

RIVANNA MEDICAL'S

Accuro[™]



Pocket-sized ultrasound device for spinal anesthesia guidance.

USER'S MANUAL

RIVANNA[™]

735-00005 Rev E

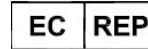


CAUTION: In the United States, federal law restricts this device to use by or on the order of a physician.

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The **Accuro** ultrasound system referenced in this document is covered by US and foreign patents pending.

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For the most up-to-date information, see the online manuals at rivannamedical.com. Examples provided by RIVANNA in this User's Manual do not in any way represent real patient or exam data.





Accuro™ USER'S MANUAL

Quick Start

Spinal Anesthesia Guidance



SCAN IN TRANSVERSE ORIENTATION. The red dashed line and cross hair indicate that the interlaminar space has been identified.

To perform an epidural or spinal anesthesia procedure:

1. Turn on the Accuro

Turn on the Accuro by pressing the power on/off button.

2. If using the Accuro Locator™ needle guide (sold separately), then place onto the Accuro

3. Select the SPINE imaging mode

Press the SPINE icon from the HOME screen.

4. Apply gel and start scanning

Apply ultrasound gel to the lumbar spine area and scan in the transverse orientation, taking care to hold the Accuro perpendicular to the imaging surface. Optimize brightness and zoom as desired.

5. Find mid-line

Move the device left or right to ensure the mid-line indicator is centered on the imaging screen (indicated by a dashed white or red vertical line as shown).

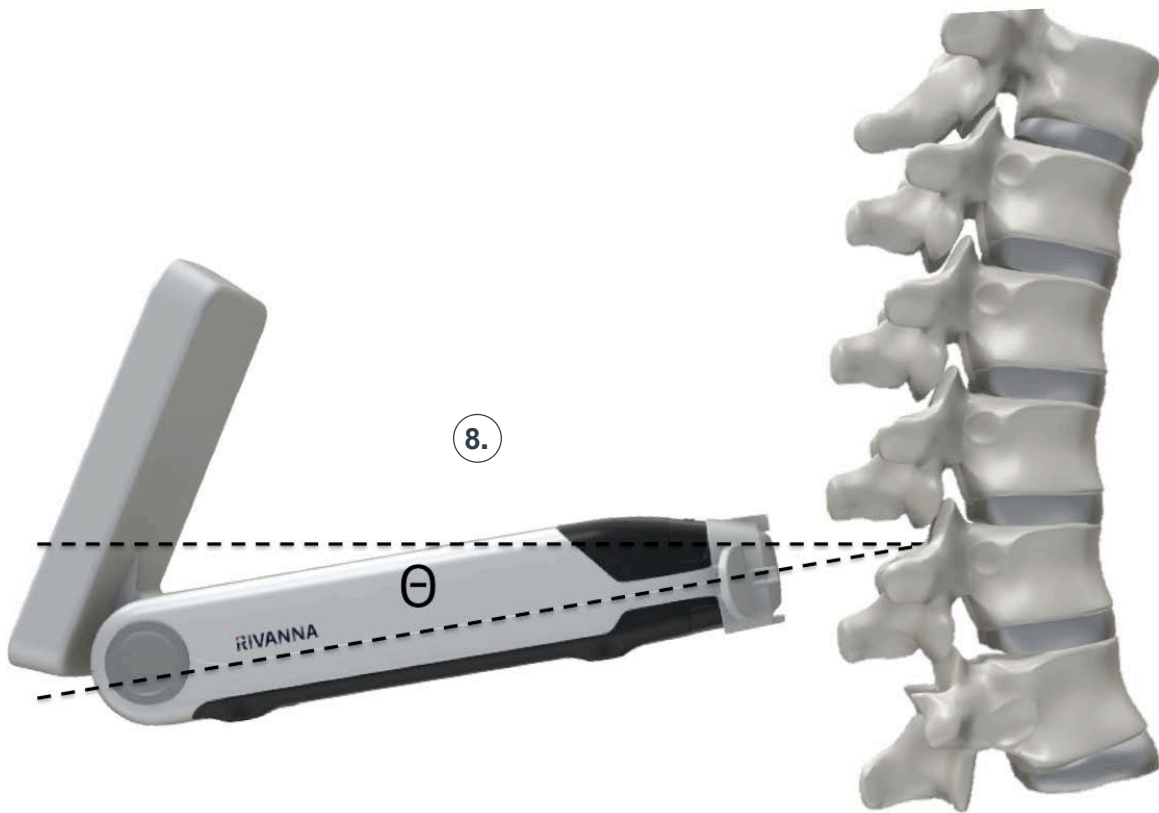
6. Find the interlaminar space*

Scan with the Accuro along the lumbar spine region until the interlaminar space is automatically identified at the desired intervertebral level (indicated by cross hair and orange overlay as shown).

*CAUTION: The images and calculations provided by the Accuro instrument are intended for use by competent users, as a diagnostic tool. The user should be aware of the instrument specifications, accuracy, and limitations. These limitations must be considered before making any decision based on images and quantitative values.

Quick Start

Spinal Anesthesia Guidance



Tip: For proper identification of the interlaminar space, the angle of the Accuro must allow the ultrasound beam to cleanly enter the interlaminar space without intersecting the spinous process.

Tip: SpineNav3D identifies anatomy in the transverse orientation only. For other orientations, turn off SpineNav3D overlays or scan using the BONE icon from the HOME screen.

7. Remember the depth

Take note of the automated interlaminar space depth, which is indicated by the orange number (top panel; orange number).

8. Remember the angle

Take note of the angle at which the device is held in order to detect the interlaminar space in the image.

9. Mark the skin

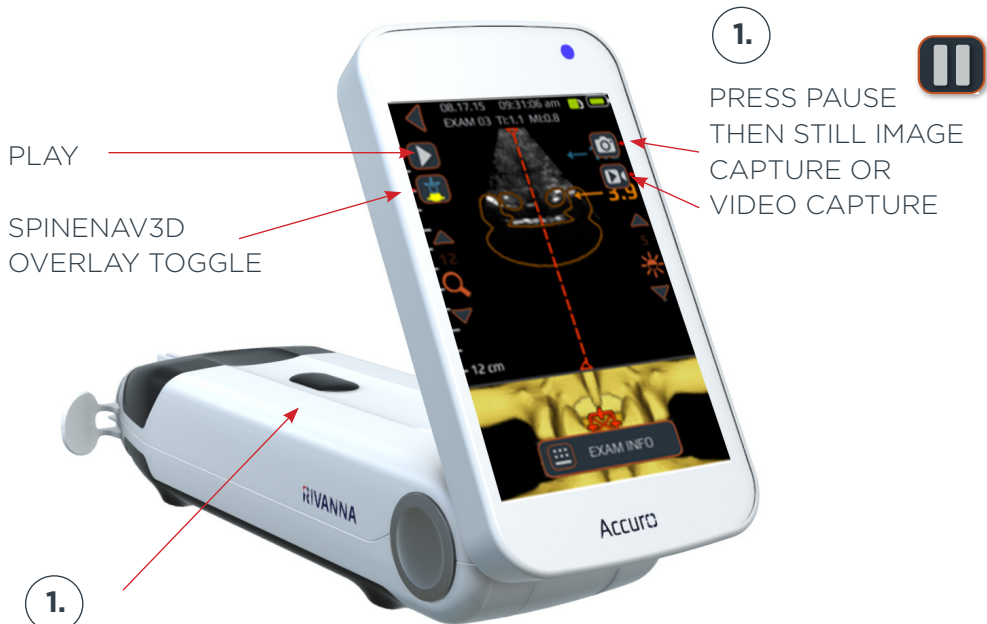
Disengage the Accuro Locator needle guide and press gently against the skin.

10. Perform the injection

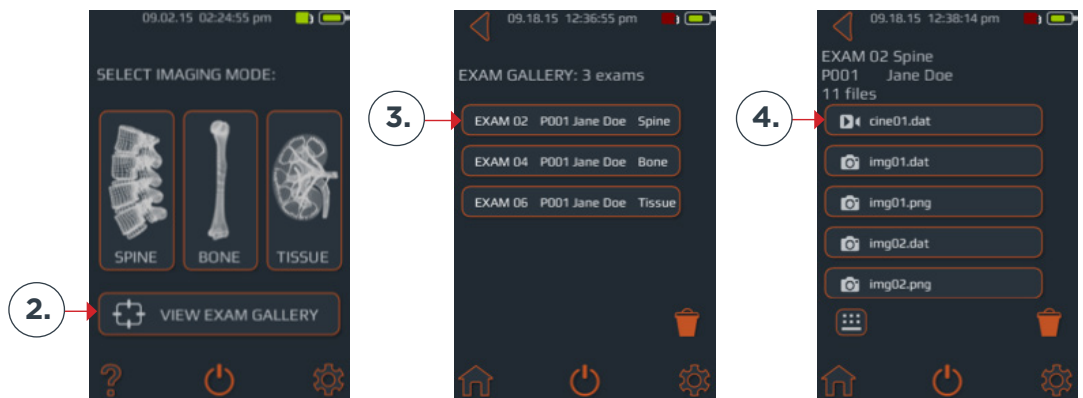
Remove the ultrasound instrument from the scanning site and perform the injection according to standard protocol while remembering both the depth of the interlaminar space and following the angle at which the device was held to detect the interlaminar space.

Quick Start

Save an Image to an Examination File



1. ALTERNATIVELY, CAPTURE STILL WITH PHYSICAL BUTTON DURING LIVE IMAGING

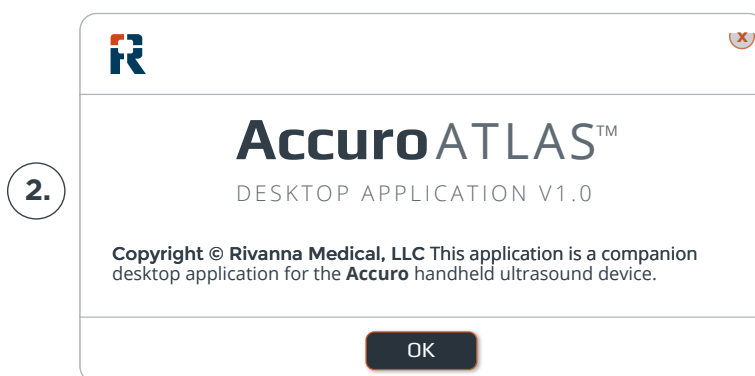


To save an image to an examination file:

1. Press the pause button then the still-image capture or video capture buttons on the **Accuro** touchscreen. Alternatively, quickly press and release the physical device button. The image will be saved to the current Exam for review in the GALLERY.
2. From the HOME screen, select VIEW EXAM GALLERY.
3. Next, select the desired Exam from the menu.
4. Select the desired image to review.

Quick Start

Save an Image to an Examination File



To annotate, generate exam reports, or save exam images to an external computer:

1. For best results, shut down Accuro and connect to an external computer using the provided micro-USB to USB cable. Restart Accuro while connected.
2. Find the ATLAS drive on the external computer and run the AccuroATLAS application to enable image annotation, generation of exam reports, and/or saving of exam images.

Minimum system requirements:

Computer operating systems
Microsoft Windows®
7/8/8.1/10 or Mac OSX 10.9

Minimum RAM - 1 GB

USB 2.0

Minimum processor - 1 GHz

Minimum display - 1024 x 768

For the most up-to-date information, see the online manuals at rivannamedical.com.

Table of Contents

Accuro

Quick start	4	Accuro maintenance	28
Table of contents	8	Instrument care and maintenance inspection	28
Important information	10	Cleaning and disinfection	28
Product description	10	<i>Cleaning procedure</i>	28
Principles of operation	10	<i>Disinfecting procedures</i>	28
Indications for use	10	Electromagnetic compatibility (EMC)	29
Essential Performance	10	Electromagnetic Emissions	30
Contraindications	10	Electromagnetic Immunity	31
Statement of prescription	10	Electromagnetic Emissions	31
Warnings and cautions	10	ALARA Principle	32
<i>WARNINGS</i>	10	<i>Applying ALARA</i>	32
<i>CAUTIONS</i>	10	<i>Direct controls</i>	32
Introducing the Accuro	11	<i>Indirect controls</i>	32
Instrument parts and features	11	<i>Receiver controls</i>	32
Components	11	Other technical specifications	33
Battery Charger Components	11	Instrument specifications	33
Accessories	11	Operating and storage conditions	33
Displays, controls, and indicators	12	Probe specifications	33
Console display and functions	12	Acoustic output specifications	33
Home screen	12	Battery specifications	33
BONE and TISSUE preset scanning screen	13	Accuracy statement	33
SPINE preset scanning screen	14	Summary of acoustic quantities	34
Gallery main screen	16	Accuro safety	35
Gallery image selection screen	16	Symbols	35
Gallery still-image view screen	17		
Gallery video playback screen	18		
Settings screen	19		
Using the Accuro	20		
Using SpineNav3D to guide epidural and spinal anesthesia	20		
<i>Additional scanning tips</i>	23		
General purpose scanning with the Accuro	24		
Image storage, review, and export	25		
<i>Save an image to an examination file</i>	25		
<i>Review saved images in the gallery</i>	26		
Generate exam reports and/or save exam images to an external computer	27		

Important Information

Product description

The **Accuro** is a pocket-sized and battery operated ultrasound instrument. The device is a single self-contained unit consisting of an ultrasound system, ultrasound probe, and rotatable touchscreen display. The instrument provides a SPINE imaging preset to facilitate spinal anesthesia imaging guidance with real-time 3D navigation of the lumbar spine. The SPINE preset uses patent-pending technology, called SpineNav3D, to automate spinal bone landmark detection and depth measurements and to assess real-time scan plane orientation in 3D.

Accuro ultrasound scans and measurements can be saved in an examination file on the device and exported to a computer for storage or printing.

Principles of operation

Medical ultrasound imaging uses an ultrasound transducer, which transmits and receives high frequency mechanical waves. The transmitted ultrasound waves reflect off of structures in the body that exhibit changes in acoustic impedance. A portion of the reflected ultrasound energy returns to the ultrasound transducer and is converted back into an electrical signal, which is then amplified, digitized, and processed through a series of filters. The digital signal is transformed into an image that can be saved in memory and displayed to the display screen in real-time.

The **Accuro** SPINE preset uses ultrasonic reflections acquired from multiple scan planes to obtain 3D volume scans of the lumbar spine. The SpineNav3D technology facilitates image interpretation of individual 2D lumbar spine scans by automating spinal bone landmark detection and depth measurements and providing a real-time assessment of scan plane orientation in 3D. SpineNav3D technology makes image interpretation and measurements of the lumbar spine anatomy simple, quick, and easy. A sonographer is not required to use the SPINE preset.

Real-time 2D scans from either SPINE or BONE presets are formed using patent pending BoneEnhance technology. The BoneEnhance technology provides images of bone anatomy at greater bone-to-tissue contrast compared with conventional ultrasound image reconstructions.

Indications for use

The **Accuro** ultrasound scanner is intended for diagnostic ultrasound imaging of the human body in the following clinical applications:

- Abdominal
- Musculoskeletal (Conventional and superficial)
- Cardiac
- Peripheral vascular

A typical examination using the **Accuro** is guidance of neuraxial anesthesia.

Essential performance

The essential performance of the **Accuro** consists of ultrasonic image display of the dimension and location of spinal anatomy, display of ultrasound indexes pertaining to safety related indications, and prevention of unintended or excessive ultrasound output and transducer assembly surface temperature.

Contraindications

The **Accuro** ultrasound instrument is not intended for ophthalmic use or any use causing the acoustic beam to pass through the eye.

Statement of prescription

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

Warnings and cautions

The **Accuro** should only be used by trained individuals who have been authorized by a physician. All users must read the entire User's Manual prior to using the **Accuro**. To prevent damage of the equipment or injury to yourself or others, carefully read the following warnings and cautions before using the **Accuro**. Rivanna Medical, LLC disclaims all responsibility and liability for the operating safety, reliability and performance of the **Accuro** if the warnings and cautions disclosed in this User's Manual are disregarded in any way.

The **Accuro** has not been evaluated for use with high frequency (HF) surgical equipment.

Important Information

WARNINGS

WARNING! Risk of explosion, fire, or serious injury

If you use the **Accuro** in the presence of flammable anesthetics, the hazard of potential explosion exists.

Do not place the **Accuro** near a heat source or expose it to direct flame. Such exposure may lead to corrosive liquid leakage, electrical shock, or fire.

Stop using the **Accuro** if the casing is damaged. Failure to do so may result in electrical shock or fire.

Electrical shock may result from using damaged USB cables with the **Accuro** or if modifications are made to the **Accuro** by anyone other than personnel authorized by RIVANNA.

Avoid dropping or subjecting the **Accuro** to severe impacts. This could result in electrical shock, corrosive liquid leakage, and injury.

If battery leakage is present, wear protective gloves and discard the **Accuro** immediately following applicable regulations.

WARNING! Potential patient hazard

Do not use the **Accuro** instrument for ophthalmic indications. Ophthalmic use may cause patient injury.

CAUTIONS

CAUTION: Potential patient hazard from acoustic exposure

To date, exposure to diagnostic medical ultrasound has not been shown to produce adverse health effects. However, medical professionals should use ultrasound only when clinically indicated. Medical professionals should use the lowest exposure times possible. The ultrasound output of the **Accuro** is

not user-adjustable and is limited to the minimum level necessary for effective performance.

CAUTION: Hazardous materials present. Assure proper disposal.

The **Accuro** may contain lead, mineral oils, batteries, and other environmentally hazardous materials. When the **Accuro** has reached the end of its useful service, follow your local protocols for hazardous waste disposal.

CAUTION: Assure proper distance from patient.

When transmitting data to or from your computer, make sure that the **Accuro**, accessories, and the computer are outside of the patient vicinity (more than six feet from the patient).

CAUTION: Assure proper computer system and/or printer configuration

When using the **Accuro** with an external computer system and/or printer unit, the computer system and/or printer unit must be minimally certified to EN/IEC 60101-1-1 system standard.

CAUTION: Damage to the instrument may occur

Only apply commercially available ultrasonic couplant, which has been specifically formulated for use in medical applications, to the acoustic window (or face) of the probe. Failure to do so may cause damage to the **Accuro** instrument.

CAUTION: Damage to the instrument may occur

Do not attempt to sterilize the **Accuro** instrument. Damage to the **Accuro** instrument may occur.

CAUTION: Damage to the instrument may occur

Hot water in excess of 113°F or 45°C may damage the instrument.

CAUTION: Damage to the instrument may occur

Do not immerse the instrument in disinfectant solution.

CAUTION: Images and calculations are not to be used as the sole basis for clinical diagnosis

The images and calculations provided by the **Accuro** instrument are intended for use by competent users, as a diagnostic tool. They are explicitly not to be used as the sole, irrefutable basis for clinical diagnosis. Users are encouraged to account for the clinical utility of the **Accuro** and make their own professional conclusions.

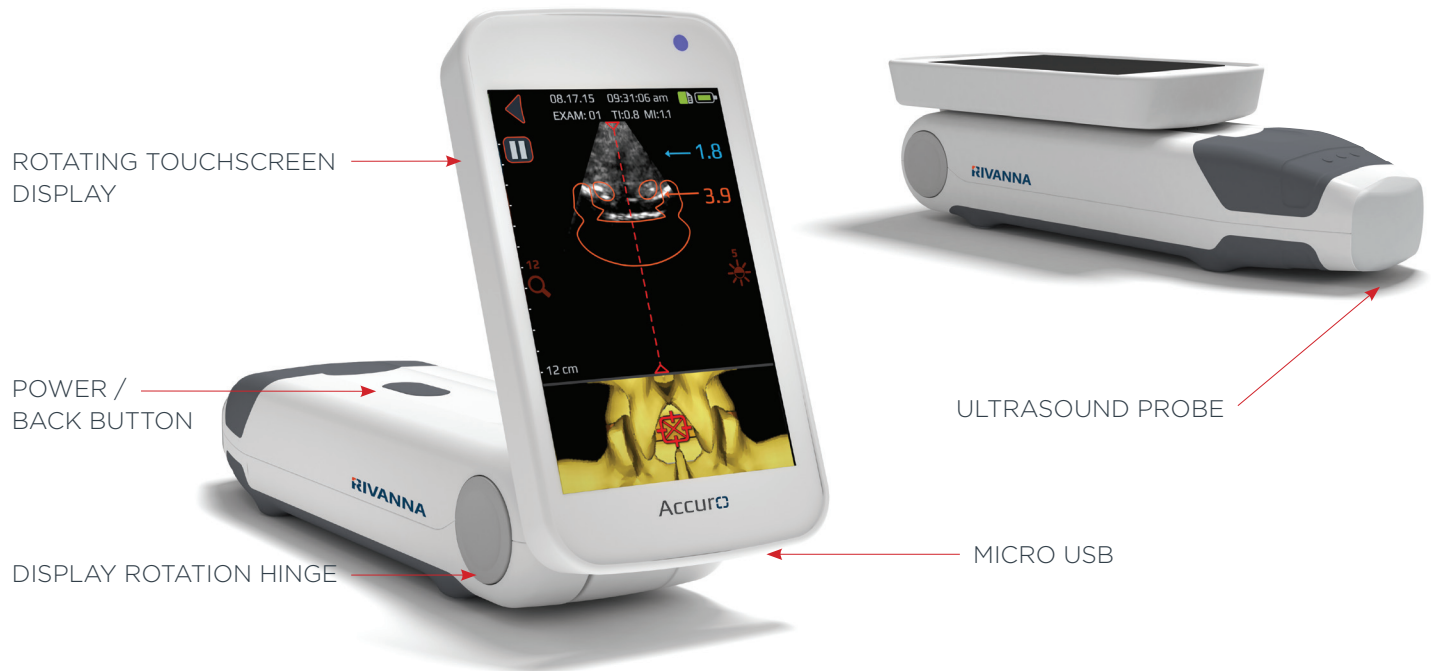
CAUTION: Risk of inaccurate measurements

The images and calculations provided by the **Accuro** instrument are intended for use by competent users, as a diagnostic tool. The user should be aware of the instrument specifications, accuracy, and limitations. These limitations must be considered before making any decision based on images and quantitative values.

Incorrect image settings, equipment malfunction, or failure to correctly operate the **Accuro** can result in measurement errors or failure to detect certain details in the image. The user must be thoroughly familiar with the operation of the **Accuro** in order to optimize its performance and to recognize possible malfunctions and limitations. Application training is available through the sales representative.

Introducing the Accuro

Instrument parts and features



Components

Battery charger components

PART NAME	DESCRIPTION
USB wall charger	Charges the battery inside the Accuro
Micro-USB to USB cable	Connects the USB wall charger to the Accuro

Accessories

PART NAME	DESCRIPTION
Acoustic coupling gel	Travel sized ultrasound coupling gel
Carrying case	Transports Accuro and accessories

Displays, Controls, and Indicators

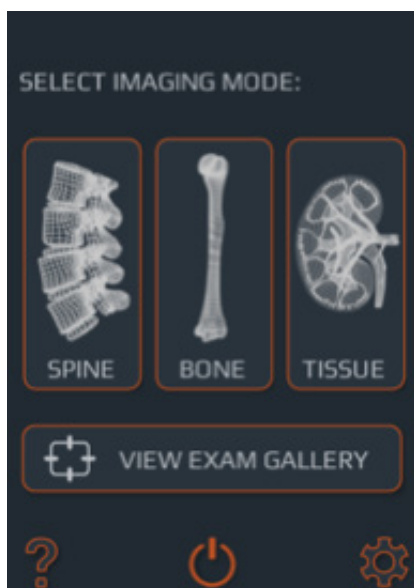
Console display and functions




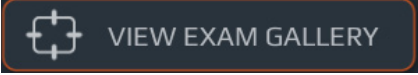





The **Accuro** console consists of an LCD touchscreen display and a single power button. The LCD display presents a combination of user information, scan displays, and prompts, which vary depending on the current device function.

The power button has the function of either powering on/off the device, putting the device in sleep mode, or saving images. The functionality depends on the state of the device, such as the current screen, and the length of the button hold.

Home screen

The HOME screen appears when the **Accuro** is first powered on. The HOME screen serves as a starting point for all the main functions of the **Accuro**.

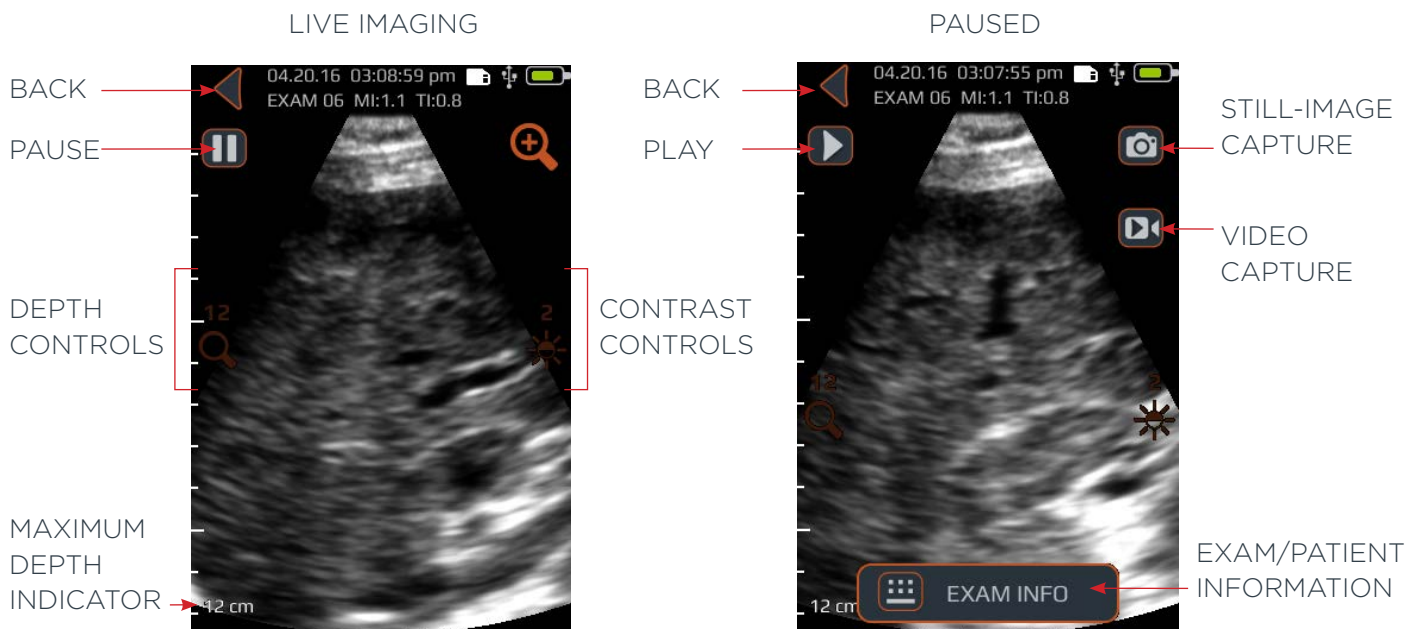


BUTTON OR INDICATOR	FUNCTION
	Press to go to SPINE imaging preset using SpineNav3D automation.
	Press to go to BONE imaging preset using BoneEnhance technology.
	Press to go to general purpose ultrasound TISSUE imaging.
	Press to go to the GALLERY main menu screen.
	Press to access the Accuro HELP screen.
	Press to power off the device.
	Press to go to the SETTINGS screen.
	Indicates the current battery charge.
	Indicates the available mmc storage space.

Displays, Controls, and Indicators

BONE and TISSUE preset scanning screen

The BONE or TISSUE scanning screen appears after you press the BONE or TISSUE button from the HOME screen.



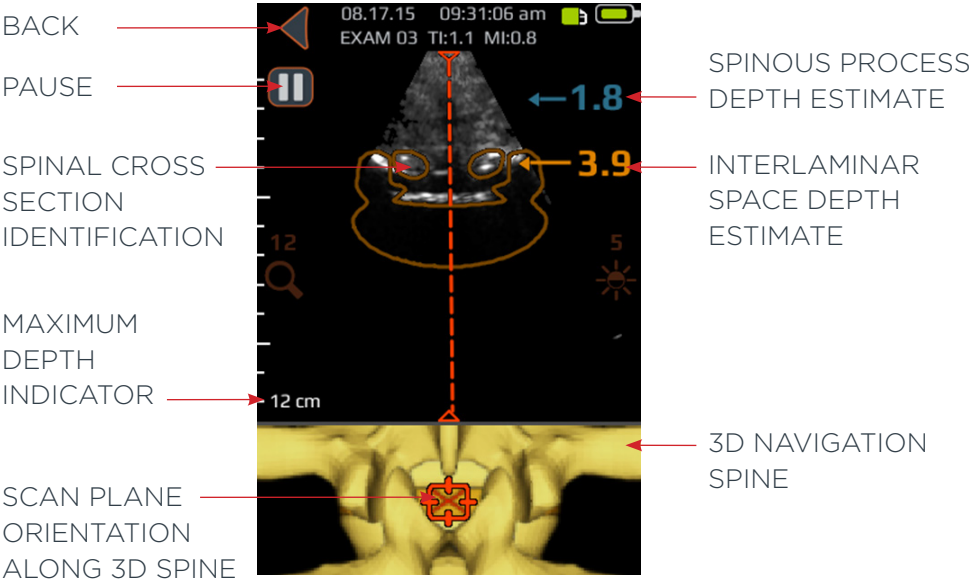
BUTTON OR INDICATOR	FUNCTION
	Press to go back to HOME screen.
	Press to pause current imaging session.
	Press to resume imaging session. This button replaces pause button after pause button is pressed.
	Press to toggle quick zoom. Quick zoom will increase resolution and decrease imaging depth.
	Press up or down arrow to increase or decrease imaging depth.
	Press up or down arrow to increase or decrease image brightness. In the BONE imaging preset, brightness controls are used to increase or decrease the tissue signal brightness only.
	Press to save the current image on the screen. The saved image will be stored in the GALLERY and associated with the current exam. This button is present after the pause button is pressed.
	Press to save a video of the previous 4 seconds. The saved video will be stored in the GALLERY and associated with the current exam. This button is present after the pause button is pressed.
	Press to go to the exam information page to enter patient and exam information.
	Press the physical device button to save the current image to the exam during live imaging. This button can save either still-image or video capture depending on the user's settings.

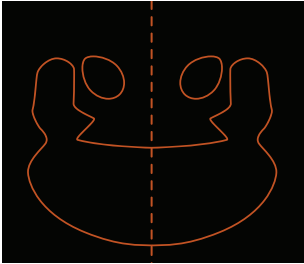
Displays, Controls, and Indicators

SPINE preset scanning screen


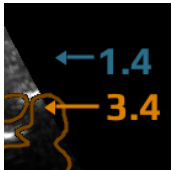









The SPINE preset screen appears after you press the SPINE button from the HOME screen.

CAUTION: For accurate imaging results, SpineNav3D™ must be performed in the lumbar spine region with a transverse scan plane orientation.



BUTTON OR INDICATOR	FUNCTION
	<p>Indicator in the top panel of the SPINE preset screen that automatically identifies the presence and location of either interlaminar space or spinous process cross-sections within the 2D scan.</p> <p>The cross-section overlay is orange when interlaminar space is identified and blue when spinous process is identified.</p> <p>The cross-section overlay possesses a transparency that indicates algorithmic confidence of correct interlaminar space or spinous process identification. A less transparent overlay indicates high confidence in anatomy detection while more transparency indicates less confidence. The transparency of the overlay matches that of the 3D navigation spine in the bottom image panel.</p>

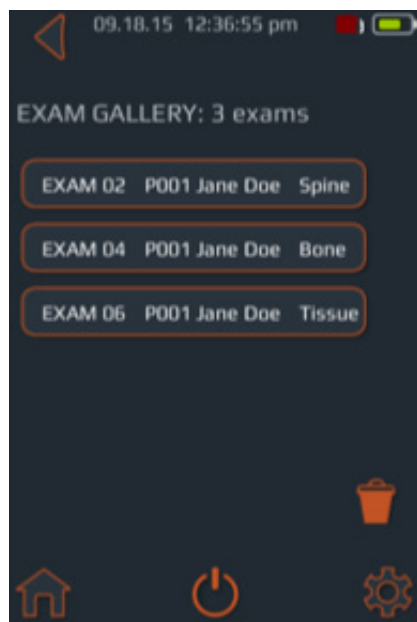
Displays, Controls, and Indicators








BUTTON OR INDICATOR	FUNCTION
	<p>Indicator in the bottom panel of the SPINE preset screen that illustrates the position and orientation of the current 2D scan plane along a 3D spine reconstruction.</p> <p>The 3D spine possesses a transparency that indicates algorithmic confidence of correct spinal position detection. A less transparent 3D spine indicates high confidence in position and scan plane orientation while more transparency indicates less confidence. The transparency of the 3D navigation spine overlay matches that of the cross-section overlay in the top image panel.</p>
	<p>Indicator along the right of the display that automatically detects the depths of the interlaminar space and spinous process depths. Interlaminar space is indicated with orange text while spinous process is indicated with blue text. The depth indicator possesses a transparency that indicates algorithmic confidence of correct interlaminar space or spinous process position detection.</p>
	<p>Press to go back to HOME screen.</p>
	<p>Press to pause current imaging session.</p>
	<p>Press to resume imaging session. This button replaces the pause button after pause button is pressed.</p>
	<p>Press up or down arrow to increase or decrease imaging depth.</p>
	<p>Press up or down arrow to increase or decrease image brightness. The brightness control is used to increase or decrease the tissue signal brightness only.</p>
	<p>Press to save the current image on the screen. The saved image will be stored in the GALLERY and associated with the current exam. This button is present after the pause button is pressed.</p>
	<p>Press to save a video of the last 4 seconds before the imaging session was paused. The saved video will be stored in the GALLERY and associated with the current exam. This button is present after the pause button is pressed.</p>
	<p>Press to go to the exam information page where patient information and exam information is entered.</p>
	<p>Press the physical device button to save the current image to the current Exam. This button can save either still-image or video capture depending on user's preference. To toggle between still-image and video capture go to HOME->SETTINGS->Physical Button.</p>

Displays, Controls, and Indicators

Gallery main screen

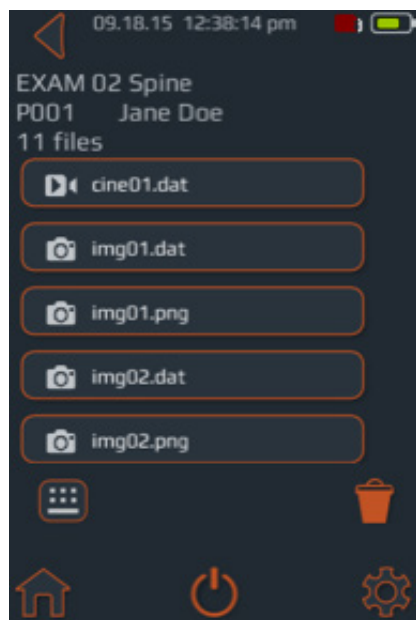
The GALLERY screen appears after you press the VIEW EXAM GALLERY icon from the HOME screen.











BUTTON OR INDICATOR	FUNCTION
	Press to go to HOME screen.
	Press to go to HOME screen.
	Press to power off the device.
	Press to go to the SETTINGS screen.
	Press to select exam(s) for deletion.
	Indicates the current battery charge.
	Indicates the available mmc storage space.

Gallery image selection screen

The GALLERY image selection screen appears after you press the VIEW IMAGE GALLERY icon from the HOME screen and then select an Exam from the GALLERY main screen.

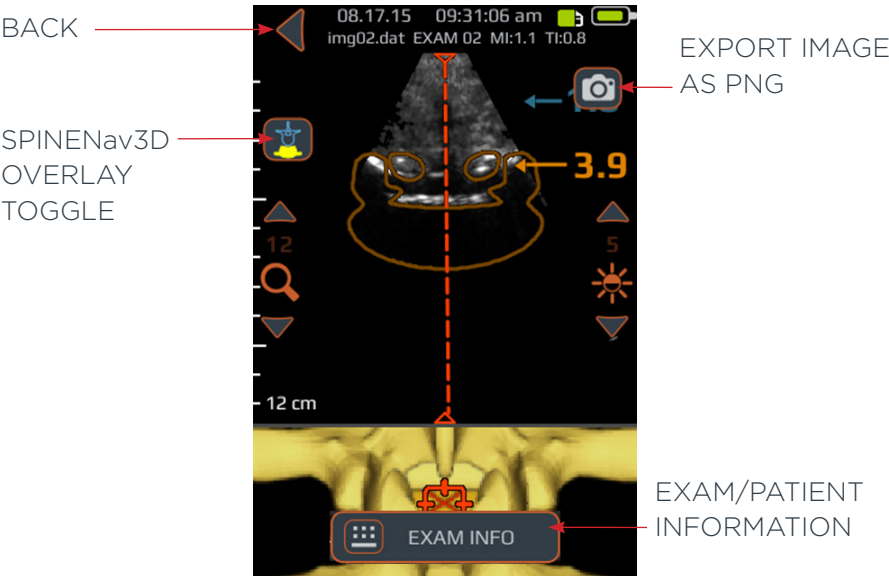






BUTTON OR INDICATOR	FUNCTION
	Press to go to HOME screen.
	Press to go to HOME screen.
	Press to power off the device.
	Press to go to the SETTINGS screen.
	Press to select exam(s) for deletion.
	Indicates the current battery charge.
	Indicates the available mmc storage space.
	Press to go to the exam info page where patient information and exam information can be entered.

Displays, Controls, and Indicators

Gallery still-image view screen

The GALLERY still image view screen appears after you press the GALLERY icon from the HOME screen, then select an Exam from the GALLERY main screen, and select a file with a '.dat' prefix.

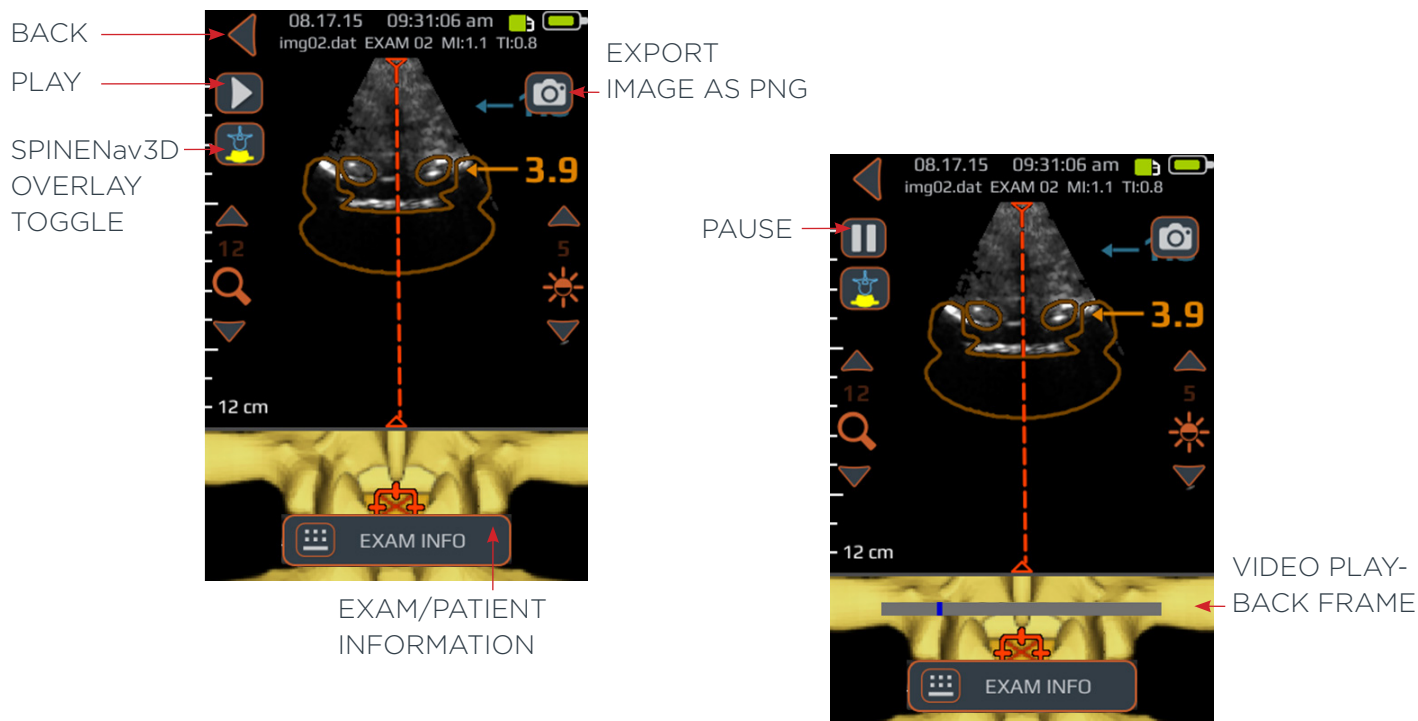









BUTTON OR INDICATOR	FUNCTION
	Press to go back to GALLERY image selection screen.
	Press to export current image as '.png' file.
	Press to go to the exam info page where patient information and exam information is entered.
	Press button to cycle through four options: 1. 3D model on, only 2. Overlay on, only 3. Both 3D model and overlay on 4. Both 3D model and overlay off

Displays, Controls, and Indicators

Gallery video playback screen

The gallery video playback screen appears after you press the GALLERY icon from the HOME screen, then select an Exam from the GALLERY main screen, and select a file with a 'video' prefix

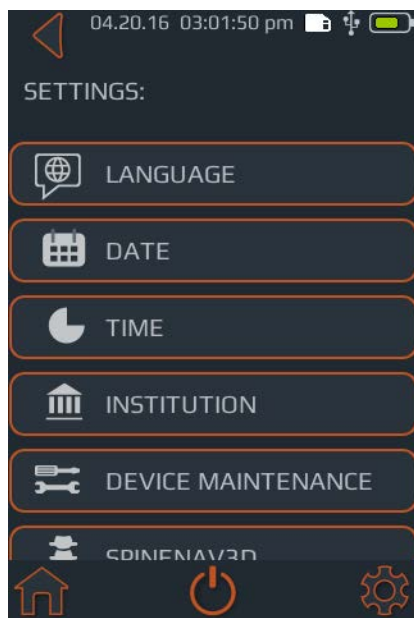


BUTTON OR INDICATOR	FUNCTION
	Press to go back to GALLERY image selection screen.
	Press to export current image as '.png' file.
	Press to go to the exam info page where patient information and exam information is entered.
	Press to start/resume video playback.
	Press to pause video playback.
	Press button to cycle through four options: 1. 3D model on, only 2. Overlay on, only 3. Both 3D model and overlay on 4. Both 3D model and overlay off
	Video playback progression indicator.

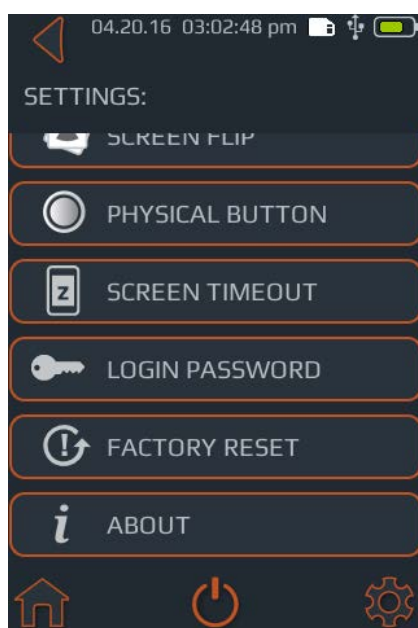
Displays, Controls, and Indicators

Settings screen

The SETTINGS screen appears after you press the SETTINGS icon from the HOME screen.



Swipe up or down to display more settings items.



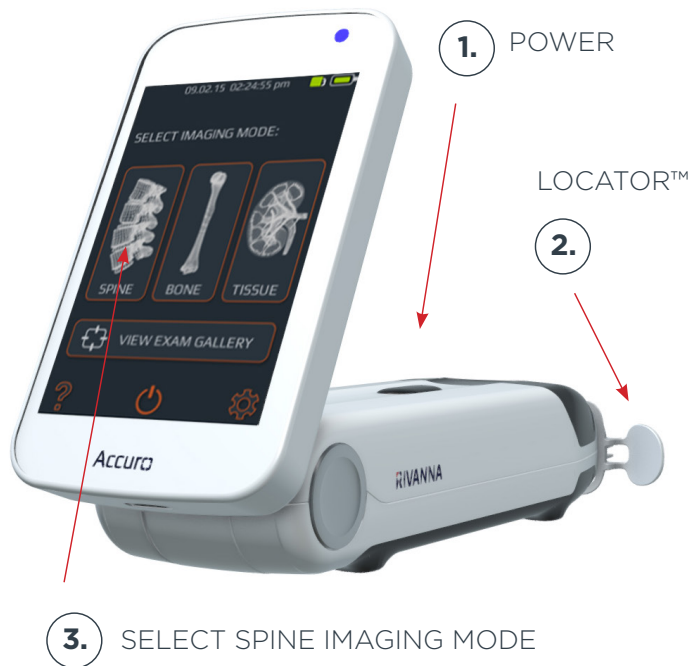
BUTTON OR INDICATOR	FUNCTION
	Press to go to HOME screen.
	Press to power off the device.
	Press to go to the settings main menu.
	Press to set language.
	Press to set the date.
	Press to set the time.
	Press to set the institution name.
	Press for further options to perform system diagnosis and repair.
	Press to turn on/off SpineNav3D overlay icon and/or 3D model icon.
	Press to toggle screen flip on/off (180 degrees flip).
	Press to choose between video or still-image action for physical button quick press.
	Press to set time before device automatically goes to sleep.
	Press to toggle device password protection on/off and set password.
	Press for option to perform a factory reset. Factory reset will restore device to default conditions.
	Press for more information about Accuro.

Using the Accuro

Using SpineNav3D to guide epidural and spinal anesthesia

The **Accuro** SPINE preset uses ultrasonic reflections acquired from multiple scan planes to obtain 3D volume scans of the lumbar spine. The SpineNav3D technology facilitates image interpretation of individual 2D lumbar spine scans by automating spinal bone landmark detection and depth measurements and providing a real-time assessment of scan plane orientation in 3D. SpineNav3D makes image interpretation and measurements of the lumbar spine anatomy simple, quick, and easy. A sonographer is not required to use the SpineNav3D preset.

To perform a clinical lumbar spine epidural or related spinal anesthesia procedure:



1. Turn on the Accuro.

Turn on the **Accuro** by pressing the power on/off button.

2. If using the RIVANNA Locator needle guide (sold separately), then place onto the Accuro.

3. Select the SPINE imaging preset.

Press the SPINE icon from the HOME screen.

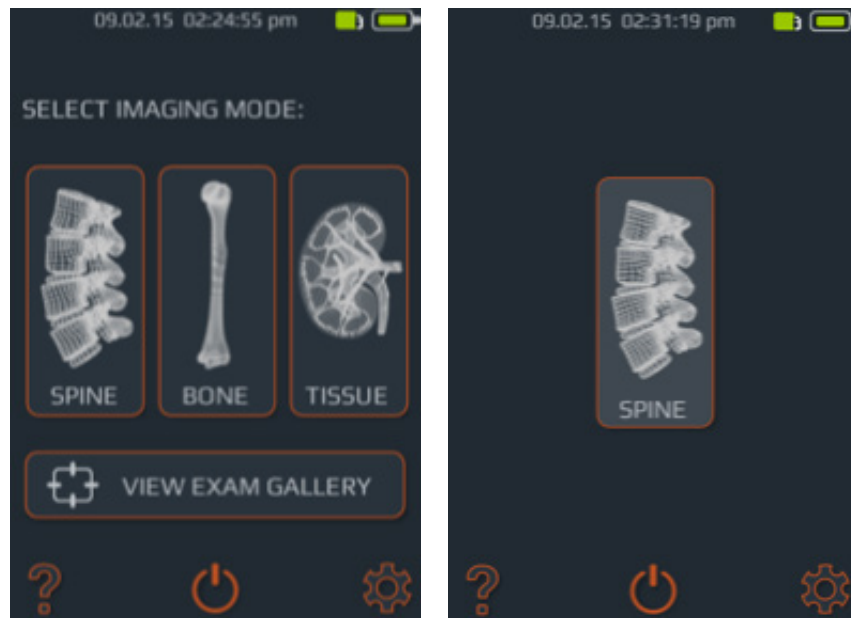
4. Apply gel and start scanning.

Apply ultrasound gel to the lumbar spine area of the

patient in the approximate area of the desired interlaminar space. Scan with the **Accuro** in the transverse orientation along the patient's lumbar spine region.

Using the Accuro

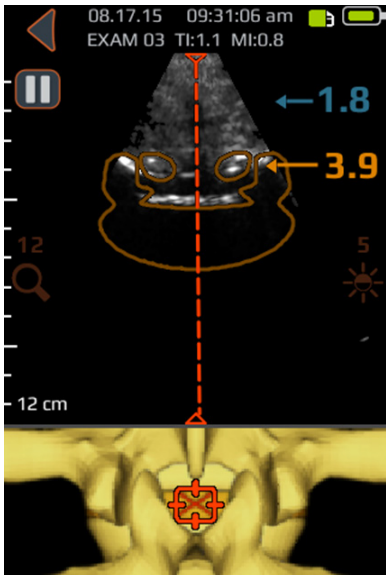
Press the *SPINE* icon from the *HOME* screen.



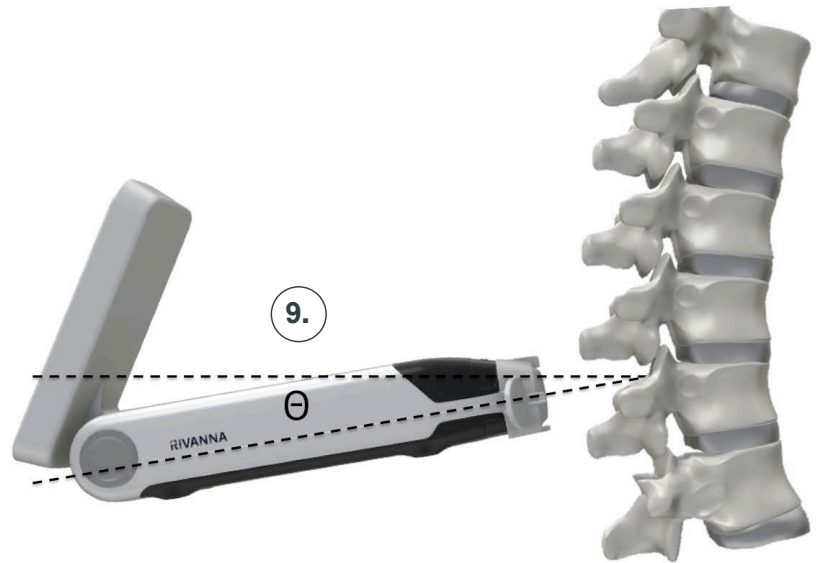
4. SCAN WITH THE **ACCURO** IN THE TRANSVERSE ORIENTATION



Using the Accuro



8.



Tip: For proper identification of the interlaminar space, the angle of the Accuro must allow the ultrasound beam to cleanly enter the interlaminar space without intersecting the spinous process.

5. Optimize the image.

Use the brightness and depth controls to optimize the image. The depth should be set at least 3 cm deeper than the expected depth of the epidural space.

6. Align the Accuro with the spine mid-line.

Move the device left or right to ensure the mid-line indicator is centered on the imaging screen (indicated by a dashed red line as shown).

7. Find the interlaminar space.

Scan with the **Accuro** along the lumbar spine region until the interlaminar space is automatically identified at the desired

intervertebral level (indicated by cross hair and orange overlay as shown).

8. Remember the depth

Take note of the automated interlaminar space depth, which is indicated by the orange number (top panel). When properly aligned, both cross-section overlay indicator (top panel) and 3D spine indicator (bottom panel) achieve maximum opacity. **NOTE: Overlay and 3D indicator can be turned on/off from the Settings screen. The factory default is 'on'.**

9. Remember the angle

Take note of the angle at which the device is held in order to detect the interlaminar space in the image.

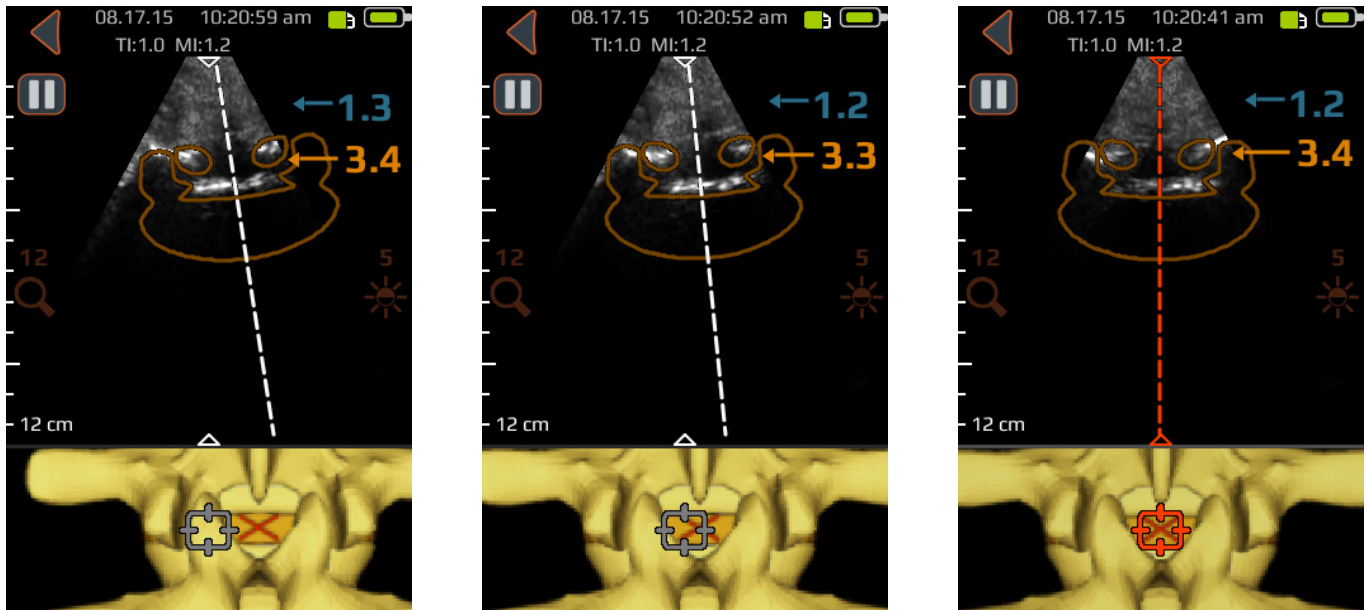
10. Mark the skin.

With the interlaminar space identified on the display screen, and center in the image, disengage the Accuro Locator needle guide and press gently against the skin. If the Accuro Locator needle guide is not used, then note the skin position corresponding to the middle of the transducer face using a preferred method, such as a surgical marker.

11. Perform the injection.

Remove the ultrasound instrument from the scanning site and perform the injection according to standard protocol. Use the skin location identified in Step 10 as the starting point for needle insertion. Use the depth reading from Step 8 and angle of insertion following Step 9.

Using the Accuro



Move the device left or right to ensure the mid-line indicator is centered on the imaging screen (indicated by a dashed red line as shown).

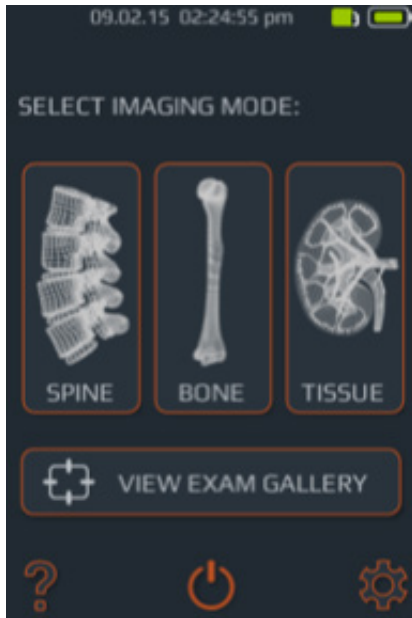
Additional scanning tips

CAUTION: For accurate imaging results, SpineNav3D must be performed in the lumbar spine region with a transverse scan plane orientation.

CAUTION: The images and calculations provided by the **Accuro** instrument are intended for use by competent users, as a diagnostic tool. The user should be aware of the instrument specifications, accuracy, and limitations. These limitations must be considered before making any decision based on images and quantitative values.

Tip: For scanning orientations other than transverse, it is recommended that the SpineNav3D overlays are turned 'off' from the Settings screen, or alternatively, that scanning is performed using the BONE icon from the home screen.

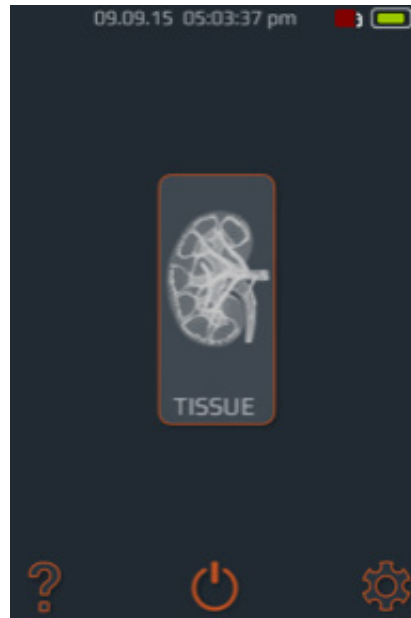
Using the Accuro



General purpose scanning with the Accuro

To perform a clinical diagnostic scan with the **Accuro**:

1. Turn on the Accuro.



2. Select the TISSUE icon from the Home screen.



3. Optimize the image.

If needed, adjust the image using the general purpose imaging controls (see BONE and TISSUE preset scanning screen).

4. Perform the diagnostic scan.

Using the Accuro

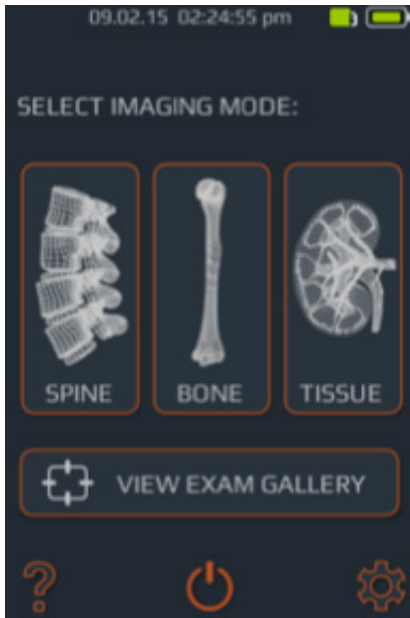


Image storage, review, and export

Save an image to an examination file

1. Turn on the Accuro.
2. Select desired imaging preset icon from the HOME screen.
3. Perform the scan.

4. Capture image.

When the desired scan is achieved, press the still-image button (see BONE and TISSUE preset scanning screen) on the **Accuro** touchscreen or quickly press and release the physical device button. The image will be saved to the current Exam for review in the GALLERY.

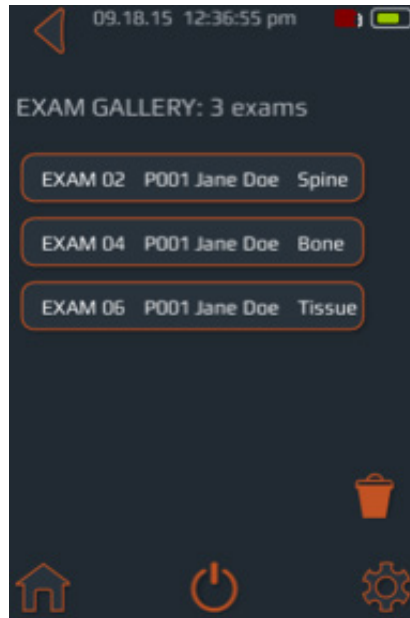
Using the Accuro



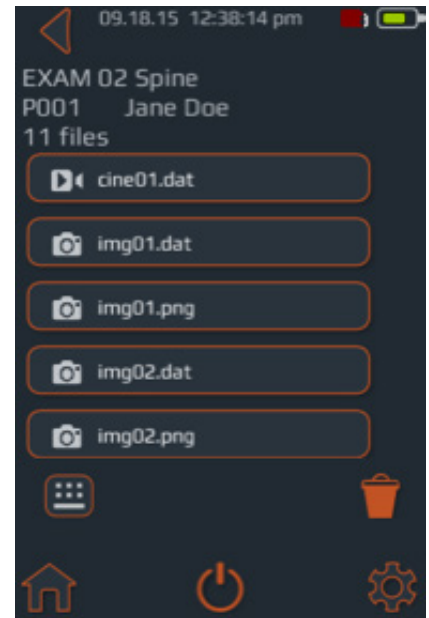
Review saved images in the gallery

After an exam is conducted, you may want to review the saved images for data entry and/or printing. To review the saved images in the GALLERY:

1. From the Home screen, select VIEW EXAM GALLERY.

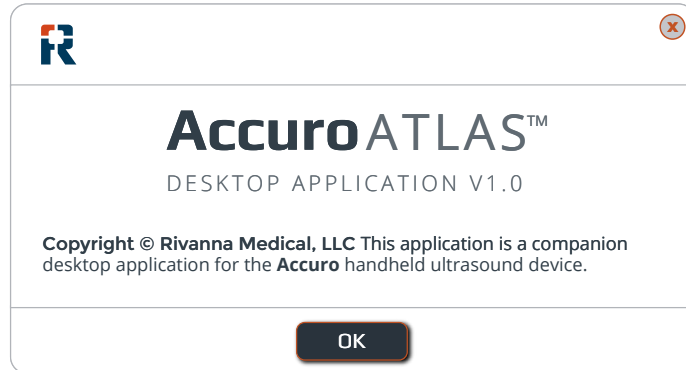
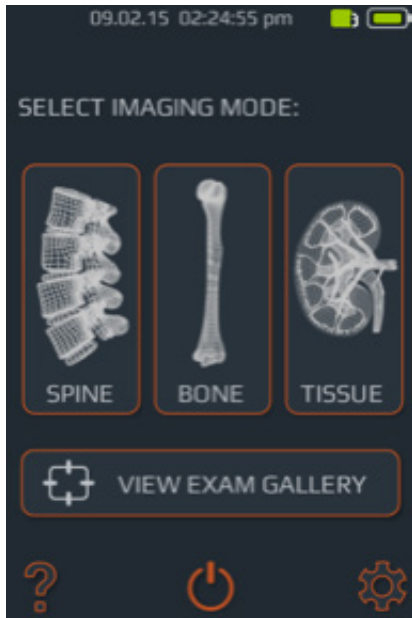


2. Next, select the desired Exam from the menu.



3. Select the desired image to review.

Using the Accuro



Generate exam reports and/or save exam images to an external computer

To annotate, generate exam reports, or save exam images to an external computer:

1. For best results, shut down Accuro and connect the Accuro to an external computer using the micro-USB to USB cable provided with Accuro.
2. Restart Accuro while connected.
3. Find the ATLAS drive on the external computer and run the AccuroATLAS application to enable image annotation, generation of exam reports, and/or saving of exam images.
4. A quick start guide for the desktop application can be accessed by pressing “F1” key on a keyboard or by navigating to the Help -> Documentation menu.

Minimum system requirements

Note: In order to access the AccuroATLAS auto-run software, the following minimum system requirements must be met:

Computer operating systems
Microsoft Windows® 7/8/8.1/10
or Mac OSX 10.9

Minimum processor - 1 GHz

Minimum RAM - 1 GB

USB 2.0

Minimum display - 1024 x 768

Accuro Maintenance

Instrument care and maintenance inspection

The **Accuro** should be inspected for physical damage and cracks prior to every use of the instrument. Stop using the **Accuro** if damage is noted. Failure to do so may result in electrical shock or fire.

Other than the routine inspection and cleaning described in this User's Manual, there is no periodic or preventive maintenance required for **Accuro**. There are no components that require periodic testing or calibration for performance assurance.

Cleaning and disinfection

Cleaning procedure

The **Accuro** instrument should be cleaned between patient uses. To clean the **Accuro** probes, follow these instructions:

Turn off the **Accuro** system.

Dampen a nonabrasive cloth with isopropyl alcohol and wipe the probe until thoroughly cleaned.

Gently wipe the dampened cloth over exterior surfaces requiring cleaning.

Wipe with a dry cloth.

Disinfecting procedures

If the instrument needs to be disinfected, dampen the nonabrasive cloth with Cidex® from Advanced Sterilization Products and wipe the instrument until thoroughly cleaned.

CAUTION: Damage to the instrument may occur

Do not immerse the instrument in disinfectant solution.

Use cleaning and disinfecting procedures as described above.

Electromagnetic Compatibility (EMC)

The **Accuro** has been designed and tested and found to comply with the electromagnetic compatibility (EMC) limits for medical devices to the EN/IEC 60601-1-2:2007 standard for EMC. These limits are designed to provide reasonable protection against harmful interference in a typical medical installation.

WARNING: Use of the **Accuro** adjacent to or stacked with other equipment should be avoided because it could result in improper operation. If such use is necessary, this equipment and the other equipment should be observed to verify that they are operating normally.

WARNING: Use of accessories, transducers and cables other than those specified or provided by RIVANNA could result in increased electromagnetic emissions or

decreased electromagnetic immunity of this equipment and result in improper operation.

CAUTION: Medical electrical equipment requires special precautions regarding EMC and must be installed and operated according to these instructions. It is possible that high levels of radiated or conducted radio-frequency electromagnetic interference (EMI) from portable or mobile RF communications equipment or other strong or nearby radio-frequency sources, could result in performance disruption of the ultrasound system. Evidence of disruption may include image degradation or distortion, erratic readings, equipment ceasing to operate, or other incorrect functioning.

If this occurs, survey the site to determine the source of disruption, and take the following actions to eliminate the source(s):

- Turn equipment in the vicinity off and on to isolate the source
- Relocate or re-orient the interfering source
- Increase distance between source and the ultrasound unit
- Educate clinical staff to recognize potential EMI-related problems
- Restrict use of cell phones, etc. near the ultrasound unit
- Purchase medical devices that comply with IEC 60601-1-2:2007


Electromagnetic emissions

Guidance and manufacturer's declaration – electromagnetic emissions

The Accuro is intended for use in the electromagnetic environment specified below. The customer or the user of the Accuro should assure that it is used in such an environment.		
Emissions Test	Compliance	Electromagnetic Environment — Guidance
RF Emissions CISPR 11	Group 1	The Accuro uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment. The Accuro is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
RF Emissions CISPR 11	Class A	
Harmonic Emissions IEC 61000-3-2	Class A	
Voltage Fluctuations/ Flicker Emissions	Complies	

Electromagnetic Compatibility (EMC)

Electromagnetic Immunity

The Accuro is intended for use in the electromagnetic environment specified below. The customer or the user of the Accuro should assure that it is used in such an environment.			
Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment – Guidance
Electrostatic Discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	In compliance	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 6100-4-4	±2 kV for power-supply lines ±1 kV for input/output lines	In compliance	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV line(s) to line(s) ±2 kV line(s) to earth	In compliance	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5% U_T (>95% dip in U_T) for 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles < 5% U_T (>95% dip in U_T) for 5 s	Immunity	Mains power quality should be that of a typical commercial or hospital environment. If the user of the Accuro requires continued operation during power mains interruptions, it is recommended that the Accuro system be powered from an uninterruptible power supply or a battery.
Power Frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	In compliance	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 V	Portable and mobile RF communications equipment should be used no closer to any part of the Accuro including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance 1.2 1.2 80 MHz to 800 MHz 2.3 800 MHz to 2.5 GHz where is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, ^a should be less than the compliance level in each frequency range. ^b Interference may occur in the vicinity of equipment marked with the following symbol: 
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	

Electromagnetic Compatibility (EMC)

NOTE: *Ut is the AC mains voltage prior to application of the test level.*

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

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

- a. Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the **Accuro** is used exceeds the applicable RF compliance level above, the **Accuro** should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the **Accuro**.
- b. Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Electromagnetic Emissions

Recommended separation distances between portable and mobile RF communications equipment and **Accuro**.

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

Rated maximum output of transmitter (W)	Separation Distance According to Frequency of Transmitter (m)		
	150 kHz to 80 MHz 1.2	80 MHz to 800 MHz 1.2	800 MHz to 2.5 GHz 2.3
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3

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

NOTE 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structure, objects, and people.

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

ALARA Principle

ALARA is the guiding principle for the safe use of diagnostic ultrasound. Sonographers and other qualified ultrasound users, using good judgment and insight, determine the acoustic exposure that is “as low as reasonably achievable.” There are no set rules to determine the correct acoustic exposure for every clinical situation. The qualified ultrasound use determines the most appropriate way to keep exposure low and bio-effects to a minimum, while obtaining a clinically efficacious study.

A thorough knowledge of the imaging modes, transducer capability, system setup, and scanning techniques is essential. The imaging mode determines the nature of the ultrasound beam. A stationary beam (non-scanning mode) results in a more concentrated exposure than a scanned beam (imaging mode), which spreads the acoustic exposure over the scanned area. The transducer capability depends upon the frequency, penetration, resolution, and field of view. The default system presets are set at the start of each new patient. It is the scanning technique of the qualified ultrasound user along with patient body habitus variability that determines the system setting during the examination.

The variable which affect the way the qualified user implements the ALARA principle include: patient body size, location of the bone relative to the focal point, attenuation in the body, and ultrasound exposure time. Exposure time is an especially

useful variable because the qualified user can, for the most part, control it. The ability to limit exposure over time supports the ALARA principle.

Applying ALARA

The system imaging mode selected by the user is determined by the diagnostic information required. B-mode imaging provides anatomical information and Tissue Harmonic Imaging, which uses higher received frequencies, provides less image clutter, artifact, and improves the overall resolution of the B-mode image. Understanding the nature of the various operational modes allows the qualified user to most effectively apply the ALARA principle.

Prudent use of ultrasound requires that patient exposure to ultrasound be limited to the lowest acoustic output for the shortest time necessary to achieve acceptable diagnostic results. Decisions that support prudent use are based on the type of patient, exam type, patient history, ease or difficulty in obtaining diagnostically useful information, and potential localized heating of the patient due to transducer surface temperatures.

The user uses the system controls to adjust image quality and limit ultrasound acoustic output. The system controls are divided into three categories relative to acoustic output: controls that directly affect output, controls that indirectly affect output, and receiver controls.

Direct controls

The **Accuro** system does not contain any controls that directly affect output.

Indirect controls

The **Accuro** system does not contain any controls that indirectly affect output.

Receiver controls

The receiver controls are the gain controls. Receiver controls do not affect acoustic output. They should be used, if possible, to improve image quality before using controls that directly or indirectly affect output.

Other Technical Specifications

Instrument specifications

Item	Specification
Maximum dimensions	5.1 cm x 6.5 cm x 16.5 cm
Weight	0.7 lb (0.31 kg)
Display type	48.96 mm x 73.44 mm (480 pixels x 320 pixels, 166 dpi)

Operating and storage conditions

The **Accuro** is designed to function under the following operating and storage conditions:

Condition	Description
Storage temperature	-10°C - 50°C
Storage humidity range	20% - 95% non-condensing
Operating temperature	10°C - 35°C
Operating humidity range	20% - 80% non-condensing

Probe specifications

Item	Description
Diameter	12 mm
Frequency	5 MHz
Sector size	60°
Max scan depth	12.5 cm

Acoustic output specifications

See summary of acoustic quantities on the following page.

Battery specifications

The **Accuro** contains a Lithium Ion battery than is permanently enclosed in the instrument unit. The battery is not replaceable. A battery icon is located on the instrument upper right display and indicates the current charge level and when recharging is required. The battery meets the following specifications:

Item	Description
Battery type	Lithium ion
Battery life	Up to 90 minutes of continuous imaging
Charge time	< 4 hours from an empty battery to full charge

Battery is charged by plugging the device into the provided USB cable and the USB cable into the provided USB wall charge.

Accuracy statement

The measurement accuracy of linear distances and SpineNav3D landmark depth estimates are validated on images of tissue-equivalent ultrasound phantoms. Both phantoms possessed speeds of sound 1540 +/- 10 m/s. In in-vivo use, the accuracy may be greater due to variations in speed of sound.

Specification	Accuracy
Linear distance measurement accuracy (vertical and horizontal)	< 6%
SpineNav3D accuracy	< 3 mm (< 10%)

Other Technical Specifications

Summary of acoustic quantities

Transducer Model: Accuro

Operating Mode: B-Mode

Index Label			MI	TIS			TIB	TIC
				Scan	Non-scan		Non-scan	
					A _{aprt} ≤1 cm ²	A _{aprt} >1 cm ²		
Maximum index value			1.05	0.822	-	-	-	#
Associated acoustic parameter	p _{r,3} (MPa)		1.67					
	W ₀ (mW)			69.2	-		-	#
	min of [W _{.3} (z ₁), I _{TA,3} (z ₁)] (mW)					-		
	z ₁ (cm)					-		
	z _{bp} (cm)					-		
	z _{sp} (cm)		3.30				-	
	d _{eq} (z _{sp}) (cm)						-	
	f _c (MHz)		2.50	2.50	-	-	-	#
	Dim of A _{aprt}	X (cm)		1.20	-	-	-	#
		Y (cm)		1.20	-	-	-	#
Other Information	PD (μsec)		1.47					
	PRF (Hz)		1280					
	p _r @ PII _{max} (MPa)		2.21					
	d _{eq} @ PII _{max} (cm)						-	
	Focal Length	FL _x (cm)		6.0	-	-		
		FL _y (cm)		6.0	-	-		
	I _{PA,3} @ MI _{max} (W/cm ²)		220					
Operating Control Conditions	Sector scan 4 pulse mode 128 lines over 60 degrees							

Note 1: Information need not be provided for any formulation of TIS not yielding the maximum value of TIS for that mode.

Note 2: Information need not be provided regarding TIC for any TRANSDUCER ASSEMBLY not intended for transcranial or neonatal cephalic uses.







Note 3: Information on MI and TI need not be provided if the equipment meets both the exemption clauses given in 51.2 aa) and 51.2 dd).

(a) Intended use does not include cephalic so TIC is not computed

No data reported.

Safety

Symbols

SYMBOL	DEFINITION
	Type BF applied part
	Manufacture date
	Manufacturer of project
	Follow Instructions For Use (IFU)
	Serial number
IPX1	Degree of protection against harmful ingress of water
	Dispose of product in accordance with Directive 2012/19/EU

Accuro™ USER'S MANUAL

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