains at  $0^\circ$  rotation.

The following illustration shows the relation of these two image planes to the elevation tilt icon and to the x4 transducer head. The plane of the right image moves as if the two planes are hinged at the apex. The default tilt angle is  $0^\circ$ , meaning that the left and right image planes are identical.



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**NOTE**

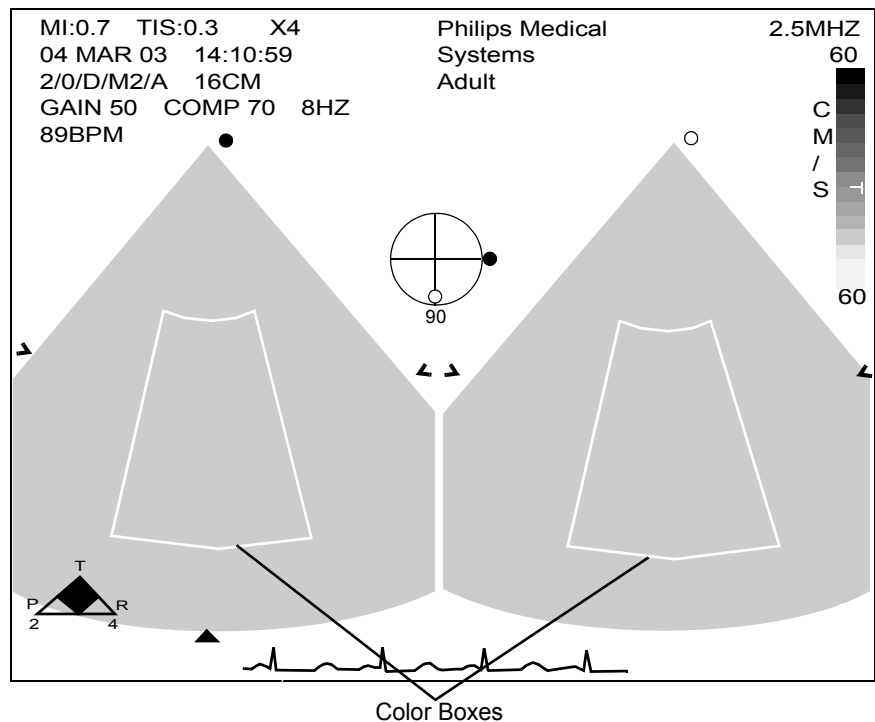
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- You can save BiPlane images to the 2D hard disk, a magneto optical disk (MOD), or transfer the images over a network. For more information on storing BiPlane images, see [“Managing BiPlane Images” on page 4-14.](#)
- Harmonics is available in BiPlane mode.

## BiPlane Color and BiPlane Zoom Overview

BiPlane Color mode is an extension of BiPlane mode. BiPlane Color and BiPlane Zoom modes work very much like 2D Color and 2D Zoom modes. The color box or zoom preview box on the left image behaves the same as it would in 2D Color or 2D Zoom Preview mode. You use the **Size** and **Position** keys to resize or reposition the color box or zoom preview box on the image using the trackball.

The following illustration shows an example BiPlane Color image.



In lateral tilt and rotation modes, the box on the right image tracks the left color box vertically, but does not move left or right because the color boxes together define a contiguous color volume. In elevation tilt, however, the boxes in both images move together.

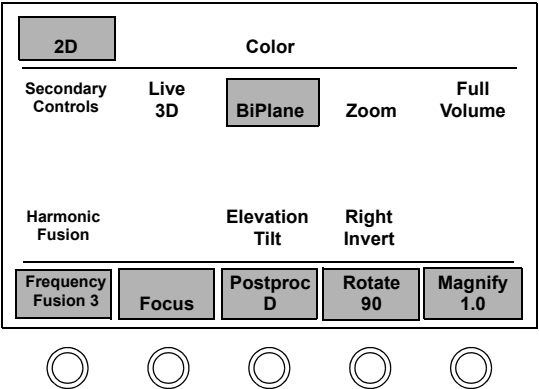


# BiPlane Controls

To access BiPlane imaging:

- Touch **BiPlane** on the right touch panel.

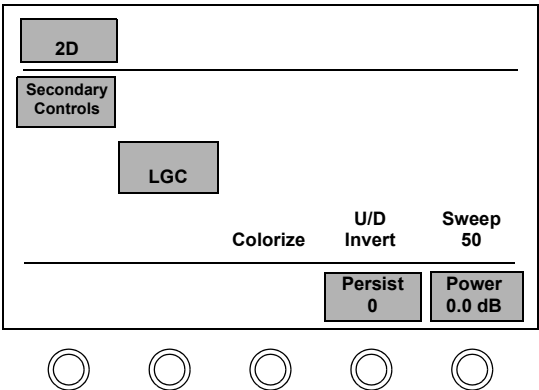
The BiPlane primary controls appear on the right touch panel.



To access additional BiPlane controls:

- Touch **Secondary Controls** on the right touch panel.

The BiPlane secondary controls appear:



The following table describes the BiPlane controls:

Control Name	Description
Color Density	Selects either medium or high line densities for BiPlane color images. To access the Density rotary control, touch <b>BiPlane</b> , <b>Color</b> , and <b>Density</b> on the right touch panel. - _ _ ^ _ _ +
Elevation Tilt	Turns elevation tilt on or off.  In elevation tilt, the trackball sweeps the plane of the right image forward and backward in elevation. The plane of the right image moves as if the two planes are hinged at the apex. The default tilt angle is 0°, meaning that the left and right image planes are identical.  To activate elevation tilt, do one of the following: <ul style="list-style-type: none"><li>• Touch <b>Elevation Tilt</b>, if it is not highlighted.</li><li>• Move the trackball quickly up or down.</li><li>• Set <b>Rotate</b> to 0.</li></ul> NOTES: Elevation tilt ranges from -30° to +30°. When elevation tilt is off, the trackball adjusts lateral tilt. When elevation tilt is on, the <b>Rotate</b> control setting is 0.
Lateral tilt)	In lateral tilt, the trackball sweeps the elevation plane of the right image across the lateral plane that provides the left image, without having to move the transducer. The default tilt angle is 0°. To activate lateral tilt, do one of the following: <ul style="list-style-type: none"><li>• Touch <b>Elevation Tilt</b>, if it is highlighted.</li><li>• Move the trackball quickly to the right or left.</li></ul> NOTE: Lateral tilt ranges from -45° to +45°.
Right Invert	Controls L/R Invert for the right image by changing the <b>Rotate</b> rotary control by 180°. NOTE: This control disappears when <b>Elevation Tilt</b> is on.

Control Name	Description
Rotate	Rotates the viewing angle of the BiPlane image on the right of the screen. The rotation icon follows the rotation angle. <b>Rotate</b> settings other than 0, 90, and 270 automatically center tilt to 0°.

NOTE: When set to 0, **Elevation Tilt** automatically comes on.

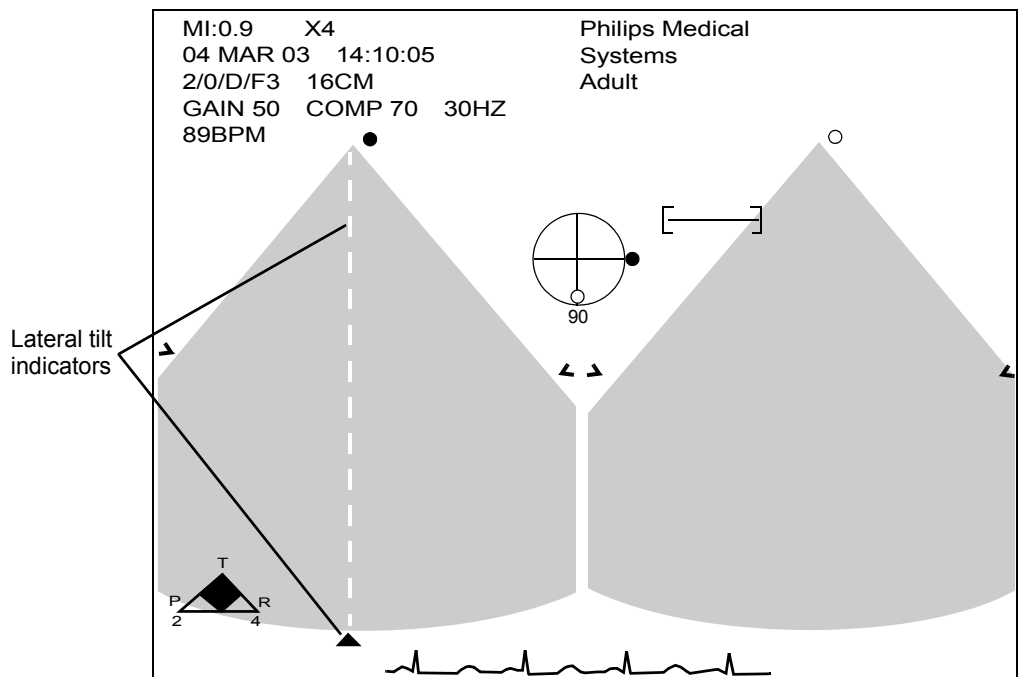
NOTE	For more information about applying BiPlane imaging controls, see <i>SONOS BiPlane Imaging</i> (a CD guide), provided with your system documentation.
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## Acquiring a BiPlane Image

You can manipulate BiPlane images by rotating, tilting, and using the BiPlane controls.

- 1 Obtain an optimized 2D image before you begin using the BiPlane mode.
- 2 Touch **BiPlane** on the right touch panel.

The BiPlane screen appears. When the trackball is moved, a dashed line on the left image represents the lateral tilt indicator (the position of the right image plane with respect to the left).



- 3 Select the type of tilt (lateral or elevation), as described below and in the control descriptions starting on [page 3-7](#).

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**NOTE**

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Set tilt prior to entering Zoom or Color modes. The only way to alter tilt in Zoom or Color modes is to pan the zoom area or reposition the color box.

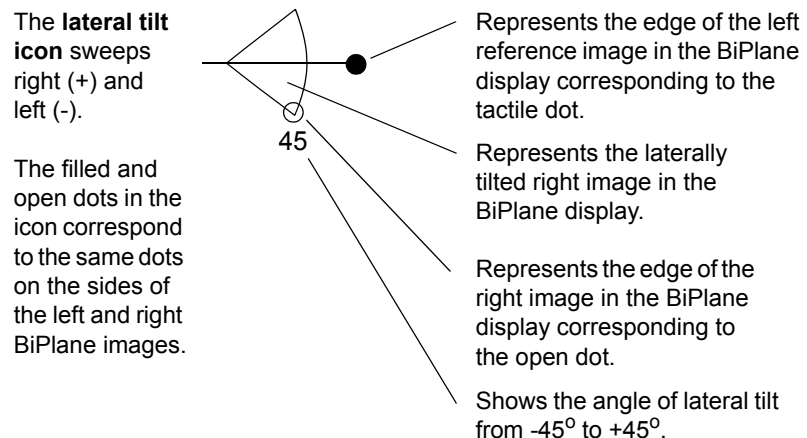
- 4 Use the trackball to place the tilt indicator along the anatomy of interest.

When the trackball motion stops, the tilt angle changes to the selected position.

- Lateral tilt sweeps the elevation plane of the right image across the lateral plane that provides the left image, without having to move the transducer.

Scan results at the default lateral-tilt angle ( $0^{\circ}$ ) are shown in the fixed, left reference image. The left and right image planes remain perpendicular at all lateral-tilt settings. These settings range from  $-45^{\circ}$  to  $+45^{\circ}$ .

When using lateral tilt, an indicator on the left image shows the orientation of the right image relative to the left reference plane. A tilt icon between the images shows the direction and degree of lateral deflection away from the left reference plane, when looking down from above.



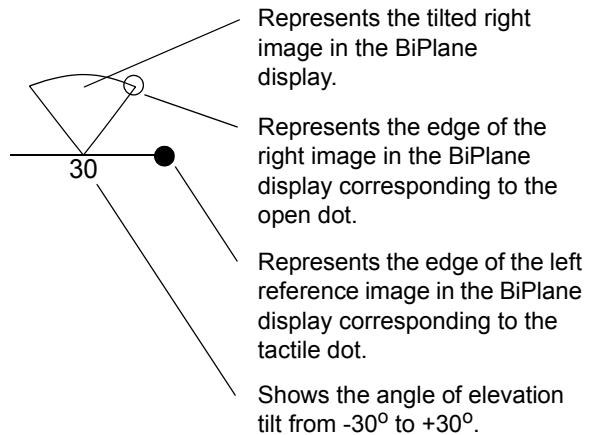
- Elevation tilt sweeps the plane of the right image forward and backward in elevation, without having to move the transducer. The plane of the right image moves as if the two planes are hinged at the apex.

The default tilt angle is  $0^{\circ}$ , meaning that the left and right image planes are identical. Elevation-tilt settings range from  $-30^{\circ}$  to  $+30^{\circ}$ .

When using elevation tilt, a tilt icon between the images shows the direction of elevation tilt with respect to the left reference plane and the angle between the left and right image planes.

The **elevation tilt icon** sweeps up and down.

The filled and open dots in the icon correspond to the same dots on the sides of the left and right BiPlane images.



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**NOTE**

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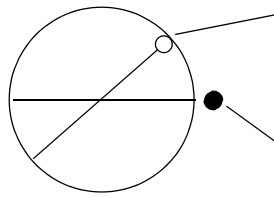
Both elevation tilt image planes are at  $0^{\circ}$  rotation.

- 5 Touch **Color** to apply this tilt to a color-flow image, if desired.

- 6 Rotate the image if needed by turning the **Rotate** rotary control in 5° increments.

The **rotation icon** shows the changing angle between the left and right BiPlane image planes.

The filled and open dots in the icon correspond to the same dots on the sides of the left and right BiPlane images.



Represents the edge of the right image in the BiPlane display corresponding to the open dot.

Represents the edge of the left reference image in the BiPlane display corresponding to the tactile dot.

Shows the angle of rotation between the left and right image planes.

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#### NOTE

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You cannot tilt and rotate a BiPlane image at the same time.

- 7 Touch **Zoom** to magnify the image.

The zoomed region of interest appears.

- 8 Position the zoom box at the anatomy of interest and touch **Zoom** again.
- 9 Touch **Color** if you want to use color and it is not already active.

When you tilt the color image, the tilt follows the color box when rotation is at 90° or 270°.

- 10 Press **Acquire**. Or press **Freeze**, touch **Replay** and then press **Acquire**.

- 11 Do one of the following:

- Press **Enter** to accept the image.
- Press **Acquire** again to delete the image.

- 12 Store the image to an MOD or to the SONOS hard disk.

For detailed information on storing images, see [Chapter 4, “Managing Images.”](#)

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# Chapter 4 Managing Images

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## Managing Live 3D Echo Images

The location to which you store and export images on the SONOS system depends on the image type and SONOS model number. The following tables summarize the storage and export locations.

**Table 4-1 SONOS 7500 Storage and Export Options**

Image Type	MOD	3D Hard Disk	IDI (for export)	CD-R (for export)
2D	yes	no	yes	no
Live 3D Echo	no	yes	no	yes
Gated Sequential 3D	yes	no	no	no

**Table 4-2 SONOS 5500 Storage and Export Options**

Image Type	MOD	3D Hard Disk	IDI (for export)	CD-R (for export)
2D	yes	N/A	yes	N/A
Live 3D Echo	N/A	N/A	N/A	N/A
Gated Sequential 3D	yes	N/A	no	N/A

SONOS 7500 systems with Live 3D have a 3D hard disk. All Live 3D images are stored as either SONOS files or AVI files. You can review SONOS files, identified by the 3D icon, on the system. Although you cannot review AVI files on the SONOS system, they are useful if you want to export the images for review on an offline computer.

When the SONOS system is storing or retrieving, no other functions can be performed on the system. You may cancel the saving or retrieving operation. When the system is writing files to the CD-R, you can cancel the process, but all CD-R data is lost and the CD-R cannot be reused.



## 3D Hard Disk Capacity

Before using storage and retrieval functions, the system checks the 3D hard disk space. If the system is running low on available disk space, a screen message appears, showing the remaining space and suggesting that some files be deleted.

Select **Okay** and press **Enter** to acknowledge the message.

For information about deleting files, see [“Deleting Live 3D Files from the 3D Hard Drive” on page 4-11](#).

## 3D Hard Disk Retrieval

You access the 3D retrieval features using the Disk Retrieve - Studies and Disk Retrieve - Images dialog boxes. The following illustration shows the Disk Retrieve - Studies dialog box:

**NOTE** In this and similar retrieval and export windows, you can click on a column heading to sort the listings according to that column’s contents.

Dialog box title

List of patient information

Accepts your selections

Displays individual images stored in study

Closes the dialog box and returns to the previous process

Selects all of the displayed studies

Deselects any selected studies

Allows you to select more than one study at a time

Disk Retrieve - Studies

Patient Name	Comment	Date
HANS SCHMITT	3D Loops & AVI's	07 APR 2003 14:25:24
JOHN PHILIPS	3D Loops & AVI's	07 APR 2003 14:21:56
SALLY MAY	3D Loops & AVI's	07 APR 2003 14:23:59
SAMANTHA JONES	3D Loops & AVI's	07 APR 2003 14:27:37

OK

List Contents

Cancel

Select All

Select None

☒ Multi-Select

Free Disk Space: 9610 / 17492 MBytes

Available space on the 3D Hard Disk

When you use the **List Contents** button, the Disk Retrieve - Images screen appears and the List Contents button changes to **List Studies**. Use the **List Studies** button to return to the Disk Retrieve - Studies dialog box.

---

**NOTE**

---

A dialog box displays the progress of retrieving files from the disc.

---

**NOTE**

---

If you retrieve an entire study that is too large, the “Loop Memory Full” message appears and some images are not retrieved.

## Storing Live 3D Images

Live 3D loops are stored on the 3D hard disk. The amount of data you can store is limited only by the amount of 3D hard disk space available. However, you should not use the 3D hard disk for long-term storage. You should export and archive Live 3D images daily.

---

**CAUTION**

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There is no back-up mechanism for restoring images that may be lost if a hard disk failure occurs. Be sure to export Live 3D images daily.

You can store multiple versions of optimized 3D images on subpages. When you create a subpage, the settings are stored in loop memory. When you store the loop to disk, the original image and all associated subpages are stored.

You can manually label the images if the system is set to manual commenting in the comment options under Disk Setup. Make sure auto commenting is off.

## Storing images on the 3D hard disk

To store Live 3D Echo images with optimization settings to the 3D hard disk:

- 1 After acquiring and optimizing a loop, touch **Create Subpage** on the right touch panel.

The subpage is stored to loop memory. The page number in the Subpage rotary increments by one.

- 2 To create additional subpages, repeat step 1.

- 3 To store your image to the 3D Hard Disk, touch **Disk Store**.

The original image and the subpages you created are stored to the 3D hard disk.

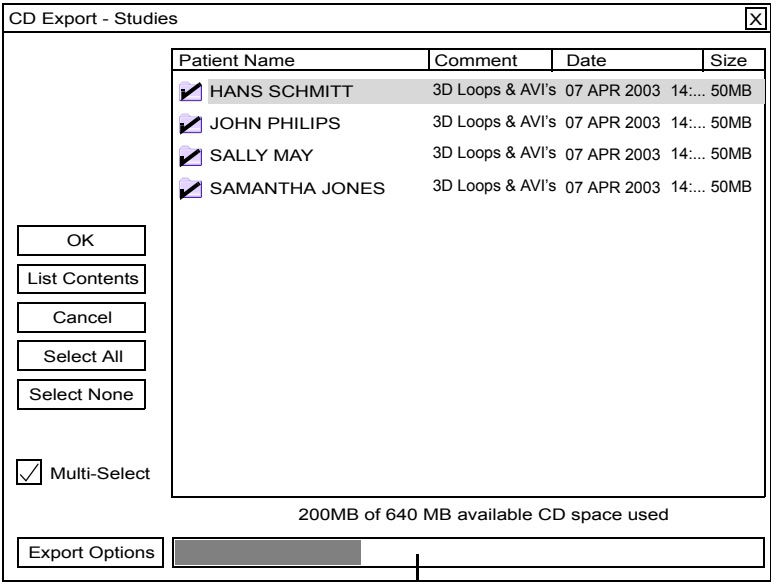
## Storing images to a CD-R

Always use high quality, brand name CD-R media. Handle the CD-R by the edges only and store the CD-R in its case when not in use.

To store images to a CD-ROM:

- 1 Touch **Disk**.
- 2 Touch **Export to CD**.

The CD Export - Studies dialog box appears:



As you select studies for export, this bar shows how much storage space is used on the CD and how much storage space remains.

3 Use the **Export Options** button to choose between the following options:

- **Create third-party compatible export files**

This option allows you to choose whether to export third-party compatible files along with the raw SONOS files.

When checked (the default setting), the system exports both types of files. This allows third-party 3D software to use the images, but also uses more space on the CD.

When unchecked, the system exports only raw files, which saves space on the CD.

NOTE: If you uncheck this box and later want to use third-party 3D software with images exported only as SONOS raw files, load the raw files into the SONOS system, resave them to the 3D hard disk, and then export them to a different CD with this option enabled.

- **Revert to backwards compatible third-party export files**

This option allows you to choose whether to compress files being exported.

When unchecked (the default setting), the SONOS system compresses files being exported. This prevents older SONOS systems (and some third-party software) from using the files, but uses less space on the CD.

When checked, the SONOS system does not compress files being exported. This allows older SONOS systems (and some third-party software) to use the uncompressed files, but uses more space on the CD.

NOTE: This option is available only if the option **Create third-party compatible export files** is selected.

- **Default media size**

This option allows you to enter the specific size of the media being used. This value is used only to estimate how much space will be used on the CD.

---

**NOTE**

---

- The system continues to use these export-option settings until they are changed.
- A SONOS D.1 system can read any SONOS D.0 CD data, regardless of how these options are set on the D.1 system.

4 To select the files to export, do one of the following:

If you want to ...	Then ...
export an entire study	a. Select the study and press <b>Enter</b> . b. Select <b>Okay</b> and press <b>Enter</b> .
choose individual images in a study to export	a. Select the study and press <b>Enter</b> . b. Select <b>List Contents</b> and press <b>Enter</b> . c. Select the image or images to export, select <b>Okay</b> , and then press <b>Enter</b> .

A dialog box appears, requesting that you insert an approved blank disk into the CD drive.

**NOTE** When you click on a study, there could be a brief delay while the system computes its size.

5 Insert a CD-R into the CD drive, select **Begin**, and then press **Enter** .

The CD Operation Progress dialog box displays the progress of converting files, preparing the disk, adding data to the disk image, writing disk contents, and closing the disk.

**CAUTION** If you select **Cancel** during the write operation, the data is not stored on the CD and the CD will be unusable.

When the write operation is finished, a dialog box appears, confirming that the CD write operation completed successfully.

**NOTE** If the amount of disc space required to export your files exceeds the capacity of the CD-R, a dialog box prompts you to continue exporting to another disk. Use **Verify** to verify the current CD contents or use **Next Disk** to export to an additional disk.

- 6 To confirm the data was successfully written to the CD, select **Verify** and press **Enter** .

The CD Operation Progress dialog box displays the progress of verifying the files.

When the files on the CD are verified, a dialog box appears, confirming that the write and verification operations were successful.

- 7 Select **Okay** and press **Enter** .

### **Storing images as AVI files**

To store Loop Display images as AVI files to the 3D hard disk:

- In Loop Display mode, touch **AVI Store**.

A window may appear for adding a comment.

---

**NOTE**

---

You can manually label the images if the system is set to manual commenting in the Comments Options under Disk Setup. Make sure auto commenting is off.

The **AVI Store** touch control remains highlighted while the image is stored.

---

**NOTE**

---

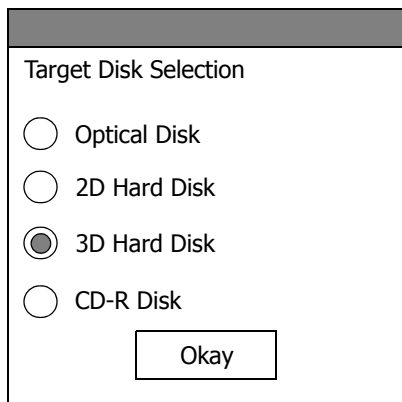
AVI images can be stored with 3D swivel activated, for better anatomy depth perception.

## Retrieving Live 3D Images from the 3D Hard Disk

To retrieve Live 3D images from the 3D hard disk:

- 1 In Live 3D mode, touch **Loop**.
- 2 Touch **Disk Retrieve**.

The following dialog box appears:



A dialog box titled "Target Disk Selection" with a gray header bar. It contains four radio button options: "Optical Disk", "2D Hard Disk", "3D Hard Disk" (which is selected, indicated by a filled circle), and "CD-R Disk". At the bottom right of the dialog is an "Okay" button.

- 3 Select **3D Hard Disk**, select **Okay**, and then press **Enter** .

The list of stored studies appears in the Disk Retrieve - Studies dialog box.











The following table describes the icons that might appear in the Patient Name column:

---

**NOTE**

---

You can bookmark Live 3D files. If a 3D file is bookmarked, its symbol appears with a yellow background. For more information on bookmarking loops, see the *Reference Manual, System Basics*.

Symbol	Definition
	Live 3D file
	Bookmarked Live 3D image
	Live 3D image exported to CD-ROM
	Live 3D image exported to CD-ROM and verified
	3D study
	Entire study exported to CD-ROM
	Entire study exported to CD-ROM and verified
	AVI file
	AVI exported to CD-ROM
	AVI exported to CD-ROM and verified



If automatic commenting is on, the following mnemonics for the 3D and BiPlane modes might appear in the Comments column:

Mnemonic	System Mode
3D	Live 3D
3DZ	3D Zoom
3FV	Full Volume
BP	BiPlane
3DC	3D Color

- 4 To view the individual images in a study, select the study folder, press **Enter**, select **List Contents**, and then press **Enter**.

The list of the images in the selected study appears:




OK

List Studies

Cancel

Select All

Select None

Patient Name	Comment	Date
 JOHN PHILIPS	Car Adult 3D	07 APR 2003 14:22:53
<b>3D</b> JOHN PHILIPS	Car Adult 3D	07 APR 2003 14:22:53
 JOHN PHILIPS	none	07 APR 2003 14:21:51
 JOHN PHILIPS	Car Adult 3D	07 APR 2003 14:22:06
<b>3D</b> JOHN PHILIPS	Car Adult 3D	07 APR 2003 14:22:06
<b>3D</b> JOHN PHILIPS	Car Adult 3D	07 APR 2003 14:21:51
<b>3D</b> SAMANTHA JONES	Car Adult 3D	07 APR 2003 14:27:35
<b>3D</b> SAMANTHA JONES	Car Adult 3D	07 APR 2003 14:27:35
<b>3D</b> SAMANTHA JONES	Car Adult 3D	07 APR 2003 14:27:35
<b>3D</b> SAMANTHA JONES	Car Adult 3D	07 APR 2003 14:27:35
<b>3D</b> SAMANTHA JONES	Car Adult 3D	07 APR 2003 14:27:35

☒ Multi-Select

Free Disk Space: 9610 / 17492 MBytes

**NOTE** Although AVI files appear in the list, you cannot retrieve them on the SONOS system.

- 5 Select the files to retrieve, select **Okay**, and then press **Enter**.

## Deleting Live 3D Files from the 3D Hard Drive

To delete stored Live 3D images:

---

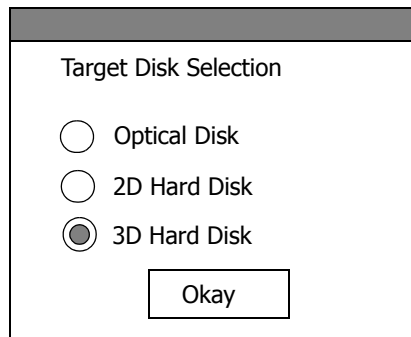
**NOTE**

---

You cannot delete files from a CD-ROM.

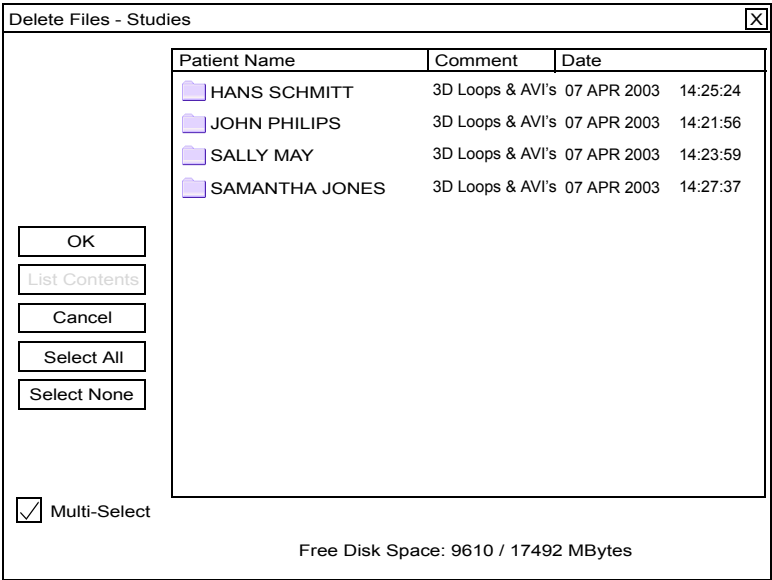
- 1 In Live 3D mode, on the left touch panel, touch **Disk**, and then **Delete File**.

The following dialog box appears:



- 2 Select **3D Hard Disk**.
- 3 Select **Okay** and press **Enter** .

The Delete Files - Studies dialog box appears:



4 To select the files to delete, do one of the following:

If you want to ...	Then ...
delete an entire study	a. Select the study and press <b>Enter</b> . b. Select <b>Okay</b> and press <b>Enter</b> .
choose individual images in a study to delete	a. Select the study and press <b>Enter</b> . b. Select <b>List Contents</b> and press <b>Enter</b> . c. Select the image or images to delete, select <b>Okay</b> , and then press <b>Enter</b> .

5 Select **Okay** and press **Enter** .

The Digital Storage dialog box appears, for confirming that you want to delete the files.

- 6 If you are sure you want to delete the files, select **Yes** and press **Enter** .

A dialog box appears showing the progress of the deletion.

- 7 Select **Okay** and press **Enter** .

The Delete Operation Progress dialog box appears to confirm the deletion.

---

## Managing BiPlane Images

You store and retrieve BiPlane images the same way you do 2D images. You can store BiPlane images to a magneto optical disk (MOD) or the 2D hard disk.

For more information about storing and retrieving 2D images, see the *Reference Manual, System Basics*. For more information about sending BiPlane images over a network with IDI, see the *Applications Manual, IDI User's Guide*.

To store a BiPlane image to MOD:

- 1 After acquiring an image, put a formatted optical disk in the drive and touch **Loop** on the left touch panel.

---

### NOTE

If IDI is installed, you must select **Enable Optical** in **Disk Setup** before acquiring the first loop of a study.

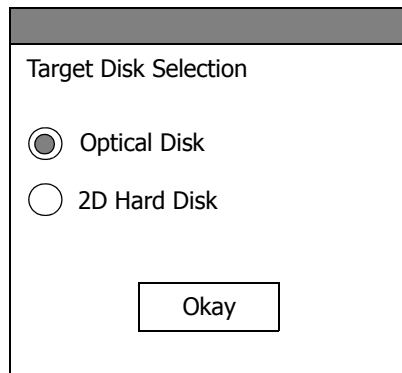
- 2 Touch **Disk Store** on the left touch panel.

---

### NOTE

If you have Disk Autostore enabled, the image will be stored when accepted following acquire.

The following dialog box appears when IDI is enabled and Enable Optical is on.:



- 3 Select **Optical Disk**, select **Okay**, and then press Enter.

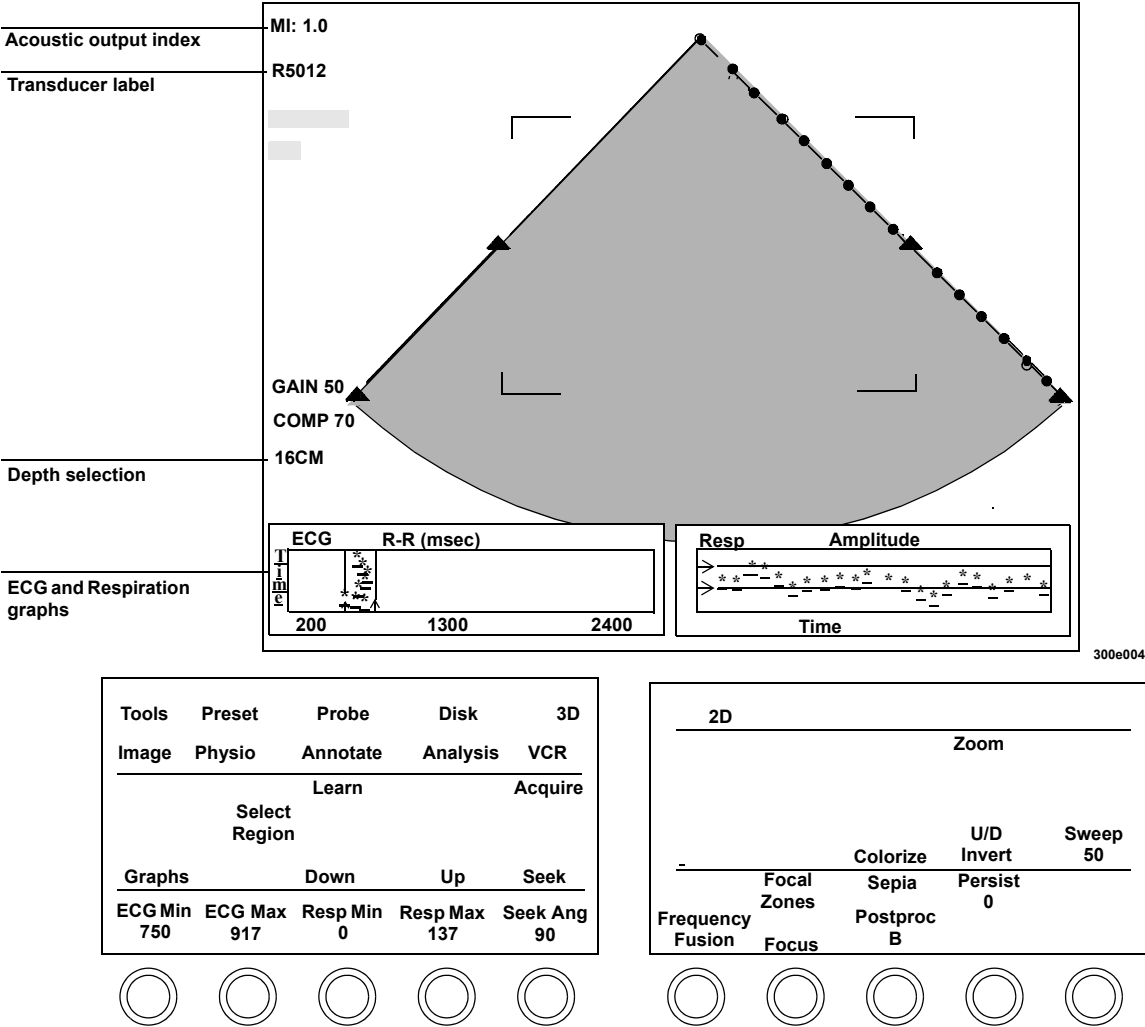
A disk icon displays the progress of the saving operation. When the operation is complete, the disk icon disappears.

For more information on retrieving stored images, see the *Reference Manual, System Basics*.



# Chapter 5    Gated, Sequential 3D Imaging

## Gated, Sequential 3D at a Glance





## Gated Sequential 3D Controls

Not all systems have the 3D option.

These controls are described in more detail in the Alphabetical Control Summary.

**Do not turn the system off or press **Reset** while storing to disk. This could damage all disk files.**

Acquire	Starts and pauses the 3D acquisition.
Cancel	Stops the 3D acquisition.
Delay 1	Sets the delay from the R-wave to start the acquisition. Only available in triggered protocols.
Delay 2	Sets the delay from the R-wave to stop the acquisition for 4D timed protocols. Starts the acquisition of the second frame in 3D Dual Frame protocols. Only available in triggered protocols.
Down	Moves the OmniPlane TEE or Transthoracic OmniPlane transducer sensor from any angle down to zero degrees. Touch the <b>Up</b> or <b>Down</b> control to stop it.
ECG Min	Adjusts minimum ECG R-to-R interval gating limit. Only present when Graphs is on and ECG triggering is selected.
End Acquire	Ends an acquisition when Advance Manual is active.
Format CROPPED	Selects a cropped quad format for acquiring images. When active, use the <b>Select Region</b> control to determine the area of the image to be stored. This looping format provides the highest quad format image resolution.
Format FULL	Selects full-screen format for acquiring and displaying looping images.
Format REDUCED	Selects a reduced quad format for acquiring images. This looping format lets you store the entire imaging sector at a reduced resolution.
Format VSPLIT	Selects vertical split format for acquiring images.
Frames	Sets the number of frames for both Multiple Frames and Non-triggered 4D acquisitions.

Graphs	Turns the display of the respiration and ECG gating graphs on and off.
Learn	Calculates respiration and ECG gating limits.
Power	Adjusts maximum transmit power in decibels (dB) where 0.0dB = maximum power, -30.0dB = minimum power. With 2D active, touch <b>Secondary Controls</b> and touch <b>Power</b> to adjust this control.
Resp Max	Adjusts the maximum respiration amplitude gating limit when Graphs is on and Respiration Gate is selected.
Resp Min	Adjusts the minimum respiration amplitude gating limit when Graphs is on and Respiration Gate is selected.
Seek	Moves the transducer sensor from any angle to the angle specified by the Seek Angle control.
Seek Angle	Selects the angle in degrees to which the transducer sensor will move. Touch <b>Seek</b> to move the sensor to this location.
Select Region	Displays and removes outline markers that indicate the area of the image that will be captured in a cropped quad-loop format.
Up	Moves the OmniPlane TEE or Transthoracic OmniPlane transducer sensor from any angle up to 180 degrees. Touch the <b>Up</b> or <b>Down</b> control to stop it.

## Setup Controls

To retain changes, save them to a preset. See the *System Basics* guide for details.

**Advance Auto** Automatically positions the rotatable array of the OmniPlane TEE or Transthoracic OmniPlane during acquisition.

**Advance A/confirm** Automatically positions the OmniPlane TEE or Transthoracic OmniPlane transducer but waits for manual confirmation before continuing with the acquisition.

**Advance Manual** Lets you control the transducer manually. The system will acquire the data once you indicate that the transducer is in place by choosing **Okay** in the dialog box and pressing **Enter**.

An angle increment of 2-3 degrees is recommended.

**Increment** Sets the angle increment used with automatic advancement of OmniPlane TEE or Transthoracic OmniPlane transducers.

**Learn Exhale** Calculates respiration limits based on the exhale portion of the respiration cycle. Only available with respiration gating.

**Learn Inhale** Calculates respiration limits based on the inhale portion of the respiration cycle. Only available with respiration gating.

**Resp. Gate** Turns respiration gating on and off.

**Review Off** Turns off Review mode.

**Review Rotate** Displays a rotating loop containing slices of the acquisition at every acquired transducer position upon completion of the acquisition. For two degree increments, shows slices at every 4th degree. Review Rotate is not available with Advance Manual.

**Review Summary** Displays six thumbnail images at evenly spaced acquisition angles and two composite images, upon completion of the acquisition. If Advance Manual is chosen, up to 12 thumbnail images will be displayed.

## Setup Controls

### Optical Disk Setup Controls

To facilitate file management, Study Mode is defaulted on.

#### Study Mode

Selects a subdirectory storage format (study format) for saving files to disk. Storing and retrieving files with Study Mode on facilitates file management. When Study Mode is off, the system stores files into the root directory (file format).

### Preset Controls

#### Protocol

Displays the Protocol menu, which contains the 3D and 4D protocols.

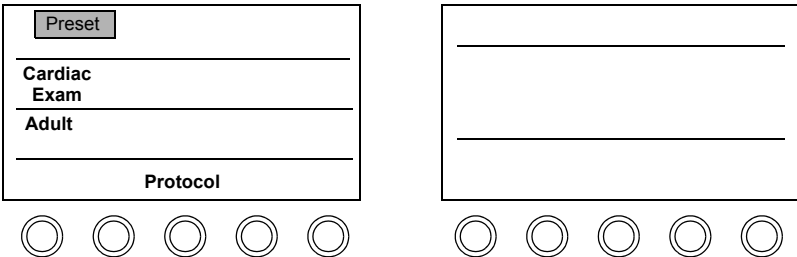
## 3D Protocols

Protocol	Acquisition Type	Description
3D	Single Frame	Acquires a single frame at Delay 1. The acquisition is triggered and gated by ECG and also respiration limits, if enabled.
	Dual Frame	Acquires two frames: one at Delay 1 and one at Delay 2. The acquisition is triggered and gated by ECG and respiration limits.
	Non-triggered	Acquires a single frame at each increment without ECG gating. Respiration gating can be used if it is enabled.
4D	Average Heart Cycle	Acquires frames throughout the heart cycle at each increment. The acquisition is triggered and gated by ECG and also respiration limits, if enabled.
	Multiple Frames	Acquires multiple frames at each transducer position. The acquisition is triggered and gated by ECG and also respiration limits, if enabled.
	Timed Acquisition	Acquires multiple frames at each transducer position starting at Delay 1 and ending at Delay 2. The acquisition is triggered and gated by ECG and also respiration limits, if enabled.
	Non-triggered	Acquires multiple, consecutive frames at each transducer position without ECG gating. Respiration gating can be used if it is enabled.

# Setting Up for a Gated Sequential 3D Acquisition

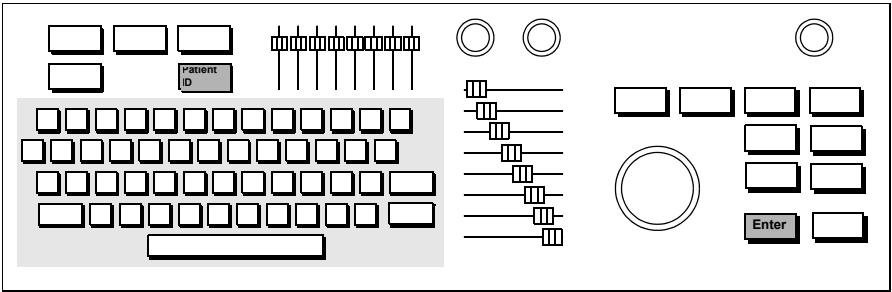
If you select your own 3D preset, you can start the acquisition after you enter the patient information.

- 1 Touch **Preset, Cardiac Exam**, and then touch either **Adult, Pediatric, TEE**, or a 3D preset that you created.

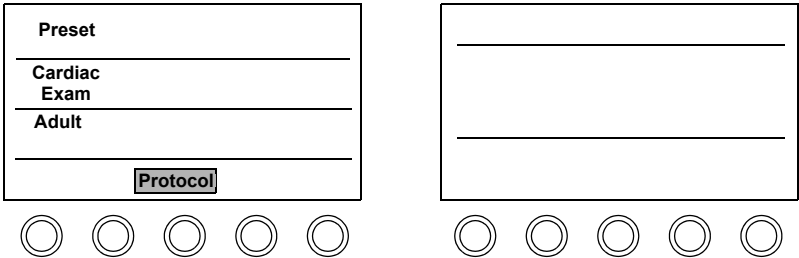


Be sure to check the available disk space.

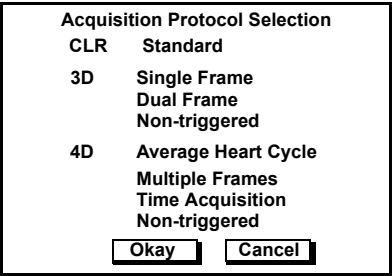
- 2 Enter the patient information and insert a formatted, initialized disk in the optical drive.



- 3 Touch **Protocol** to display the Protocol menu.

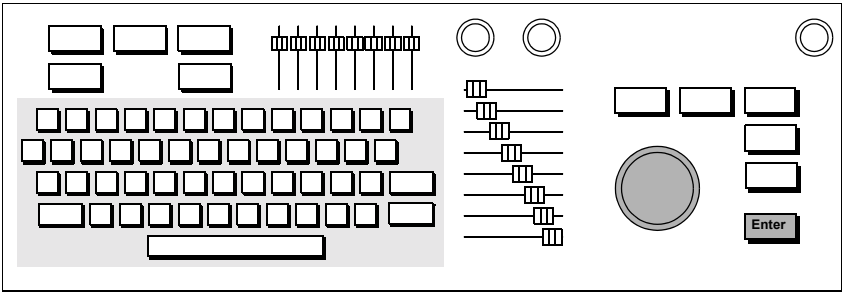


- 4 Use the trackball to move the arrow to the 3D or 4D protocol you are using, and press **Enter**.



After you select a 3D or 4D protocol, the **3D** control replaces the **Loop** control on the left touch panel.

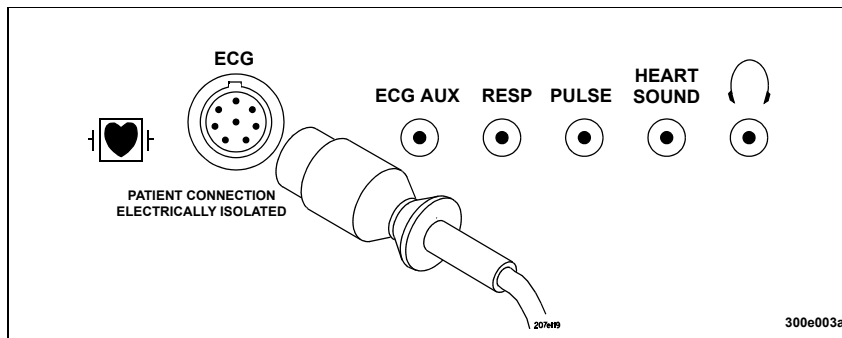
- 5 Move the arrow to **Okay**, and press **Enter**.



Gated, Sequential 3D Imaging  
**Setting Up for a Gated Sequential 3D Acquisition**

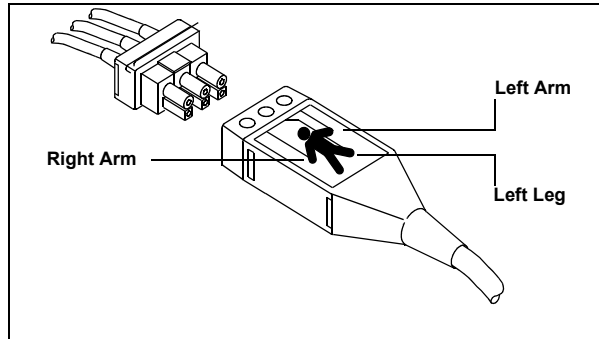
If you are using a nasal thermistor, plug it into the Resp connector located under the keyboard. Then set **Physio Resp** to 2.

- 6** Insert the ECG cable connector into the receptacle under the keyboard.





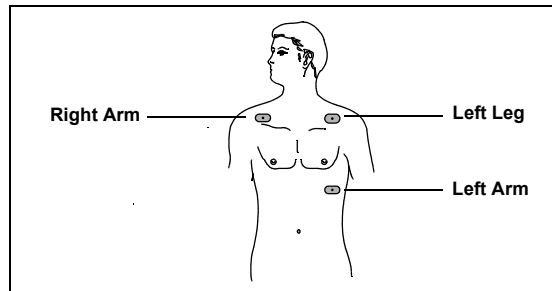
- 7 Connect the pin connector to the ECG cable.



ECG leads also provide information about respiration, if your system has this physio and it is set to **Resp Normal**.

Proper ECG lead placement is critical for receiving a good ECG and respiration signal.

- 8 Attach the electrodes and ECG leads to the patient as shown.

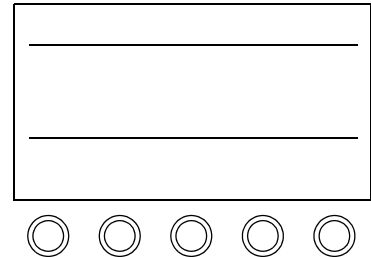
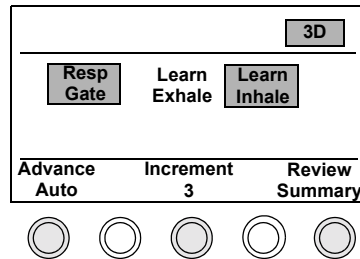


## Gated, Sequential 3D Imaging

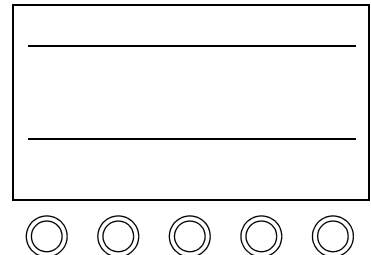
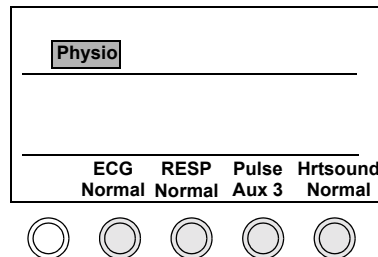
### Setting Up for a Gated Sequential 3D Acquisition

Be sure to select the Review mode now. Review settings can only be changed before the acquisition starts.

- 9 Press **Setup**, and touch **3D** to choose the Setup options. Select the **Resp. Gate**, **Advance**, **Increment**, and **Review** settings for the acquisition.

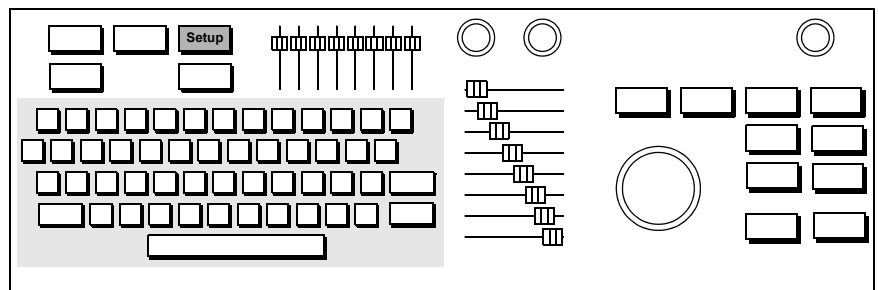


- 10 Touch **Physio** and select the input sources for the waveforms you want to view. Select **Off** for those you don't need.

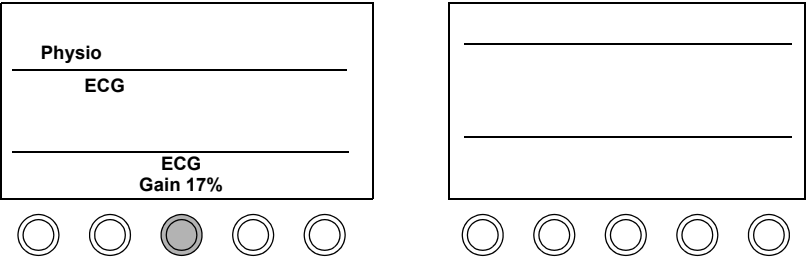


After exiting Setup, you can save the settings by touching the **Save Preset** control (located in the lower left corner of the left touch panel).

- 11 Press **Setup** to return to live imaging.



- 12 Touch **Physio** and adjust the **ECG** or **Resp. Gain** control to ensure a strong signal.

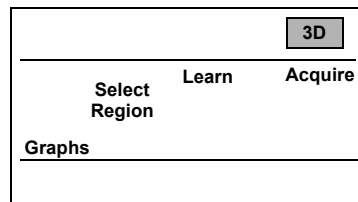


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## Conducting a Gated Sequential 3D Acquisition

This section describes the steps for an Average Heart Cycle acquisition. For setup information, see [“Setting Up for a Gated Sequential 3D Acquisition”](#) on page 5-7.

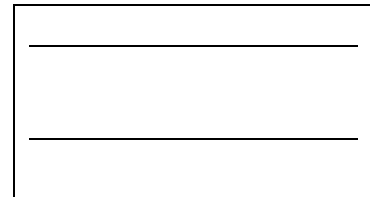
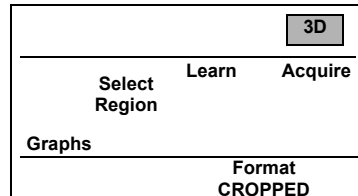
### 1 Touch **3D**.



**Format CROPPED** is active for Philips presets. Using other looping formats requires more disk space.

If the **Format** control is not visible, turn **Graphs** off and select the looping format for your acquisition.

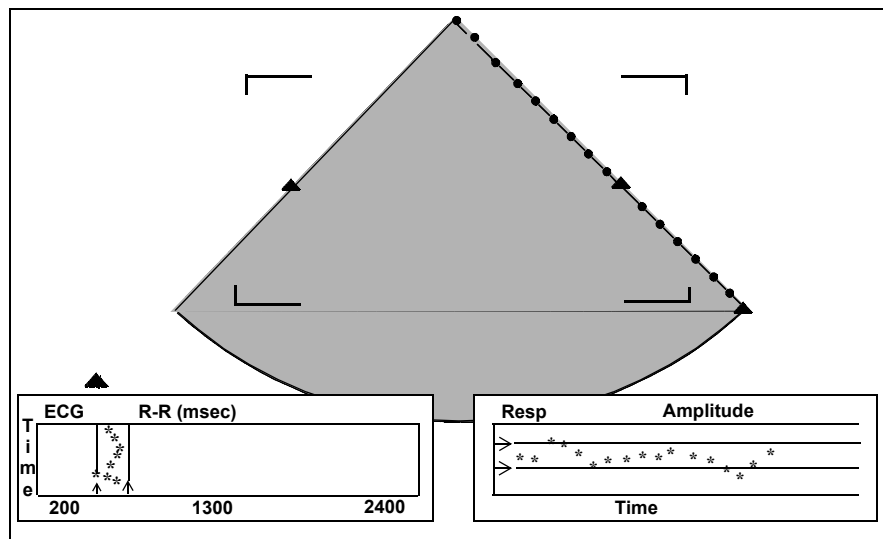
### 2 Select the looping **Format** for your acquisition.



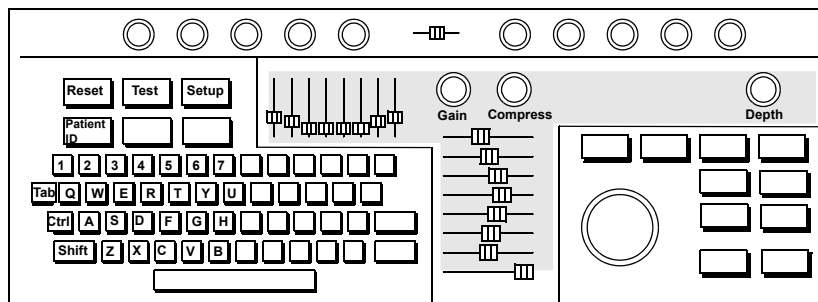
Use the graphs during acquisition to display the patient's ECG and respiration.

ECG and respiration should be stable during acquisition to ensure good quality data for 3D reconstruction and to reduce acquisition time.

- 3 Touch **Graphs** to display the ECG and respiration graphs.



- 4 Adjust the **Depth** setting so that the graphs do not interfere with viewing the anatomy.

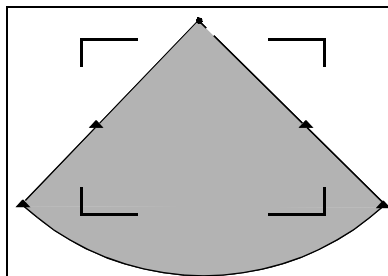


## Gated, Sequential 3D Imaging

### Conducting a Gated Sequential 3D Acquisition

The selected region should be centered on the anatomy of interest and include anatomic landmarks for reconstruction.

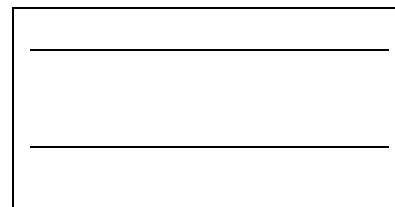
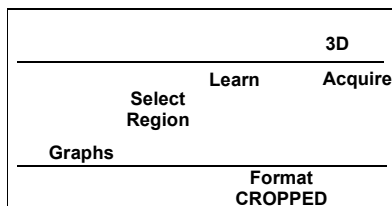
- 5 Use the trackball to position the region indicator.



Adjust all imaging controls now. No imaging controls should be changed during acquisition.

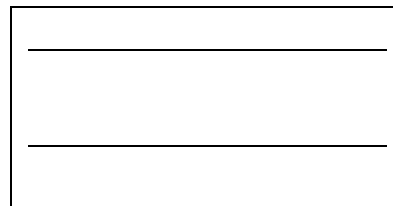
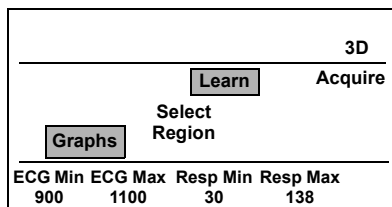
For details, see “3D Imaging Tips and Troubleshooting” on page 5-22.

- 6 Obtain an optimal image in which the area of interest is in the center and maintains good image quality through 180 degrees.



After **Learn** has finished setting the gating limits, use the **ECG**, **Resp Max**, and **Resp Min** controls to adjust the gating limits, if necessary. Narrow gating limits increase the quality of reconstruction and acquisition time. The use of narrow gatings for valves and other small structures is recommended.

- 7 Touch **Learn** to establish ECG and respiration gating limits for the acquisition.

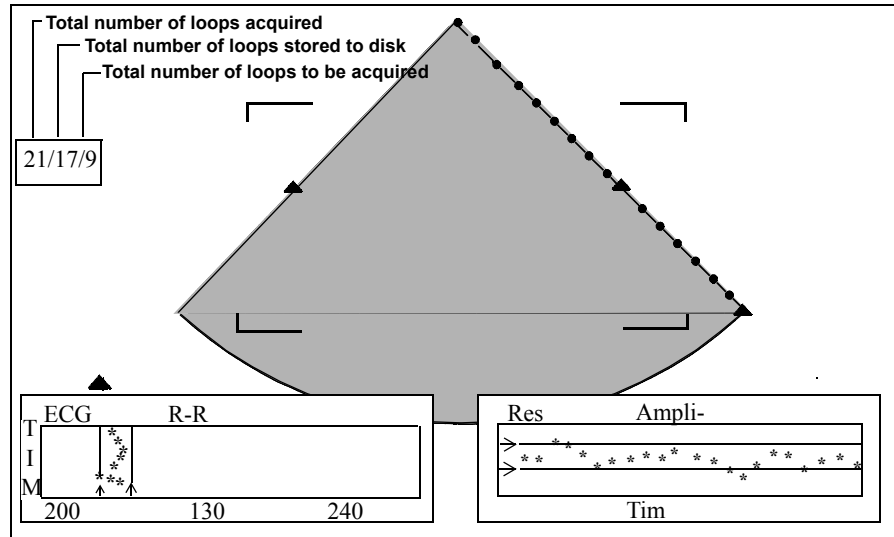


Do not change imaging control settings during the acquisition.

Touch **Acquire** a second time to pause the acquisition and again to resume the acquisition.

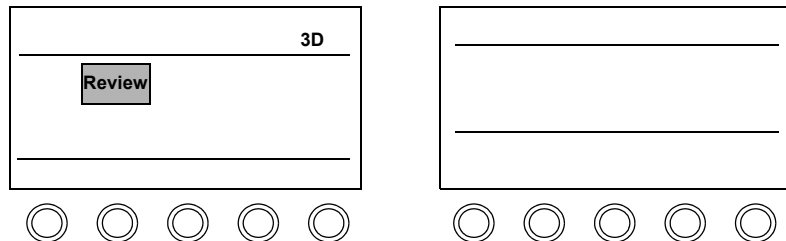
Touching **Cancel** during acquisition stops the acquisition and deletes any data that has not been stored to disk.

8 Touch **Acquire** to begin the acquisition.



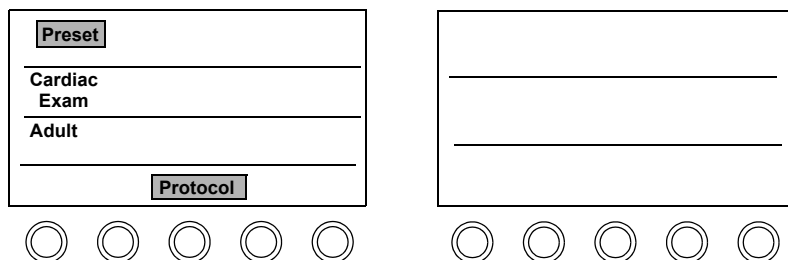
9 Touch **Review** to exit Review mode.

At the end of the study, the system automatically enters the Review mode selected in Setup, unless **Review** has been set to **Off**.



After you change presets, the **Loop** control replaces the **3D** control on the left touch panel.

- 10 To exit 3D and return to standard Loop mode, touch **Preset**, and touch either **Adult** or **Pediatric**.



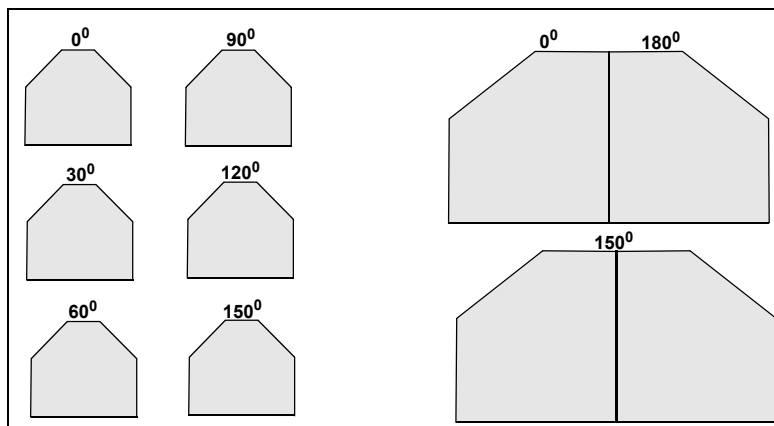


## Using Review Mode

At the end of the study, the system automatically enters the Review mode selected in Setup, unless **Review** has been set to **Off**.

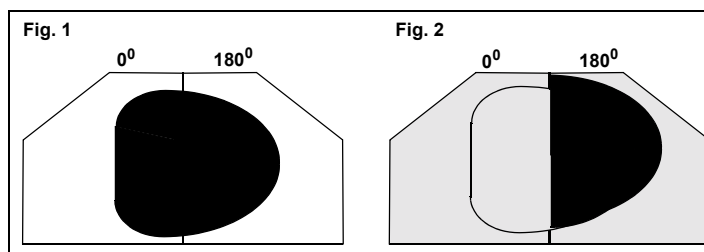
Review mode lets you identify problems in image acquisition due to transducer or patient movement.

To use Review Summary, move the trackball to change the display speed. You can also press **Freeze** and use the trackball to review the images frame-by-frame.



The first and last images acquired should line up, as if they were a single image. Use this comparison mode to determine if you need to do another acquisition.

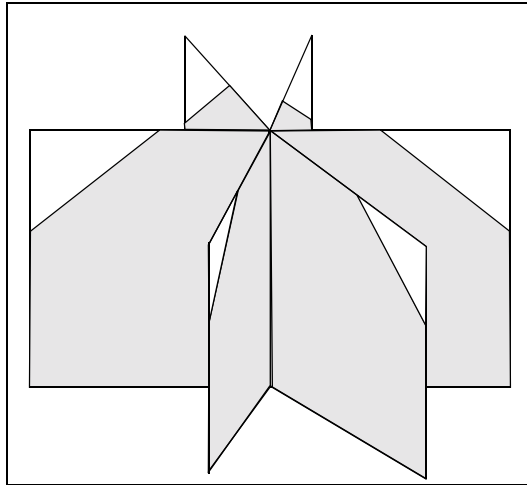
Fig. 1 shows an example where the first and last images line up correctly at 0 and 180 degrees. Fig. 2 shows an example where the images do not line up and another acquisition should be considered.



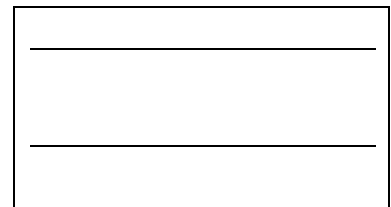
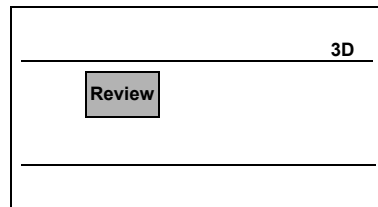
To use **Review Rotate**, move the trackball to change the display speed. You can also press **Freeze** and use the trackball to review the images frame-by-frame.

**Review Rotate** presents a rotating composite at each acquired increment. As the composite images rotate, you can identify problems in image acquisition due to transducer or patient movement.

Review mode loops are stored to optical disk and can be identified by the comment; either Summary or Rotate.



Touch **Review** to exit Review mode.



# Retrieving a Gated Sequential 3D Study from Disk

- 1 Touch **Preset**, and select **Adult** or **Pediatric**.

Preset

Cardiac Exam

Adult

Protocol

- 2 Touch **Disk** and **Disk Retrieve** to see the file list.

Disk

Disk Retrieve

For loops, be sure the active format is the same size or smaller than the loop you are displaying. For example, for split loops, **Vsplit** or **Cropped** format must be active.

Be sure to retrieve from the correct study.

- 3 To retrieve a file, select it with the trackball, and press **Enter**.

Highlight file or files to retrieve

Patient ID	Comment	Date	Description
Jones	4D,090/091,180	Jun 3, 98	CQUAD BW
Jones	4D,091/091,180	Jun 3, 98	CQUAD BW
Jones	SUMMARY	Jun 3, 98	FULL BW

☐ Select multiple items

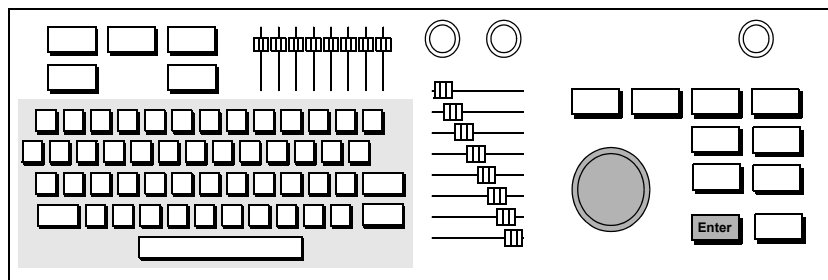
Okay

Cancel

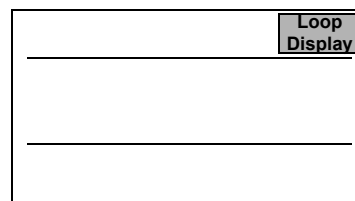
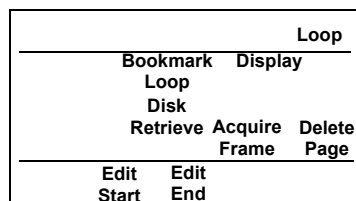
List Contents

Change Patient

- 4 Move the arrow to **Okay**, and press **Enter**.



- 5 To return to real-time imaging, touch **Loop Display**.



---

## 3D Imaging Tips and Troubleshooting

Symptoms	Suggestions
Motion artifacts appear in reconstruction	<p>Be sure that the transducer does not move during acquisition.</p> <p>When using an OmniPlane TEE transducer, hold it at the mouth and handle to minimize movement.</p> <p>Make sure that the patient is comfortable and able to remain still throughout the entire acquisition.</p> <p>If the heart rate is decreasing and the patient is alert, instruct the patient to make a fist or open his eyes to increase the heart rate.</p> <p>If the heart rate is increasing and the patient is alert, instruct the patient to close his eyes and relax.</p> <p>Gating limits may be too wide.</p> <p>Adjust monitor settings.</p> <p>Breathing should be relaxed, slow, and even. The patient should not talk, cough, etc., during acquisition.</p>
Resolution of anatomy is poor or image is only partially visible	<p>Use the highest frequency and Frequency Fusion setting acceptable.</p> <p>Make sure the target area can be viewed through 180 degrees.</p> <p>Be sure the region of interest includes anatomic landmarks for reconstruction.</p> <p>Adjust Gain to improve signal strength.</p>

Image is too soft,  
hazy, or gray

Make sure that the object of interest is positioned at the center of the sector that is the axis of rotation. This is the area of highest resolution.

Set Gain settings a little higher than normal to prevent loss of data during reconstruction.

Check the **Persistence** control. It should be set to 0.

Adjust monitor settings.

---

Gating problems

The placement of the leads is critical for ensuring proper gating limits. See [“Setting Up for a Gated Sequential 3D Acquisition”](#) on page 5-7.

The most important issue in 3D acquisitions is proper ECG and respiratory gating. The R-R interval limits should be less than or equal to 150 ms. The respiratory gating should be set to **Learn Exhale**, to exclude images during the inhale phase.

Narrower gating limits will increase the acquisition time, so a balance between reconstruction quality and acquisition time must be achieved.

The **Delay 1** value must be shorter than the current R-to-R interval. If **Delay 1** is longer than the R-to-R interval, decrease the value of **Delay 1**.

For 3D Dual acquisitions, the **Delay** values must be set apart enough to allow each frame to be acquired independently.

---

Angle increments

Two degree increments are ideal for greatest reconstruction resolution. However, this increases the duration of the acquisition, allowing a greater potential for artifacts.

Three degree increments present a reasonable compromise between resolution and duration of acquisition.

---

Transducer issues	<p><b>Advance Auto</b> and <b>Advance A/Confirm</b> can only be used with an OmniPlane or a Transthoracic OmniPlane transducer. If one is not available, change to <b>Advance Manual</b> in Setup.</p> <p>Make sure the OmniPlane transducer is positioned correctly to allow remote controlling and for proper calibration.</p> <p>The control buttons on the OmniPlane transducer handle will be disabled during an <b>Advance Auto</b> or <b>Advance A/Confirm</b> acquisition.</p>
-------------------	--

---

Cannot retrieve disk images while in a 3D protocol	<p>You must select <b>CLR Standard</b> to retrieve disk images. To select <b>CLR Standard</b>, touch <b>Preset</b>, <b>Cardiac Exam</b>, <b>Protocol</b>, and select <b>CLR Standard</b> from the protocol menu.</p>
--	--

---

**NOTE**

---

Philips does not provide off-line 3D-reconstruction software. The company providing the 3D-reconstruction software has the sole responsibility of validating the measurements that occur during reconstruction.

Philips suggests that you contact the company that supplied the reconstruction software for additional information on the implementation and accuracy of the reconstruction measurements.

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