1 About the uSmart3200T Ultrasound System

he Terason uSmart Ultrasound System is an easy-to-use, portable ultrasound system that produces high resolution images.

The microminiaturized ultrasound system runs under the Windows 7 Touch interface, for multi-touch operation. You can also connect the computer to a printer for image output.

This section of the *Terason uSmart Ultrasound System User Guide* covers the following topics:

Caution: Some actions can expose the Ultrasound System computer to attack by viruses. These actions include: installing non-Terason software, connecting a USB drive, and connecting the system to a network. If you intend to perform any of those actions, or any other action that might expose the computer to a virus, Terason strongly recommends that you install an effective anti-virus software package. Terason has found that Norton AntiVirus v.9 or above and Microsoft Security Essentials are compatible with the Terason uSmart Ultrasound System.

Caution: Do not enable Windows automatic updating. The software that is shipped on the system has been safety tested and approved.

About Ultrasound Modes

Ultrasound is primarily an operator-dependent imaging technology. The quality of images and the ability to make a correct diagnosis based on scans depend on precise image adjustments and adequate control settings applied during the exam. The Terason software provides tools to optimize the image quality during a patient scan for all image modes.

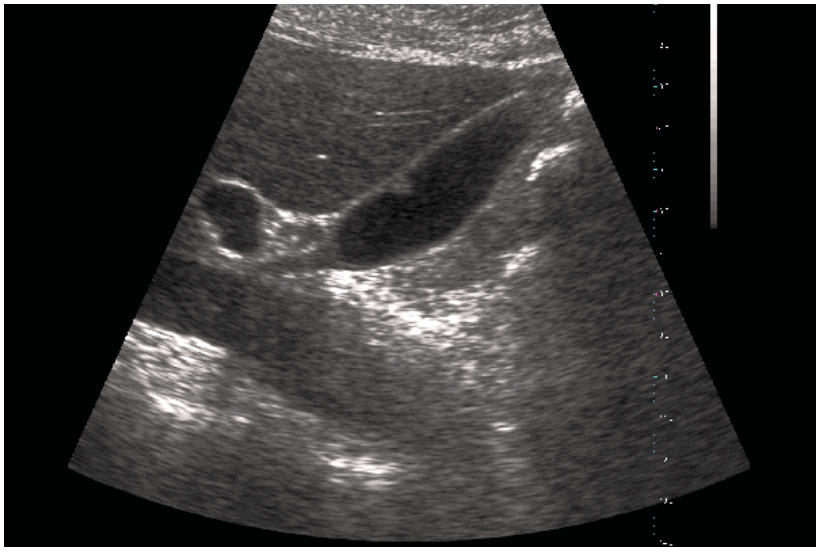
The Terason software supports the following scan modes:

- 2D Mode
- M-Mode (Motion Mode)Color Doppler
- Triplex
- Pulsed-Wave Doppler
- Omni Beam
- TeraVision

2D Mode

The Terason uSmart Ultrasound System delivers 2-dimensional digital imaging using 256 digital beam-forming channels. This imaging mode delivers excellent image uniformity, tissue contrast resolution, and steering flexibility in frequencies from 2 MHz to 12 MHz. The high channel count supports true phased array and high-element count imaging probes.

The 2D scan data displays in the 2D Imaging window. The figure below shows a sample 2D obstetrical scan.



Example 2D Scan

To use 2D, see:

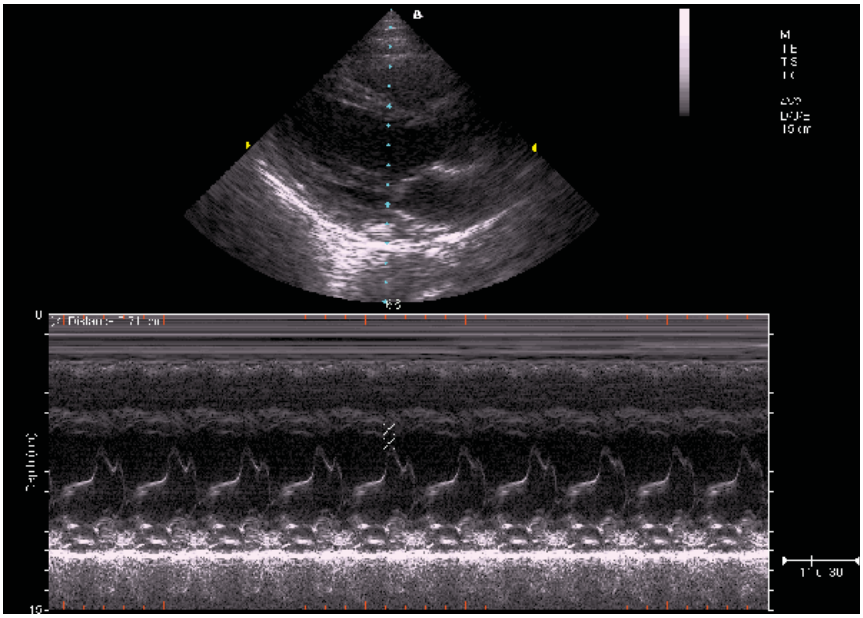
- Acquiring Images on page 48
- Using the Image Control Buttons on page 68
- Using 2D Image Controls on page 69
- Measuring in the 2D Window on page 106

M-Mode (Motion Mode)

The Terason uSmart Ultrasound System provides simultaneous 2-dimensional (2D mode) and M-Mode imaging. This combination is valuable for the efficient assessment of moving structures.

Use M-Mode to determine patterns of motion for objects within the ultrasound beam. Typically, this mode is used for viewing motion patterns of the heart.

M-Mode displays scan data of the anatomy in the 2D Imaging window, and the motion scan in the Time Series window. The following figure shows a sample M-Mode scan.



Example M-Mode Scan

For more information on using M-mode, see:

- Acquiring Images on page 48
- Using M-Mode Image Controls on page 74

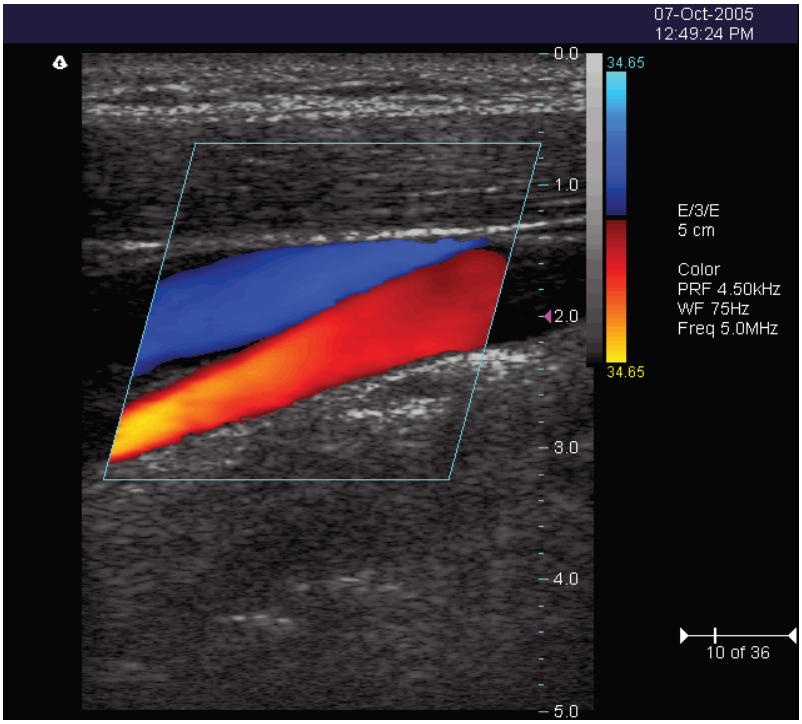
Color Doppler

Color Doppler mode is used to detect the presence, direction, and relative velocity of blood flow by assigning color-coded information to these parameters. The color is depicted in a region of interest (ROI) that is overlaid on the 2D image. Non-inverted flow towards the probe is assigned shades of red, and flow away from the probe displays in shades of blue. The mean Doppler shift is then displayed against a grayscale scan of the structures.

All forms of ultrasound-based imaging of red blood cells are derived from the received echo of the transmitted signal. The primary characteristics of this echo signal are its frequency and its amplitude (or power). The frequency shift is determined by the movement of the red blood cells relative to the probe – flow towards the probe produces a higher-frequency signal than flow away from the probe. Amplitude depends on the amount of moving blood within the volume sampled by the ultrasound beam. You can also apply a high frame rate or high resolution to control the quality of the scan.

Higher frequencies generated by rapid flow are displayed in lighter colors, and lower frequencies in darker colors. For example, the proximal carotid artery is normally displayed in bright red and orange, because the flow is toward the probe, and the frequency (velocity) of flow in this artery is relatively high. By comparison, the flow in the jugular vein displays as blue because it flows away from the probe.

The Color Doppler scan data displays in the 2D Imaging window. The following figure shows a sample Color Doppler scan.



Example Color Doppler Scan

For more information on using Color Doppler, see:

- Acquiring Images on page 48
- Using Color Doppler Image Controls on page 81

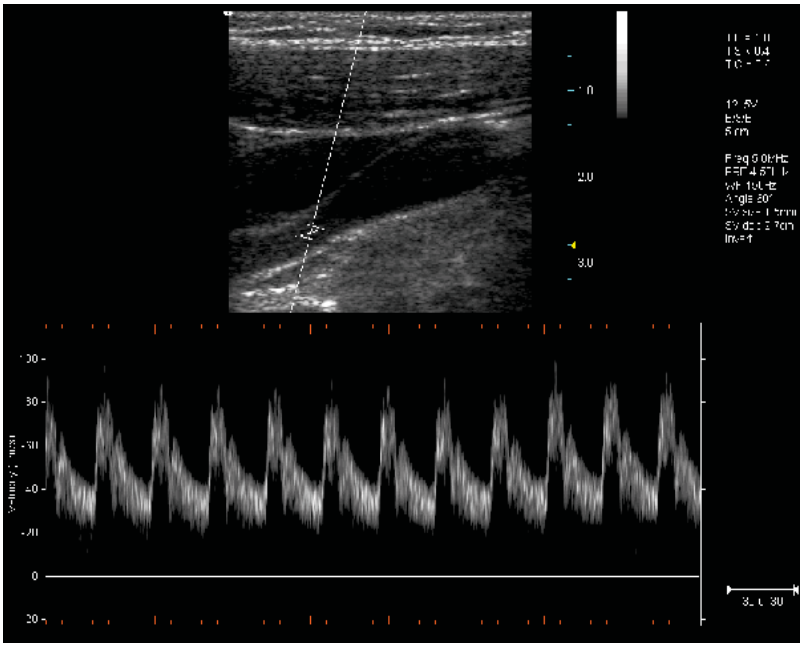
Pulsed-Wave Doppler

A Pulsed-Wave Doppler (PWD) scan produces a series of pulses used to study the motion of blood flow in a small region along a desired ultrasound cursor, called the sample volume or sample gate.

The X-axis of the graph represents time, and the Y-axis represents Doppler frequency shift. The shift in frequency between successive ultrasound pulses, caused mainly by moving red blood cells, can be converted into velocity and flow if an appropriate angle between the insonating beam and blood flow is known.

Shades of gray in the spectral display represent the strength of the signal. The thickness of the spectral signal is indicative of laminar or turbulent flow (laminar flow typically shows a narrow band of blood flow information).

In the Terason uSmart Ultrasound System, Pulsed-Wave Doppler and 2D are shown together in a mixed-mode display. This combination lets you monitor the exact location of the sample volume on the 2D image in the 2D Imaging window, while acquiring Pulsed-Wave Doppler data in the Time Series window.



Example Pulsed-Wave Doppler Scan

In the 2D scan, the long line lets you adjust the ultrasound cursor position, the two parallel lines (that look like =) let you adjust the sample volume (SV) size and depth, and the line that crosses them lets you adjust the correction angle.

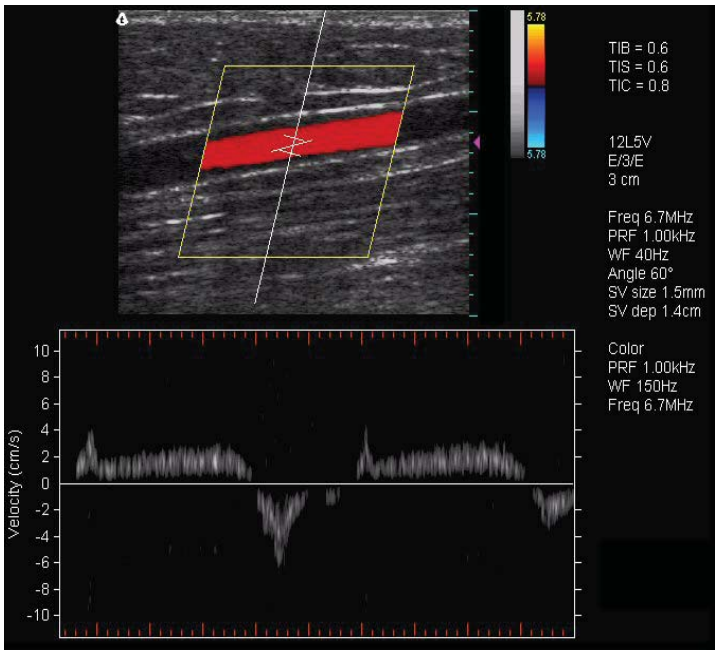
For more information on using Pulsed Wave Spectral Doppler, see:

- Acquiring Images on page 48
- Using Spectral Doppler Image Controls on page 75
- Measuring in Spectral Doppler Modes on page 112

Triplex

Triplex scan mode combines simultaneous or non-simultaneous Doppler imaging (Color Doppler, Directional Power Doppler, or Power Doppler) with Pulsed-Wave Doppler imaging to view arterial or venous velocity and flow data. Triplex allows you to perform range-gated assessment of flow.

Triplex applications include vascular studies, phlebology, perinatal, and radiology. The following triplex image example shows the greater saphenous vein.



Example Triplex Scan

For more information on using Triplex mode, see:

- Acquiring Images on page 48
- Scanning in Triplex Mode on page 85

TeraVision

TeraVision is an optional image-optimization package that sharpens images produced by the Terason uSmart Ultrasound System.

See Enhancing the Image Using TeraVision™ Optimization on page 57

Support for Medical Procedures

The Terason uSmart Ultrasound System can be configured with needle guides used for tissue biopsy, fluid aspriation, amniocentesis, and catheter placement. The system can also be incorporated into cryoablation (or targeted ablation) and brachytherapy products from other vendors. The Terason uSmart Ultrasound System scans the anatomy or vessel for size, location, and patency, and provides guide lines between which the needle will appear.

For biopsy and vascular puncture applications, a needle guide kit directs needles to the proper location for percutaneous vascular punctures and nerve blocks. The needle guide allows you to direct the needle into the center of a vessel or tissue mass, helping to avoid adjacent vital tissue. You can see the anatomy in real time before, during, and after the procedure, and can save images and Cine loops for future reference.

For cryoablation or brachytherapy applications, the system may include an insertion template and a stepper or stabilizer. The procedure for these applications is defined by the company that provides those systems. The Terason software displays the insertion grid and needles on the scan to show the progress of the procedure.

You can use the needle guides in the following modes:

- 2D Mode, see page 17
- Color Doppler, see page 18
- M-Mode (Motion Mode), see page 17

See Performing Medical Procedures on page 119 for information on using the Terason uSmart Ultrasound System to perform biopsies.

Terason Probes

The Terason uSmart Ultrasound System consists of the probe, electronics envelope, and the Terason software. All of the Terason probes can be used with all scan modes.

For a list and specifications of the probes supported by the module you have purchased, see the *Module User Guide* supplied with the system. Also see “System Specifications” and “Indications For Use” in the *Volume 2* of this guide.

Imaging, Patient, Report, and Review Windows

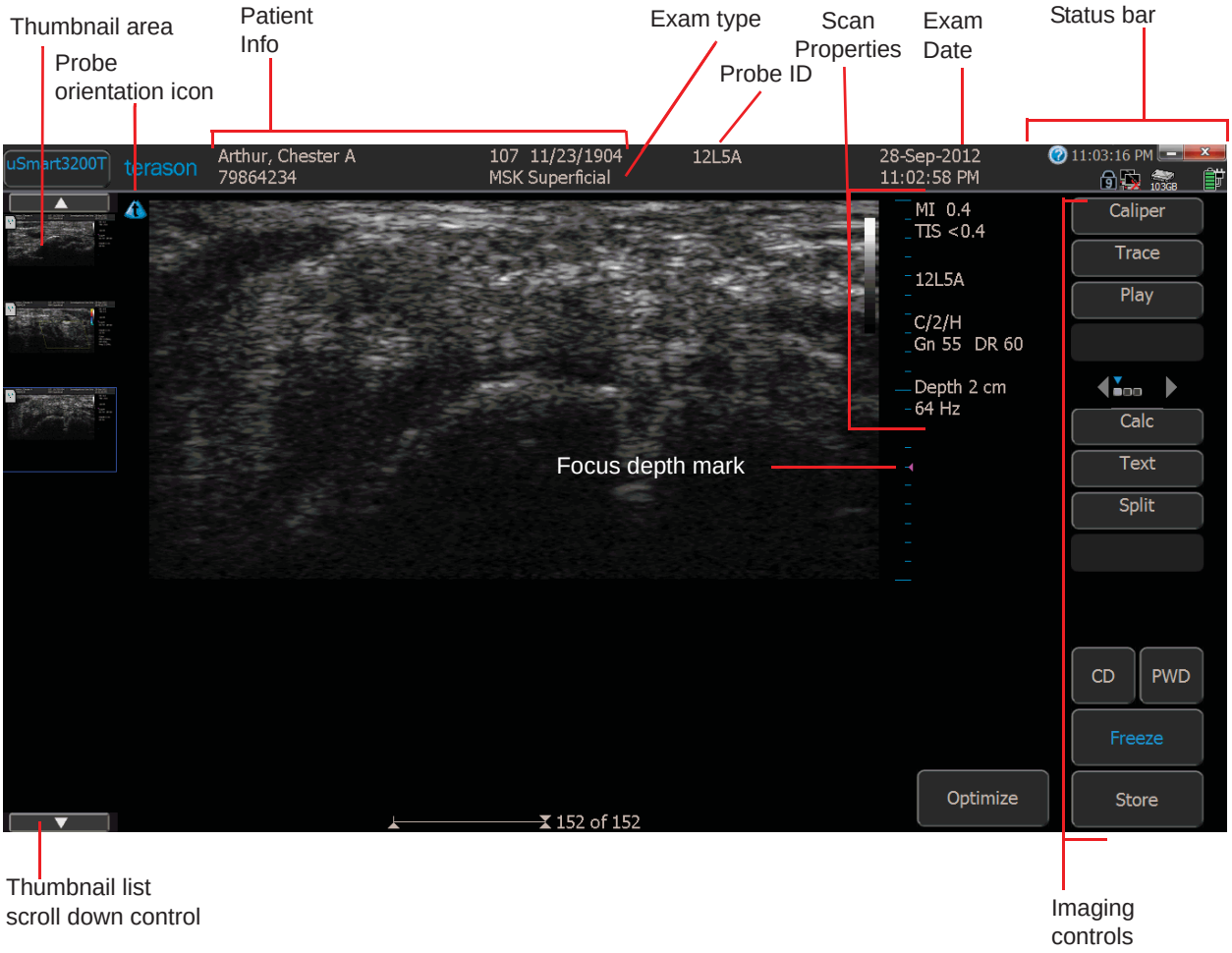
These windows use the same space on the computer screen. Tap a button to open that window.

To use these windows, see:

- Imaging Window on page 23
- Status Bar on page 24
- Report Window on page 26
- Review Window on page 27
- Working With Scan Modes on page 68
- Setting Up Patient Information on page 37
- Reviewing Patient Studies on page 90

Imaging Window

When you start the Terason software, the Imaging window displays.



Terason Imaging Window

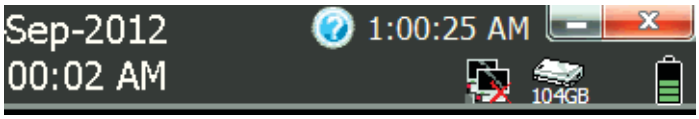
The Imaging window consists of the 2D window above the Time Series window (if the selected scan mode generates a Time Series window). The 2D window displays in all scan modes; the Time Series window displays only when scanning in M-Mode, PWD mode, or Triplex mode.

If a control, button, or menu shows in gray, it usually means that the function is not available for the current circumstances.

For details of the imaging information display, see Status Bar on page 24 and Scan Properties Display on page 24.

Status Bar

The Imaging screen includes a status bar at the upper right corner.



Status Bar

The status bar displays the following indicators, from left to right:

Help button - tap this to open the Help file.

Network connection - shows if the computer is connected to a network. If there is no connection, a red X shows on the indicator.

Disk free space - shows how much free space is left on the computer hard drive.

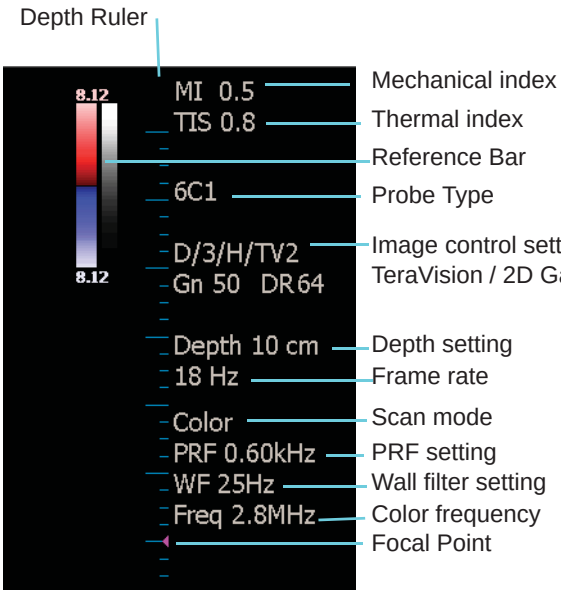
Battery charge - shows the remaining charge of the system battery, when the AC power supply is disconnected. In the illustration, the battery is fully charged. As the battery discharges, the green bands disappear, from the top down. When the battery is almost fully discharged, a single red band shows at the bottom of the indicator. When the battery is partly discharged and the AC power supply is connected, a yellow lightning bolt shows on the battery icon. When the battery is full charged and the AC power supply is connected, a red power plug icon displays in place of the battery icon.

Minimize button - tap this to minimize the Terason Ultrasound screen and view the Windows desktop. To return to the Terason Ultrasound screen, drag the Windows taskbar up from the bottom of the screen and tap the Terason icon.

Exit button - tap this to exit the Terason Ultrasound program. To restart the Terason Ultrasound program, double-tap the ultrasound icon on the Windows desktop.

Scan Properties Display

The Imaging window includes a text display that shows information about the current scan. The image control settings displayed vary, depending on the scan mode and other factors.



Scan Properties Display (*Example*)

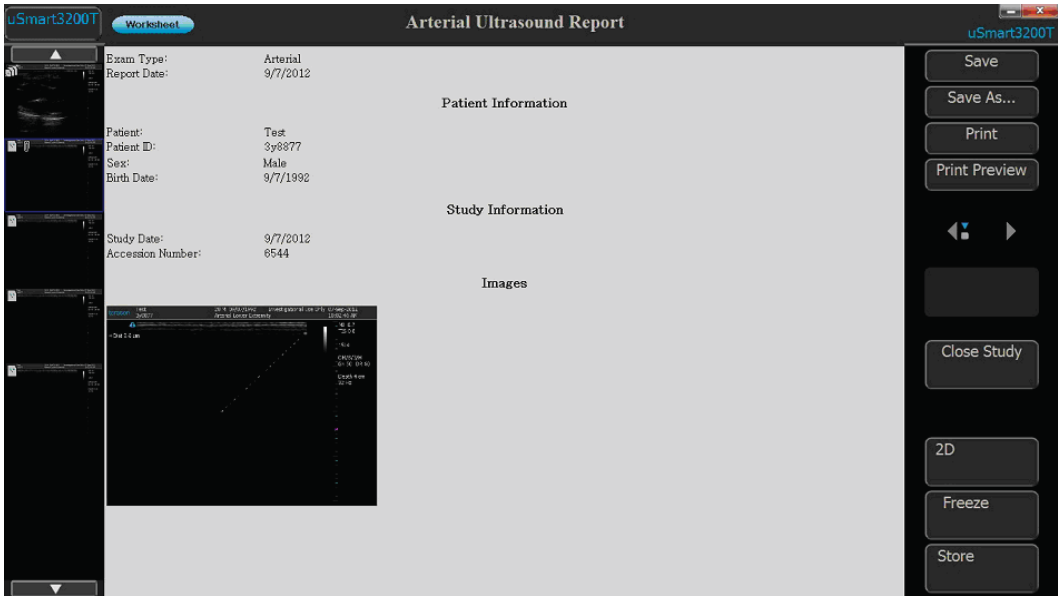
* The 2D gain display is initially 50. This is not an absolute value; the actual gain changes with different presets, but always displays as 50 initially. When you change the gain using the Gain button, the displayed value goes up or down.

See Chapter 4, Working With Scan Modes, on page 68 for explanations of how to change settings.

Report Window

The Report window displays study information including patient data, exam date, exam type, and saved images. The report is generated as patient data and study information is saved.

To open the Report window, tap the uSmart3200t button at the top left corner of the screen, then tap Report.

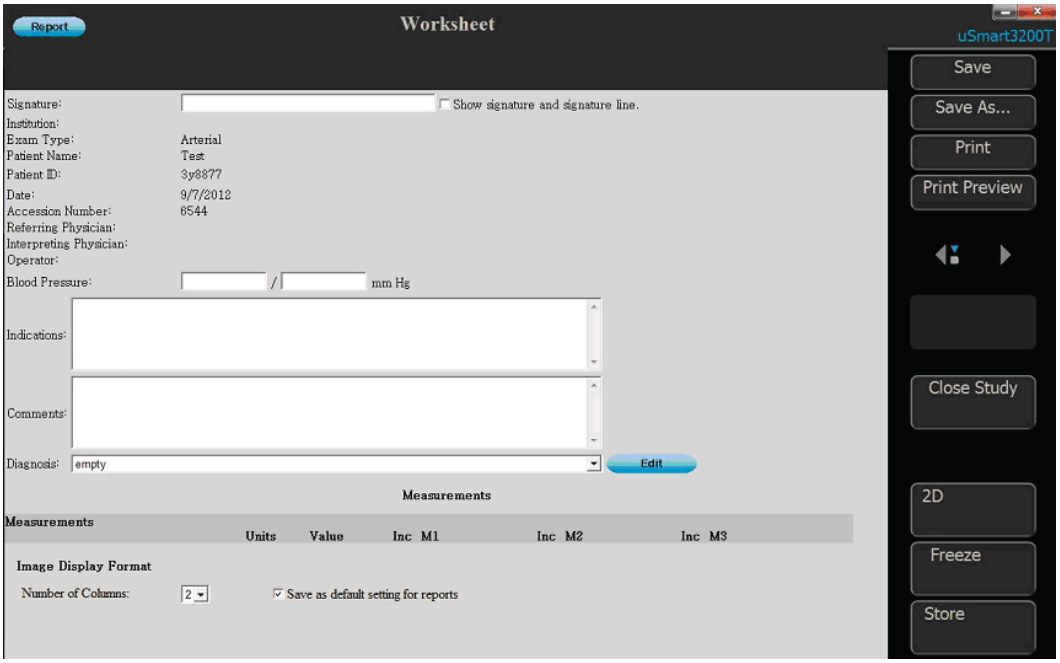


Report Window

Softkeys on the Report window control the following functions:

- **Save** - Saves a file of the report to the study folder on the ultrasound system. The file appears as a thumbnail on the Review window. Taping the thumbnail opens the file. The saved report file does not include images saved to the report.
- **Save As...** - Lets you change the format of the saved Report file. The default format is PDF; this control lets you save the file as PDF or HTML.
- **Print** - Prints the report on a printer connected to the system.
- **Print Preview** - Displays an image of the report as it will print.

A **Worksheet** button at the top left of the window lets you add information to the report. Tapping the button opens the Worksheet window.



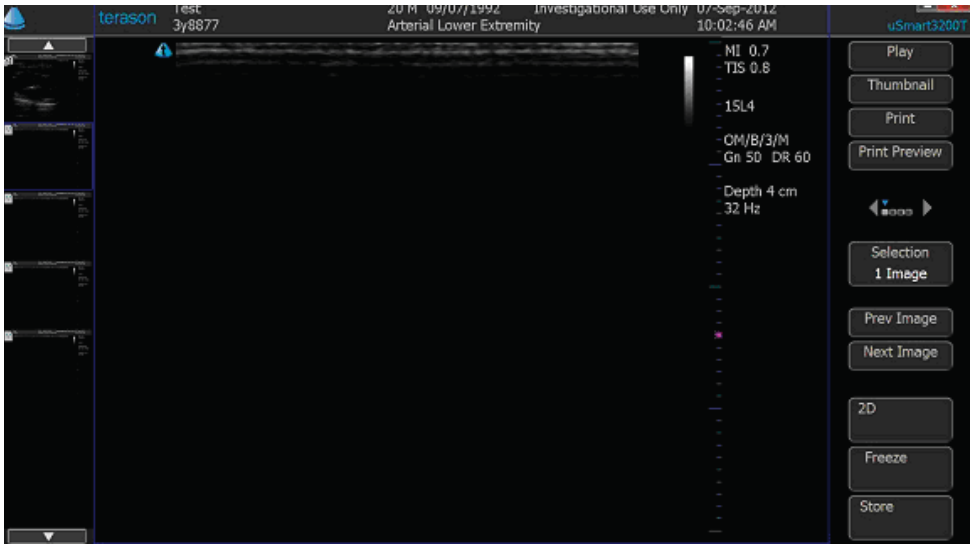
Worksheet Window

You can enter information in any of the fields on the window. The entered information automatically adds to the report. The Worksheet window has the same softkeys as the Report window. Tapping the Report button returns to the Report window.

Review Window

You can view a saved study in the Review window. While reviewing a saved study, you can add annotations and measurements in the same way as on the Imaging window. See Working with Annotations on page 59 and Working With Measurements on page 102.

Note: The text home position set in the Imaging window does not apply to the Review window. The text home position set in the Review window does not apply to the Imaging window.



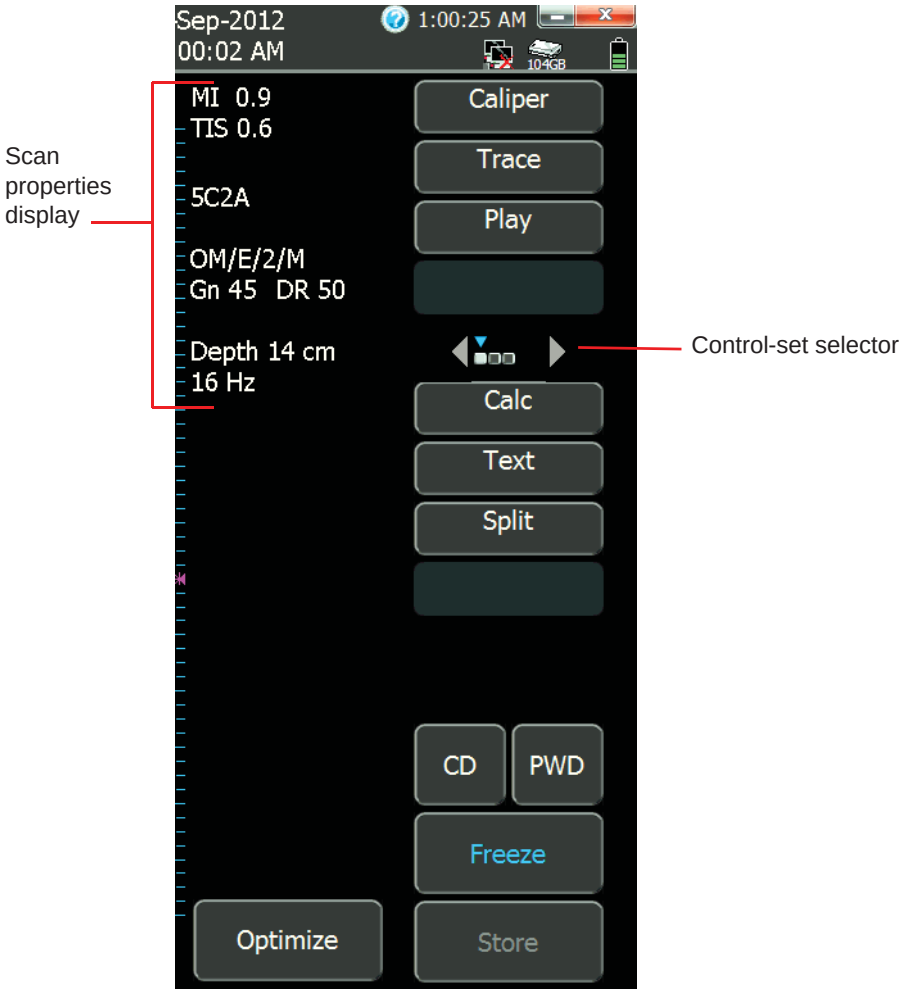
Review Window

To open the review window, tap the uSmart3200t button at the top left corner of the screen, then tap Review.

To display a saved image or report in the Review window, tap the thumbnail in the list at the left side of the screen.

The Imaging Controls

Touch-buttons at the right-hand side of the imaging screen choose and control imaging on the Terason uSmart3200T Ultrasound System.



Terason Imaging Controls

Note: The control array shown above are an example. The controls your system displays may differ from the ones shown.

Imaging Controls

The available imaging controls depend on the connected probe, the selected scanning mode, and other variables. Scanning parameters set by the controls are shown in the scan properties display and, in some cases, on the control button. (See Scan Properties Display on page 24.) The controls are arranged in groups. Freezing the image makes a different set of controls available. To cycle the display to another group of available controls, tap the right or left arrow on the control-set selector: 

Mode Selection buttons 

– These buttons select the scanning mode. The following scanning modes are supported by the uSmart3200T ultrasound system:

- 2D (sometimes called B-mode)
- CD (color Doppler)
- PWD (pulsed-wave Doppler)

Freeze **Button** 

– This button toggles between live imaging and frozen image. When the image is frozen, the word Freeze is blue.

Store **button** 

–This button saves a loop or a single-frame image to a file. When imaging is live, tapping the Store button saves a loop. When imaging is frozen, tapping the Store button saves the displayed frame.

Text **button** 

–This button enables annotation functions. Tapping the button opens a keyboard for entering text, and changes the buttons.

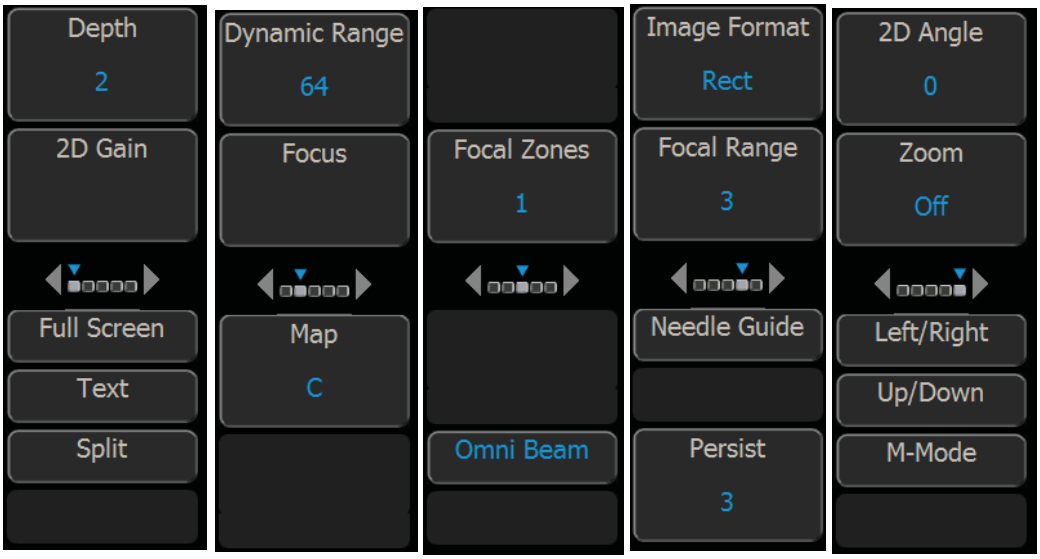
Focus **button** – This button adjusts the focus depth.

Depth **button** – This button adjusts the scan depth.

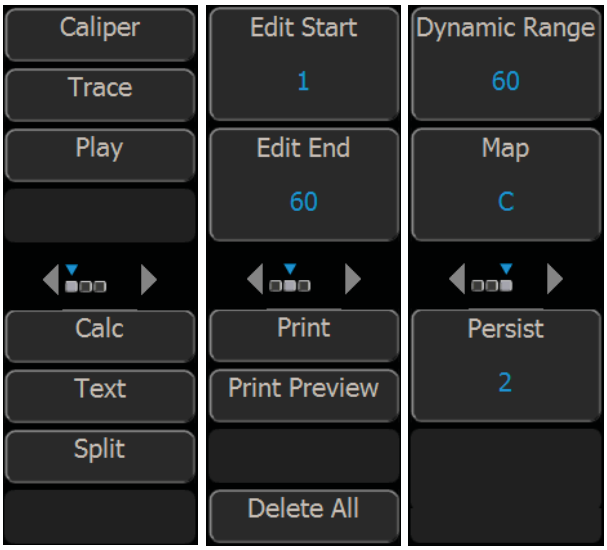
The illustrations below show examples of the buttons when the image is live and frozen. For more complete sets of the buttons for your imaging module, refer to the *Module User Guide* that came with your system.

Note: The image control buttons the system displays depend on the probe that is connected, the selected scan mode, and the selected exam. **The display you see may differ from the illustrations in this guide.**

Example Image Control Buttons



Example Live Image Control Buttons



Example Frozen Image Control Buttons

Using the Tablet

The uSmart3200T system does not include a mouse or keyboard. You can add these devices if you want by connecting them to the tablet or dock USB ports.

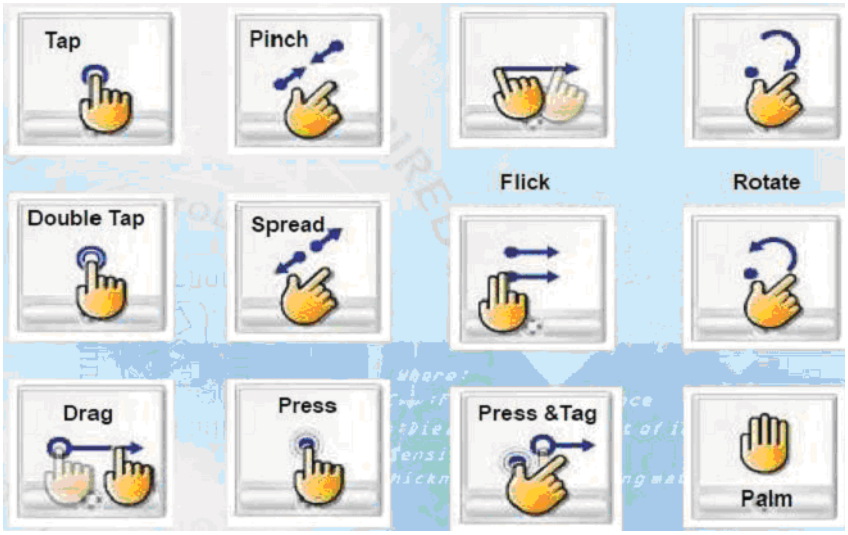
The onscreen controls can be operated with a finger, but using a capacitive-touch stylus allows greater control. Tapping with a fingernail may not work.

When you need to enter text in a text field, tap the field, and a keyboard appears on the screen. Tapping the Text button also opens the onscreen keyboard.

To open context menus that would open with a right-mouse-button click in a non-touch system, tap the onscreen item and hold your finger or stylus on it. A circle appears around the item and the context menu opens.

Controlling Imaging Using Gestures

The touch screen software includes numerous functions that are controlled by finger movements called gestures. When your fingers are touching the screen, you can use these functions, according to the following illustration and tables.



Standard Windows Gestures

Gestures for Controlling the Imaging Screen

Command	Gesture
Image Scroll	Use 1 finger to drag left and right to scroll image frame or time series on a frozen image.
Zoom And Pan	Use 2 fingers spread and drag to zoom and pan image at the same time.
*** UnZoom	Use two finger pinch quickly to unzoom.
Steer Ultrasound Cursor	Use 1 finger to flick left and right on B-Mode image when ultrasound cursor is visible.
Steer Color ROI	Use 1 finger to flick left and right outside of Color ROI to steer.
Steer Sample Volume	Use 1 finger to flick left and right in the time series image to steer the sample volume. For 2D/Spectral and Spectral/2D, use 1 finger to flick left and right at the bottom of 2D image to steer.
Steer Ultrasound Cursor	Use 1 finger to flick left and right on 2D or Color image to steer.
Full Screen Image Display	Use 3 or more fingers spread and pinch go in and out full screen.
Freeze/Live	Use 2 fingers tap to freeze. (On fingers up) Use 2 fingers to tap on paused image to unfreeze. (On fingers up)
Play/Pause	Use 1 finger tap on frame slider to toggle play and pause.
Depth	Use one finger flick up and down on image to decrease and increase depth respectively.
Split Screen	Use two finger flick to left to split with right screen active. Use tow finger flick to right to split with left screen active.
Unsplit Screen	When in split screen, use two finger flick left or right will unsplit.
Split Screen Toggle	Tap on image to select active side. Toggle on finger up.
Begin PWD Mode	Double tap on image to go to PWD or Triplex mode from B-Mode or Color with sample volume at the tapped location.

Gestures for Controlling the Imaging Screen (Continued)

ROI	Use one finger to touch and drag the inside of ROI to move to different location. Touch and drag the corner of ROI to resize.
Scale	Tap top and bottom in the velocity axis to increase and decrease scale of PWD.
Spectral Baseline	Drag image up and down to change the baseline position.
Ultrasound Cursor	Press and tap in B-Mode or Color to show cursor. Tap again to keep Cursor on image so that you can flick at bottom of image to steer. Double Tap with second finger to go to PWD or Triplex. Press and tap again to hide ultrasound cursor.
Sample Volume	Touch and drag the sample volume. Touch near the cursor line will also select the sample volume for moving.
Caliper	Use mouse cursor to move caliper. Left click to place caliper marker. Once measurement is done, click on marker again to enable repositioning of marker. Use touch with 1 finger to make measurement. Use second finger tap to place the caliper. Or Release the first finger to place caliper marker. Tap marker again to enable repositioning of marker.
Trace	See Caliper for details.
Ellipse	See Caliper for details. Click on minor axis to resize
Text	Touch near or on text to select and drag to move text. Tap away from text to end text edit.
Text Arrow	While in text mode, use press and tap to show text arrow.
Body Marker	Select softkey Marker Position then touch and drag body marker to different position.
Body Marker Probe Indicator	Touch body marker to enable probe position. Press and tap gesture to switch to probe orient. Tap away from body marker to end edit.
Arrow Marker	Touch arrow marker to enable marker position. Press and Tap to change to marker rotation. Tap away from Arrow Marker to end edit.
Next/Prev Screen	Use 3 fingers to flick left and right. Limited to change between image and review screen.
Scroll Frame	Tap left side of image to scroll to previous frame of a paused cineloop. Tap right side of image to scroll to next frame
Velocity	Tap on top and bottom half color bar to change velocity.
Auto Scroll Frame	Add a timer to auto scroll frame of a paused cineloop when finger is down. When down on left side, it is scroll back to previous frame. When down on right side on image, it will scroll to next frame.

Gestures for Controlling the Imaging Screen (Continued)

Edit Start/End Frame	Press and hold on side of frame slider to set start and end marker.
Sector Resize	Touch the marker and drag in a phase or curve image to resize.
Sector Move	Touch the bottom of the image and drag to move the sector.
Unzoom	Use two fingers to pinch quickly together
Pan Zoom Image	Use one finger to pan zoom image.

Gestures for Controlling the Review Screen

Commands	Gestures
Prev/Next image	Use 2 fingers flick left and right to select previous and next image. Tap on left and right side of image to select previous or next image for review. Use 2 fingers tap on left half and right half of image to select previous and next image respectively.
Play/Pause	Use 1 finger tap on frame slider to toggle play and pause. Use two finger tap on image to toggle play and pause.
Caliper, Text and Body Markers	Similar to Image Screen
Scroll To Next Image	Tap left and right of image to next frame in image screen and next image for review screen
Prev/Next Frame	Tap next to frame slider on left and right for previous and next frame.
Fast Forward To Start/ End Frame.	Press and hold on end of frame slider to move Start and End edit marker to start and end position.

Gestures for Controlling the Thumbnail Screen

Commands	Gestures
Scrolling	Use 1 finger drag up and down to scroll**.**
Select	Tap to select image. Image is selected on finger up (Added 4 fingers tap to play and pause, may remove it).
Right Click	Use “Press and Hold” or “Press and Tap” gesture in small and large thumbnail windows to bring up context menu.

Beep Codes

The Terason uSmart Ultrasound System produces beeps when certain events occur. The following list explains the meaning of the different beep codes.

- **Two short beeps**: Produced when a probe is connected or disconnected, or when the system is started with a probe already connected.
  This is only a notification; it is safe to use the system.
- **Eight beeps**: Produced when communication between the computer and the ultrasound engine is lost.
  If the imaging function resumes, it is safe to use the system. If the imaging function does not resume, restart the ultrasound software. If the error persists, stop using the system and contact Terason Technical Support.
- **Two-tone beeps**: Indicates that the system detected and corrected an internal transmitter timing error.
  It is safe to continue using the system. Freezing or unfreezing the scan turns the beeping off. If this occurs frequently, contact Terason Technical Support.
- **Continuous short beeps**: Produced when the system reaches an internal temperature of 72° C. The beeping stops when the internal temperature falls to less than 72° C.
  It is safe to continue using the system, but if the internal temperature rises to 80° C, the system shuts down.

Equipment List

The Terason uSmart Ultrasound System may be shipped with the following hardware:

- Terason uSmart3200T Ultrasound System, consisting of tablet computer that contains an ultrasound user interface and an ultrasound imaging engine.
- Tablet computer user guide
- Online *Terason uSmart Ultrasound System User Guide* (this document)
- CD-ROMs containing the operating system and Terason ultrasound imaging software
- One (1) power cord
- Medical grade AC/DC power adapter
- Dock
- Mobile cart
- One or more probes:
  For a list of probes supported by your imaging module, see the *Module User Guide* that came with your system.

Warning: Using accessories, probes, or cables other than those specified, with the exception of those sold by the manufacturer as replacement parts for internal components, may result in increased electromagnetic emissions or decreased EMI immunity of the Terason uSmart Ultrasound System.

Warning: To prevent injury and equipment damage, always grasp the ultrasound cart firmly when moving it. Rolling over an irregular surface could make the cart tip over if it is not firmly held. Do not park the cart on an incline, and when you do park it, set the brakes.

System Warranty

The warranty period for the Terason uSmart Ultrasound System is twelve (12) months, but you can purchase an extended warranty. To obtain warranty service, U.S. customers call Terason at 1-866-TERASON (1-866-837-2766); International customers call 781-270-4143.

The warranty on the Terason uSmart Ultrasound System is voided if unauthorized personnel perform service or maintenance on the ultrasound system, except for those service or maintenance actions specifically designated for local service technicians. To ensure correct system performance and to protect your warranty, contact Terason for service.

2 Setting Up Patient Information

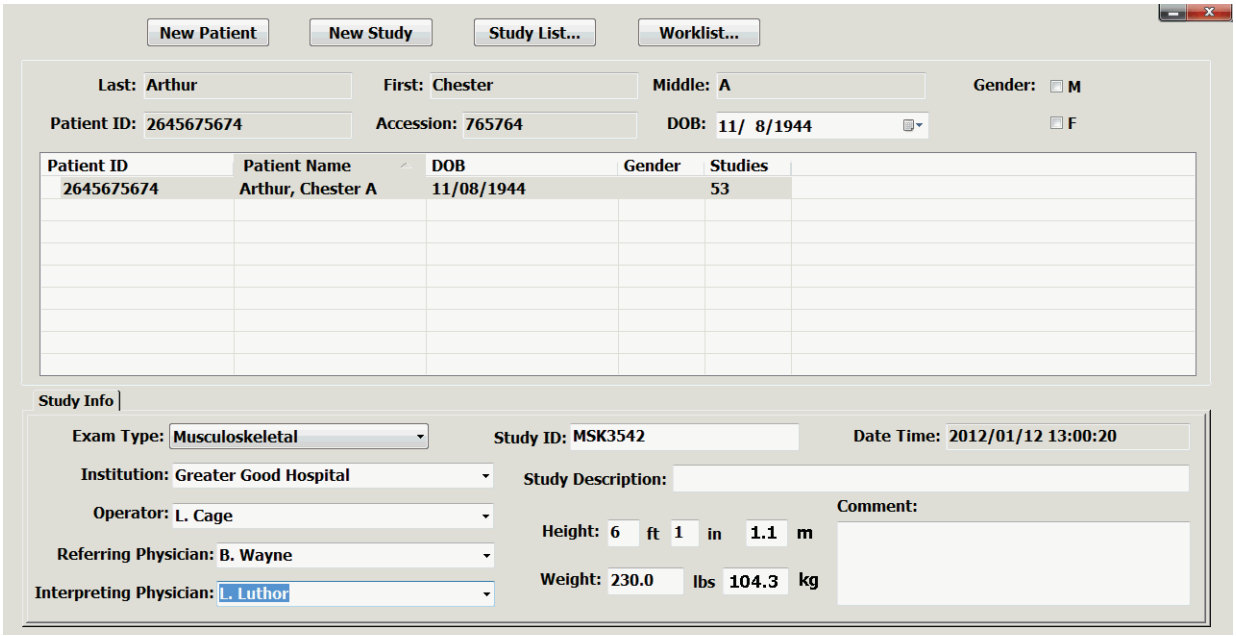
Although you can scan a patient without entering any information about that patient, you cannot save any images or loops from such an exam, so Terason recommends that you define the patient within the system. The patient data can be displayed on the scan to avoid mix-ups and is used to organize saved images.

When you save an image, the Terason software puts it in a study for the specified patient, along with a report.

To work with patient information, you should understand:

The Patient Window

To view the Patient window, tap the uSmart3200T name, then tap the Patient button.



Patient Window