

MicrUs and MicrUs Pro Series Ultrasound Systems

Echo Wave A Software

User Manual



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1. Introduction

This document ("MicrUs and MicrUs Pro Series Ultrasound Systems Echo Wave A Software User Manual") describes the TELEMED Ultrasound Systems based on MicrUs or MicrUs Pro series of ultrasound scanners and "Echo Wave A" ultrasound scanning software.

This document describes the "Echo Wave A" ultrasound software user interface, its structure, controls and how to use this software for ultrasound processing. Please note that in this manual the software screenshots shown may look slightly different from the actual software user interface because user interface may depend on the used operating system adjustments. In this document to refer to "Echo Wave A" ultrasound software may be used term "ultrasound software", "software" or "the app".

Before using this software, you must be trained in clinical procedures for conducting ultrasound examinations. This guide does not provide guidelines for clinical aspects of performing the examination or for interpreting medical ultrasound images.

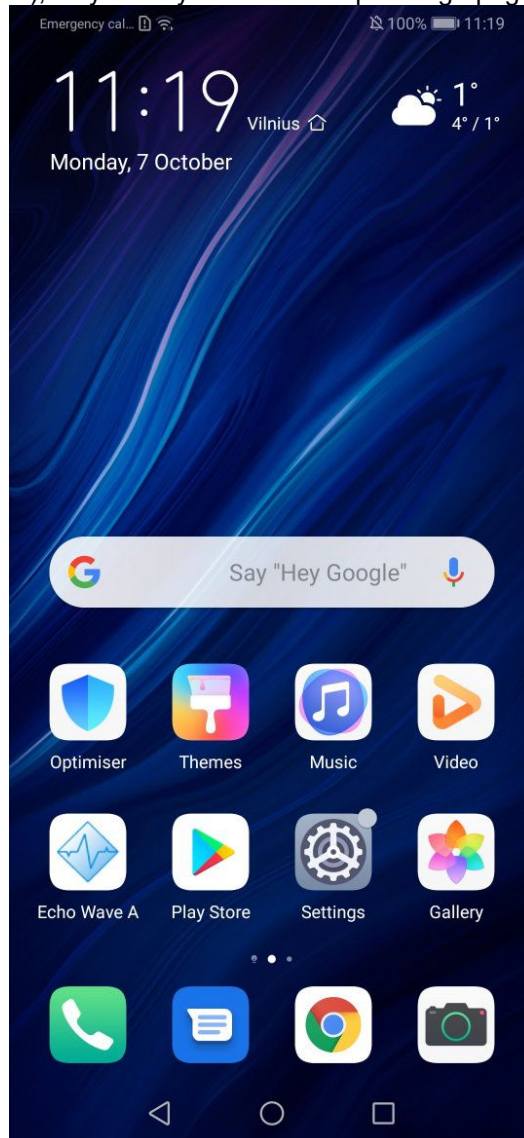
In addition, before using this software you must be familiar with the use of Android 9.0 or more recent operating system and mobile phone or tablet computer that has installed this operating system.

2. System Startup and Shutdown

2.1. System Startup

If the system was properly installed and connected, perform the following actions to start the system:

1. If required, power up mobile phone or tablet computer and unlock the screen.
2. Click "Echo Wave A" icon. The icon may be not on first, but on second or other page (or on one of the pages of installed applications), so you may need to sweep through pages to find it.




3. After click you should see ultrasound software user interface.

If is displayed dialog "Allow Echo Wave A to access photos?", click "Allow".

If is displayed dialog "Open Echo Wave A to handle MicrUs?", put check and click "OK".

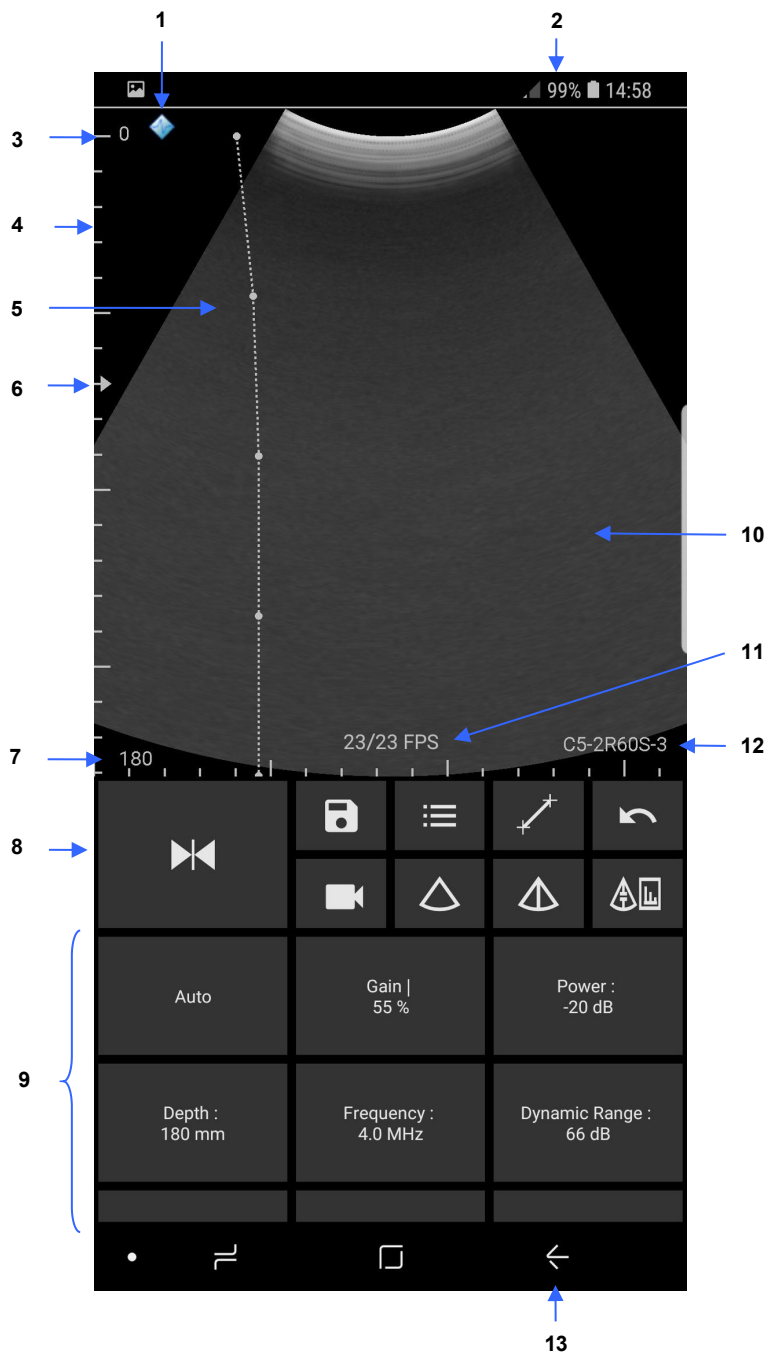
If is used option "Start app on device connection", the software will start after device connection to USB port without any additional clicks.

2.2. System Shutdown

To exit "Echo Wave A" software, click "Back" button  of the operating system or phone/tablet and, when asked if you want to close software, click "Yes". For appearance of "Back" button please check user guide of your phone/tablet.

3. Software User Interface Structure

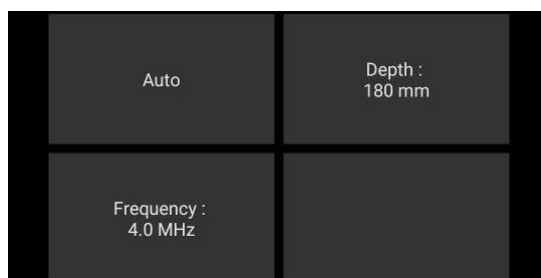
3.1. Main Window



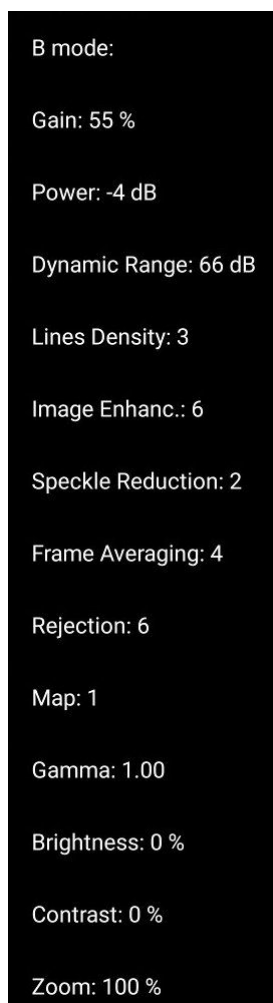
Num	Description
1	Scan direction marker that indicates at what side is first probe element.
2	Remaining phone battery indicator.
3	Zero depth (probe surface) tick mark.
4	Depth scale line.
5	TGC (Time Gain Compensation) curve.
6	Focusing depth marker.
7	Actual scanning depth (numerical value in millimeters).
8	Buttons to record cine, save image, freeze/run, open settings (presets, options), measure

	distance and other measurements (press and hold to open menu), delete measurements, change scanning modes.
9	Ultrasound scanning controls (Gain, Power, Depth and others). This area can be scrolled up/down. In combined modes like B+M, sweeps left/right change what mode controls are shown.
10	Scanned ultrasound image.
11	Ultrasound scanning frame rate (FPS - frames per second).
12	The name of connected probe.
13	Phone "Back" button (used to close windows and application).

Scanning controls area, if is turned off option "Show all scanning controls", may have smaller number of controls.

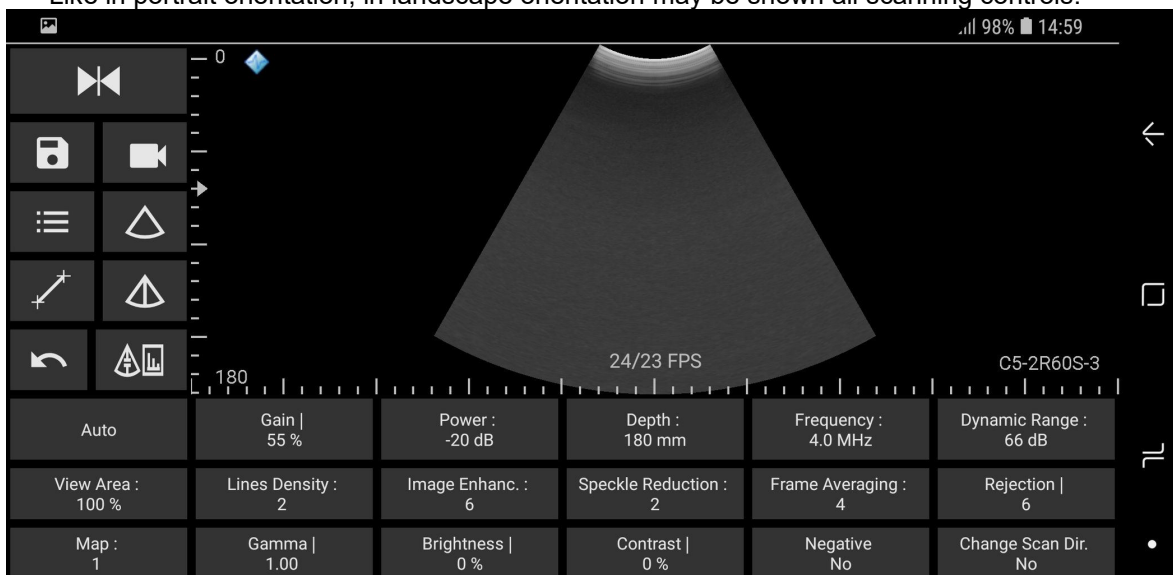


Control at right-bottom corner is customizable. To set its value, press and hold this button and from appeared menu select desired to control parameter.

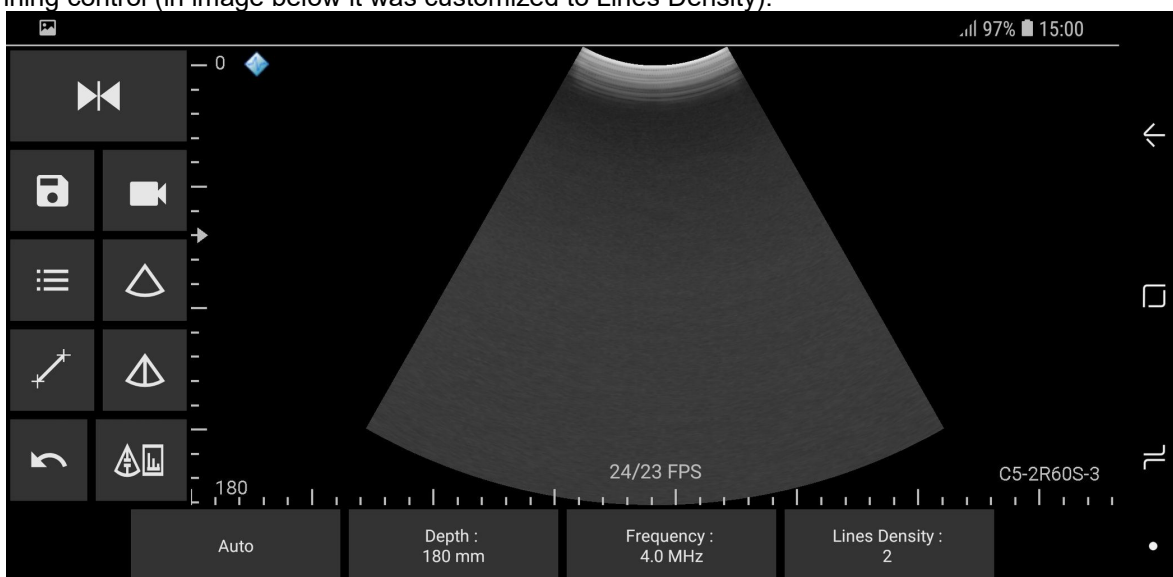


If is used landscape screen orientation, software user interface slightly differs from portrait interface, but basic functionality is similar to portrait.

Like in portrait orientation, in landscape orientation may be shown all scanning controls.

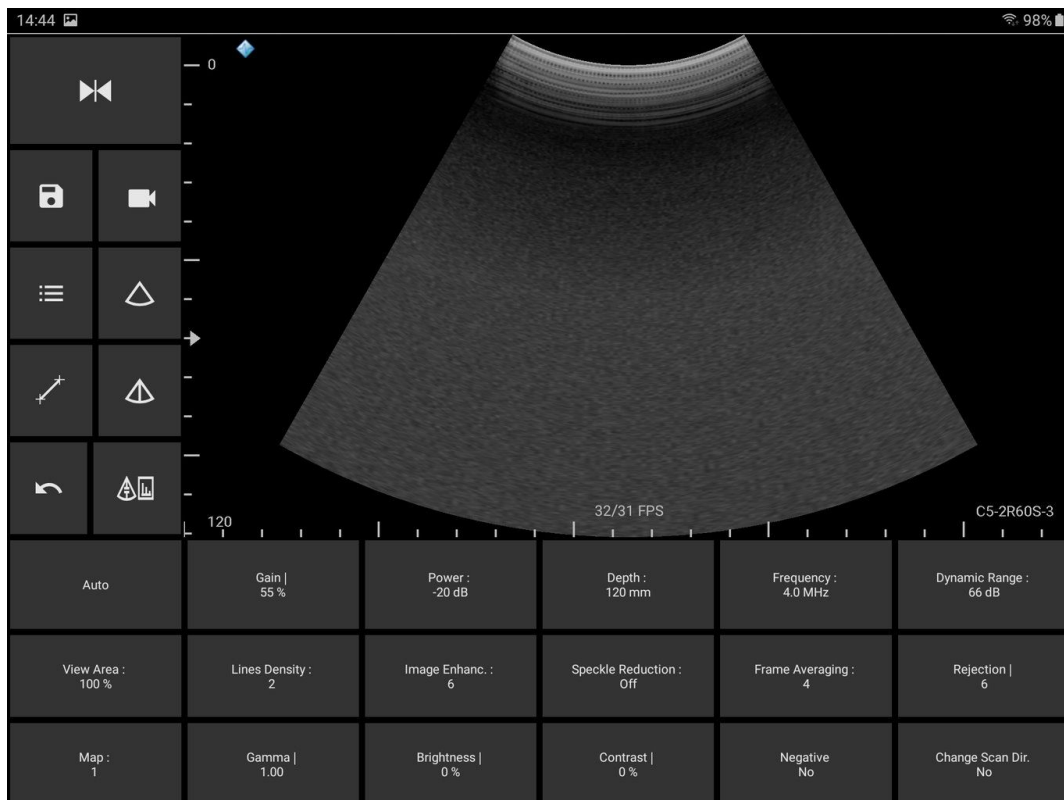
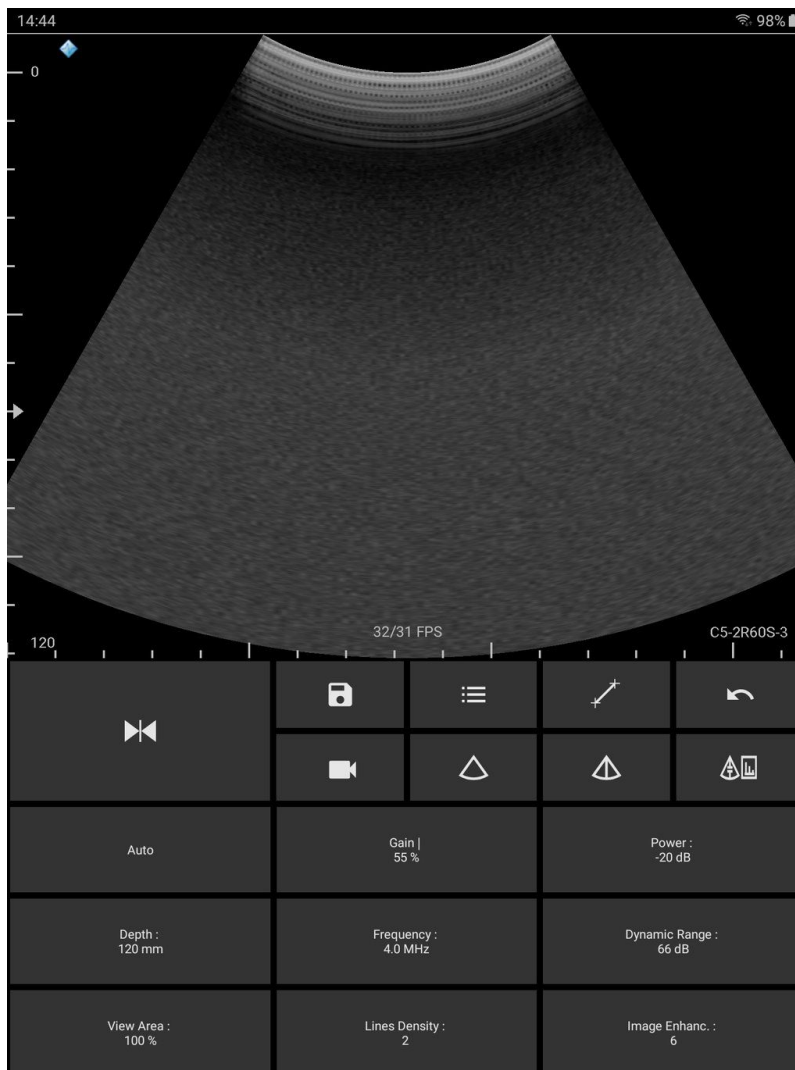


Or in landscape orientation may be shown smaller number of controls with customizable right most scanning control (in image below it was customized to Lines Density).



The software supports different screen sizes/resolutions and, depending on display, controls may look slightly different. Above screenshots correspond to 6.3 inch, 1080x2220 pixels, 420 DPI display.

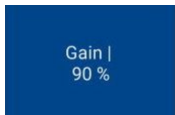
Screenshots below correspond to portrait and lanscape of 9.6 inch, 1536x2048 pixels, 320 DPI display.



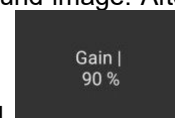
3.2. Types of Controls

This section describes software controls that may slightly differ from standard Android controls and that require some knowledge where and how to touch the screen in order to get desired result.

To change value of some ultrasound scanning parameter (like Gain, Power, Depth), while ultrasound scanning is running must be clicked corresponding button (then is turned on parameter change mode and



changed button color) and then done horizontal or vertical sweeps on ultrasound image. After

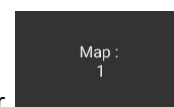


some time of inactivity, parameter change mode is turned off and button color is restored. While parameter change mode is turned on, the same button can be clicked once again to turn change mode off.

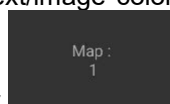
Depending on scanning parameter, the value may be changed either continuously during movement (sweep) action (e.g., Gain value) or only when finger is released (e.g., Depth value). Required mouse movement type can be determined by observing hint image (“|” or “:”) at the right of parameter name. For different scanning parameters are used different controls because different parameters have different number of values and require different time for programming of ultrasound scanning hardware. For example, the change of depth value requires much more time than the change of gain value.



If button does not have above mentioned hint image, this means that button action will be performed after usual click and does not require additional mouse actions on the ultrasound image.



Buttons that can be clicked (are enabled) have bright text/image color



that cannot be clicked (are disabled) have darker text/image color

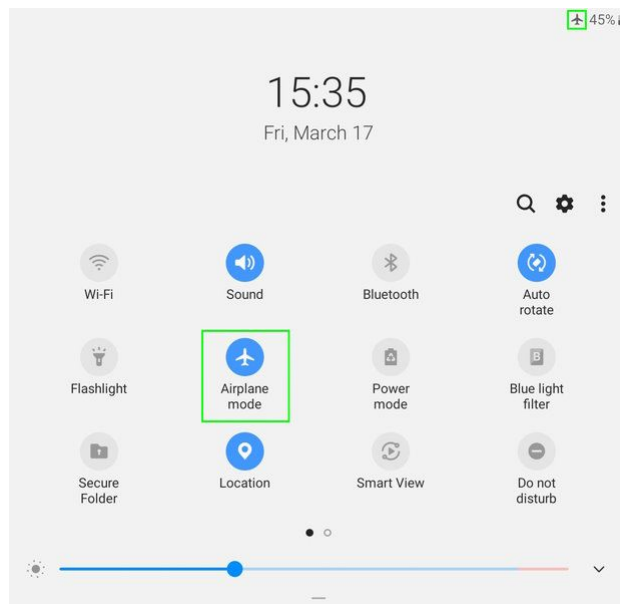
In combined scanning modes (like B+M) pages of buttons (B, M) are changed by doing horizontal (in portrait layout) or vertical (landscape layout) sweeps at controls area.

Some software parameters may be controlled by doing actions with finger(s) on the ultrasound image while buttons of scanning parameters are not active. For example, vertical press-move-release actions along B mode vertical scale line adjust B mode focusing depth. Press and hold on B mode image at any vertical position that is at the right of depth scale line will show the TGC curve, and then horizontal press-move-release actions will change TGC values at desired depths. Pinch operation with two fingers zooms in/out ultrasound image, sweep on zoomed image changes its position, and single click on zoomed image restores zoom to 100%. How to adjust each ultrasound scanning parameter and how it affects ultrasound image quality is described in other sections of this document.

If some control is not present or is disabled, this usually mean that control is either not supported at all or not supported in current software state.

4. Adjusting Mobile Device not to be Disturbed While Scanning

When doing examinations and procedures, you may want not to be disturbed. In such case you can disable wireless and cellular communications (E-mails, communication apps, cellular calls) by turning on “Airplane mode” (Flight mode). To do this, at phone/tablet screen top edge sweep with finger down for two times and click “Airplane mode” button. At right top corner near battery status should appear small airplane.











To turn “Airplane mode” off, at phone/tablet screen top edge sweep with finger down for two times and click “Airplane mode” button again.



For more information about “Airplane mode” please read user guide of your mobile device.

5. Typical Ultrasound Examination Workflow

To perform ultrasound examination, start software and follow these steps:

1. Click Freeze/Run button  to freeze/run ultrasound scanning and clear all measurements.
2. If required, enter patient identifier (ID). To do this, click "Settings" button , then "Patient" tab, enter ID, close opened window by clicking phone "Back" button.
3. Adjust ultrasound image quality using ultrasound scanning controls.
4. Use proper medical protocols to perform the ultrasound examination.
5. Click "Freeze/Run"  button to freeze the ultrasound image currently displayed.
6. Perform any measurements and calculations if required.
7. Save ultrasound image.
8. Press the "Freeze/Run"  button to restart the ultrasound scanning. Ultrasound scanning freeze/run state is indicated by the color of button and scan direction marker. While scanning, colors are as follows:  . When scanning is stopped, colors are as follows:  .
9. Optionally, repeat steps 1-8 to scan more ultrasound images.

Detailed information how to adjust ultrasound scanning parameters, do measurements and other operations will be provided in next sections.

Note. To change ultrasound probe, click "Freeze/Run" button  to freeze ultrasound scanning, change probe, click "Freeze/Run" button  to initialize connected probe and start scanning (for MicrUs Pro initialization and scanning start are done automatically). Also you can close software, change probe, start software.


When is done Freeze, by default device is powered OFF, and on Run it is powered ON and reinitialized. This is done to save battery, but reinitialization requires time. This feature can be turned off by unchecking "On-freeze power saving" at software Options.

Before starting to use the system, please check if on-screen scan direction marker matches on-probe marker by touching probe surface and observing ultrasound image. If these markers do not match, check option "Fix scan direction".

6. Selecting Ultrasound Scanning Mode

To freeze/run ultrasound, click Freeze/Run button .

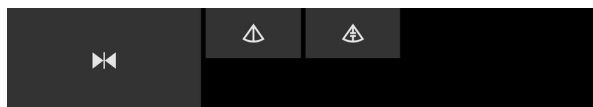
Ultrasound scanning mode can be changed only when ultrasound scanning is running. If ultrasound

scanning is frozen, click Freeze/Run button  to run ultrasound scanning.

Controls that change scanning mode are located at horizontal toolbar.



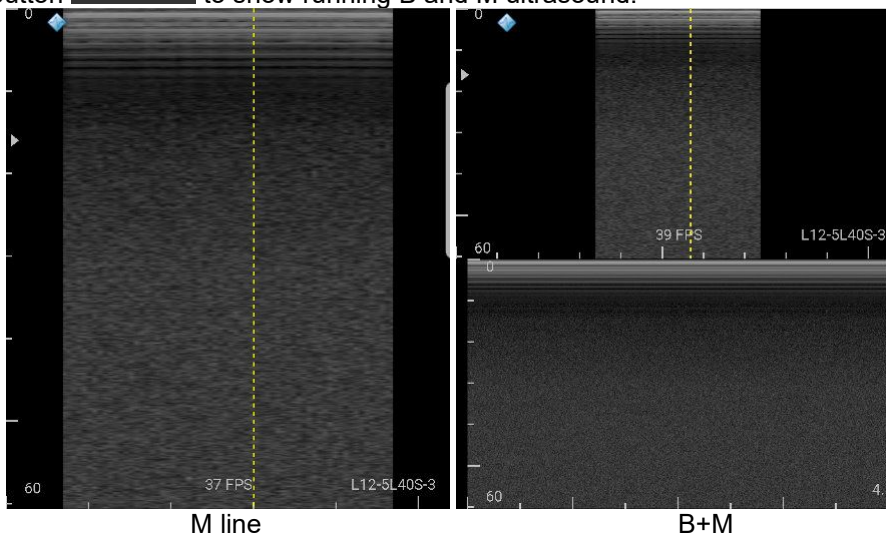
Supported scanning modes depend on ultrasound scanner model. If device supports Doppler mode, additional mode buttons appear on second page by doing left/right sweeps on toolbar (in landscape mode sweeps are top/bottom).




When scanning mode is changed, buttons may change.


To enter B+M mode, click "M-line" button ,


set M-line by clicking on B mode ultrasound image, click "B+M" button  to show running B and M ultrasound.



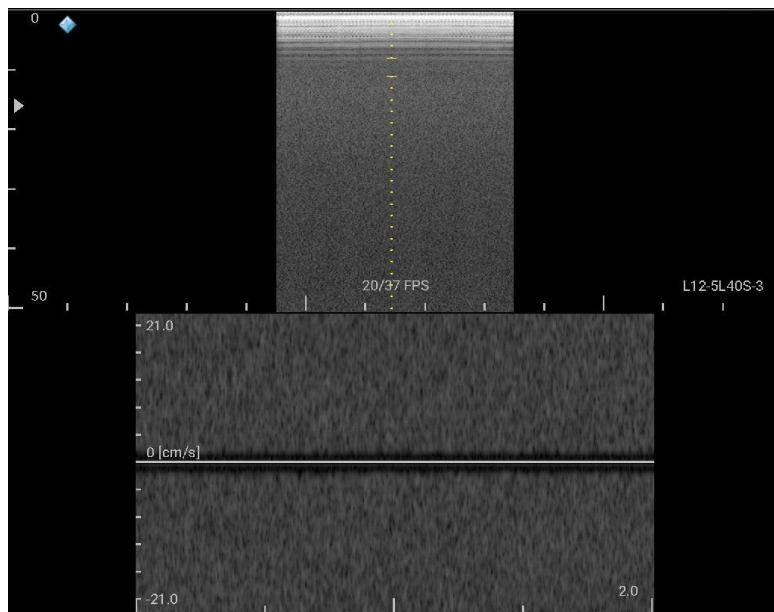
To enter M mode, open second page of mode buttons, click "M-line" button ,



clicking on B mode ultrasound image, click "M" button  to show only running M ultrasound. In M mode, vertical axis shows depth in millimeters (mm), and horizontal axis shows time in seconds (s).



To return to B mode from any other mode, click "B" button .

In any mode ultrasound can be frozen by clicking "Freeze/Run"  button, the image can be saved or done measurements on it.

To enter B+PW mode, click "B+PW" button  and set PW sample volume position by pressing on B mode ultrasound, moving pressed finger, releasing.










To make B image frozen and PW running, click “B+PW” button  again. To freeze ultrasound, click "Freeze/Run"  button

To enter PW mode, open second page of mode buttons, click “PW-line” button , set PW sample volume position, click “PW” button  to show only running PW ultrasound.

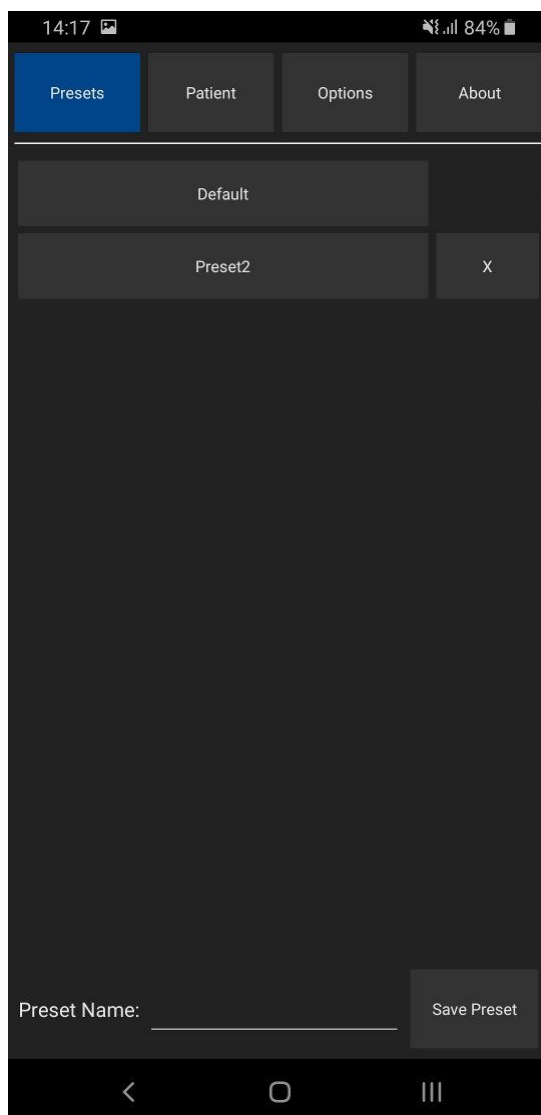
In PW mode, vertical axis shows velocity in centimeters per second (cm/s), and horizontal axis shows time in seconds (s).

When in PW mode is done adjustment of controls or any other screen touches, PW sound is muted for some time.


The list of scanning mode buttons is as follows:

-  B mode,
-  B+M mode,  M line,  M mode,
-  B+PW mode,  PW line,  PW mode.

7. Using Ultrasound Scanning Presets



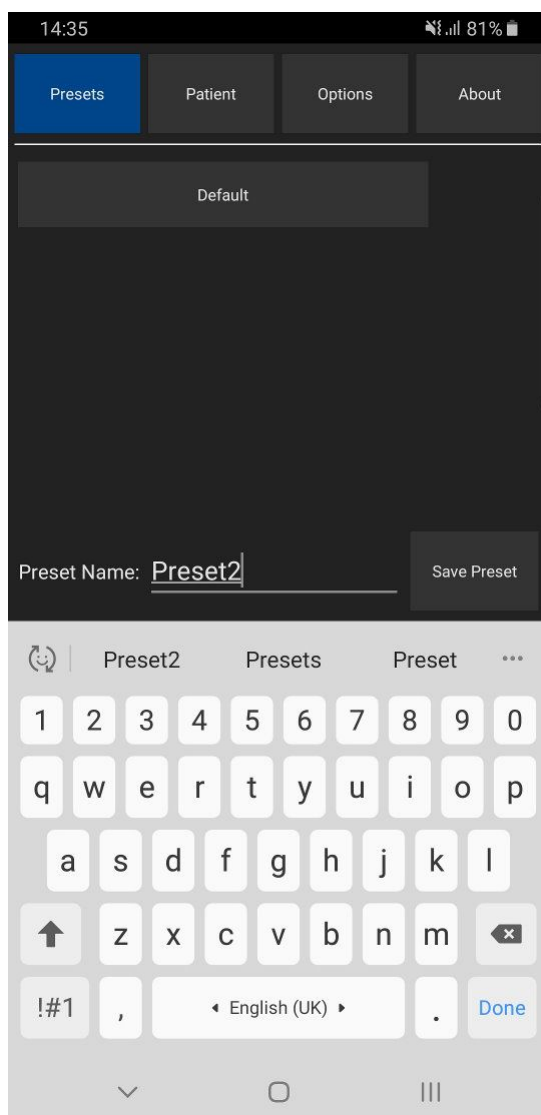
In order to apply ultrasound scanning preset, unfreeze ultrasound scanning (if now it is frozen) by clicking "Freeze/Run" button and perform the following actions:

1. Open the presets list by clicking on the "Settings" button , then "Presets" tab.
2. In the appeared list click on preset name in order to apply it. If the number of available presets is large, presets list can be scrolled by doing vertical sweeps with finger over opened presets list.
3. Optionally, repeat steps 1-2 to use another preset.



Preset sets scanning parameters of all modes.

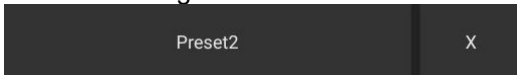
To save current ultrasound scanning parameters as preset for future use, please perform the following actions:

1. Open the presets list by clicking on the "Settings" button and "Presets" tab.
2. Click text field at the right of "Preset Name:" text, enter preset name using on-screen keyboard and click "Save Preset" button. Presets are saved to folder "Internal Storage>Documents>EchoWaveA>Presets".



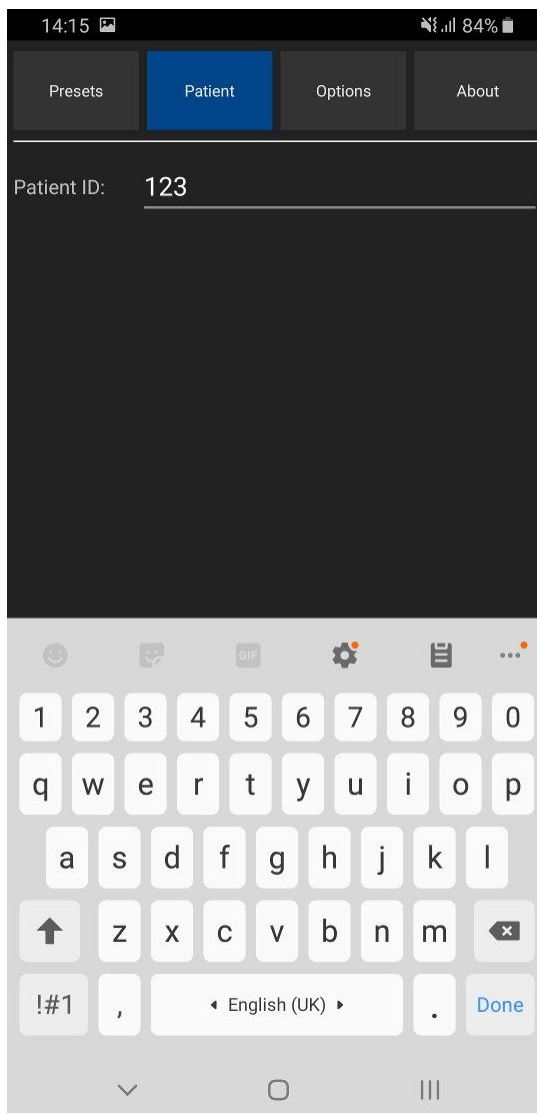
To delete ultrasound scanning preset, please perform the following actions:

1. Open the presets list by clicking on the "Settings" button  and then "Presets" tab.
2. Click preset deletion button  at the right of its name.
3. Click "Yes" when asked if you want to delete preset.






Please note that some presets are protected, and you may not be able to delete them (deletion button is not shown).

8. Patient Information



To enter patient identifier, please perform the following actions:

1. Open the Settings window by clicking on the "Settings" button , then click "Patient" button at the top.
2. Click textbox after "Patient ID".
3. Enter patient identifier.
4. Close keyboard and Settings window by clicking "Back" buttons , .

Patient identifier (if was entered) appears in file names of saved image and video files.

9. Adjusting Ultrasound Image Quality

To adjust desired scanning parameter, click corresponding button at the bottom of software window and do sweeps on ultrasound image (depending on control type). Control types were described in section “Types of Controls” of this document. All scanning parameters will be described in next sections. If any parameter is controlled using other method, then this information will be presented in the section that describes this parameter. Buttons of scanning parameters are organized to multiple rows, and to show other parameters (that are not initially visible) must be done vertical sweeps on buttons placement area.

9.1. Adjusting B Mode Controls

Gain 90 %	Power : 0 dB	Depth : 150 mm	Color Map : 1	Gamma 1.00	Brightness 0 %
Frequency : 4.0 MHz	Dynamic Range : 102 dB	Lines Density : 4	Contrast 0 %	Zoom 100 %	
Image Enhanc. : Off	Frame Averaging : Off	Rejection 0	Negative No	Change Scan Dir. No	

9.1.1. Automatic image optimization

Description

Automatic image optimization (“Auto” button) adjusts Gain, TGC and Dynamic Range. Availability of this feature depends on the ultrasound scanner used.

Adjustment

To do automatic image optimization, click “Auto” button while scanning. During optimization hold the probe on an anatomical structure of interest and do not move it.

Relations to other controls

Automatic optimization changes Gain, TGC and Dynamic Range values.

9.1.2. Focus

Description

Focus optimizes the ultrasound image by increasing the resolution of specific areas. Always try to adjust focuses so that focusing markers are at the center of the anatomical structure which is of most interest.

Values

The available list of focusing depth values depends on the probe used. Focusing depth measurement units used - millimeters (mm).

Adjustment

To change focusing depth, wait while scanning controls will become inactive and then do vertical sweeps with finger along vertical B mode scale line.

Relations to other controls

After adjusting Depth you may need to adjust the Focus controls.

9.1.3. Depth

Description

Depth adjusts the field of view. Increase the depth to look at larger or deeper structures. Decrease depth in order to look at structures near the skin surface. Additionally, you may wish to decrease the depth if there is a large part of unnecessary ultrasound image below the displayed anatomical structures of interest. You may also need to change the depth in order to see anatomical structures of interest in the center of the screen.

Values

The list of available depth values depends on the type of probe used. Measurement units used - millimeters (mm). The painted depth scale on the ultrasound image displays tick marks at 10 mm intervals.

Adjustment

Click "Depth" button and do sweeps on ultrasound image.

Relations to other controls

After adjusting the Depth you may need to adjust the Gain, TGC (Time Gain Compensation) and the Focus controls.

Smaller scanning depths usually allow you to achieve higher frame rates (FPS - Frames Per Second).

9.1.4. Dynamic Range

Description

Dynamic range is a measure of the ultrasonic device's ability to display both very weak and very strong signals at the same time while ensuring their levels can still be visually distinguished. The greater the dynamic range the better the above-mentioned ability. As a rule, every observation should be started using the maximum possible dynamic range since it provides you with the most complete diagnostic information. Narrowing or reducing the dynamic range leads to the echo image displaying more contrast. Dynamic Range is useful for optimizing tissue texture for different anatomical structures.

Values

The values available depend on the type of probe used. Measurement units used - decibels (dB).

Adjustment

Click "Dynamic Range" button and do sweeps on ultrasound image.

Hints

Adjust the Dynamic Range so that the highest amplitude edges appear as white while the lowest levels (such as for blood) are only just visible.

9.1.5. Power

Description

Power adjustment increases or decreases the acoustic power of the transmitted ultrasound signal. Larger power values allow you to increase the penetration depth and can help to achieve better image quality when observing tissues at greater depths.

Values

Available power values usually are in the interval [-20;0] dB. Measurement units used - decibels (dB).

Adjustment

Click "Power" button and do sweeps on ultrasound image.

Relations to other controls

After adjusting the Power level you may need to adjust the Gain. If you decrease the power level you may need to increase the gain. If you increase the power level you may need to decrease the gain.

Hints

Always optimize gain before increasing power levels.

Caution

Always use the lowest possible power value in order to reduce any possible negative effects on the patient. This is especially important when observing pregnant women and children.

9.1.6. Gain

Description

Gain adjustment increases or decreases the amplification of the returning ultrasound echo signal. Use this control to increase or decrease the amount of echo information displayed in the ultrasound image. Gain adjustment allows you to balance echo contrast so that cystic structures appear echo-free and reflecting tissues are filled in. Gain adjustment may brighten or darken the ultrasound image if sufficient echo information is generated.

Values

Gain values available are usually found in the interval 10-100%. Measurement units used - percentages (%).

Adjustment

Click "Gain" button and do sweeps on ultrasound image.

Relations to other controls

After adjusting the Gain you may need to adjust the Power level. If you increase the gain then you may need to decrease the power level. If you increase the power level you may need to decrease the gain. Please note that adjustments of the Gain control do not change the shape of the TGC (Time Gain Compensation) curve. Gain control adjusts overall gain while TGC controls adjust the gain at appropriate depths.

Hints

Always optimize gain before increasing the power level.

9.1.7. Change Scan Direction


Description

The Change Scan Direction (Reverse) control allows you to change the ultrasound scanning direction without rotating the probe. Use this feature when you wish to scan an anatomically correct ultrasound image without rotating the probe.

Adjustment

Click "Change Scan Dir." button.

Caution

When scanning, please observe the scan direction marker  that is painted on the ultrasound image in order to avoid any possible confusion.

9.1.8. Frequency

Description

Frequency is a characteristic that defines the resolution of ultrasonic signal. Higher frequencies increase resolution of the incoming ultrasonic signal but reduce the visibility of examined tissues at greater depths. In order to examine tissues found at small depths use larger frequencies and when examining tissues at greater depths it is better to use small frequencies.

Values

The frequency values available depend on the type of probe used. Measurement units used - megahertz (MHz).

Adjustment

Click "Frequency" button and do sweeps on ultrasound image.

9.1.9. Frame Averaging

Description

Frame averaging is an image processing technique that allows you to obtain smoother, softer images and reduces ultrasound image noise by averaging several sequential ultrasound image frames together. Use higher frame averaging values to obtain smoother images.

Values

The values available may differ depending on the type of probe but the following values are usually available: Off, 2, 3, ..., 8. These values mean the number of averaged frames. "Off" means that frame averaging is not used.

Adjustment

Click "Frame Averaging" button and do sweeps on ultrasound image.

Caution

Please note that higher frame averaging values not only make ultrasound images smoother but may also hide small image details. Frame averaging may slightly decrease the frame rate.

9.1.10. Rejection**Description**

Ultrasonic signal rejection is a processing that changes a range of the values of the ultrasonic signal received. Generally speaking, this processing is used to reduce visibility of noises on ultrasonic images.

Values

The range of values usually available is 0-32. The value means at what level the gray scale values are rejected. A value of 0 means that no rejection is performed. Higher values mean that more data is rejected.

Adjustment

Click "Rejection" button and do sweeps on ultrasound image.

9.1.11. Image Enhancement**Description**

Ultrasound images can be enhanced by using smoothing filters that remove noise or by using sharpening filters that enhance the tissue boundary visibility (e.g., for vessels).

Values

The software displays indexes of the image enhancement methods available. "Off" means that image enhancement is not used.

Adjustment

Click "Image Enhanc." button and do sweeps on ultrasound image.

Relations to other controls

Enabled image enhancement may reduce frame rate. If you want higher frame rates you may need to turn off the image enhancement.

9.1.12. Speckle Reduction**Description**

Speckle reduction is an image enhancement technique that reduces speckle noise and allows to view smoother ultrasound images.

Values

The software displays values that correspond to speckle filtration level.

Adjustment

Click "Speckle Reduction" button and do sweeps on ultrasound image.

Relations to other controls

Enabled speckle reduction may greatly reduce frame rate and slow down software operation. If your want higher frame rates, you may need to turn off the speckle reduction.

9.1.13. View Area**Description**

The View Area control adjusts the width of the field of view (scanning angle). Increase the view area to look at larger objects. You may reduce view area in order to obtain higher frame rate when observing fast moving tissues such as the heart.

Values

The range of values normally available is 50-100%. Measurement units used - percentages (%).

Adjustment

Click "View Area" button and do sweeps on ultrasound image.

9.1.14. Lines Density**Description**

Lines density adjusts the number of ultrasonic beams that are used for scanning ultrasound image. Use a higher density when you are viewing small objects. A lower density allows you to increase the frame rate and can be used when viewing fast moving objects (for example the heart).

Adjustment

Click "Lines Density" button and do sweeps on ultrasound image.

9.1.15. Map**Description**

The software allows to select gray/color map that defines how 256 input grayscale values from the interval [0;255] are transformed to output values. When is used linear map, output values are the same as input values (that is, no mapping is used).

Values

The software displays indexes of available maps. "1" means linear map.

Adjustment

Click "Map" button and do sweeps on ultrasound image.

9.1.16. *Gamma, Brightness, Contrast*

Description

The software allows you to adjust the ultrasound image palette using gamma, brightness and contrast controls. Gamma adjustment changes the gray scale values of the ultrasound image in a non-linear manner by raising the normalized values to the power of the chosen gamma value. To make the entire ultrasound image appear lighter you can increase the brightness value. By increasing the contrast value you can increase the difference between the image gray scale values and make the ultrasound image appear sharper.

Adjustment

Click "Palette", "Gamma", "Brightness" or "Contrast" button and do sweeps on ultrasound image. Gamma correction is not used if the level 1 is selected, brightness correction is not used if the level 0 is selected and contrast correction is not used if the level 0 is selected.

Hints

Before adjusting the ultrasound image Gamma, Brightness or Contrast, it is recommended that you perform the correct ultrasound image adjustment using the Gain, TGC, Power, and Dynamic Range controls.

9.1.17. *Negative*

Description

In order to invert the palette of the ultrasound image (change the dark gray scale values to light and vice versa) you can use the Negative control.

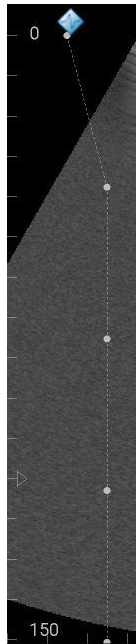
Adjustment

Click "Negative" button.

9.1.18. *Zoom*

To perform zoom in or zoom out of the B mode ultrasound image, touch B mode image with two fingers simultaneously and expanding/contracting them. When the image is zoomed and other scanning controls are not active, the image can be shifted by doing sweeps to any direction somewhere in the center of B mode image. Default zoom value (when no zoom is used) is 100%. In order to reset zoom to default, click on B mode ultrasound image. Zoom also can be done by clicking "Zoom" button (if available) and doing sweeps on ultrasound image.

9.1.19. TGC (Time Gain Compensation)



The Time Gain Compensation (TGC) controls adjust how returning signals are amplified in order to correct the attenuation that varies depending on the scanning depth and the tissue being observed. Using the TGC controls you can equalize amplification of the returning echo signal so that the density of echoes at different depths is similar. TGC allows you to control the gain level in several depth zones independently. TGC control points are spaced proportionally to the current scanning depth. Small circular markers on this curve correspond to the TGC control points.

Values

TGC values available are in the interval 0-100% (in software they are not shown). Measurement units used - percentages (%).

Adjustment

When scanning controls are not active, press and hold for several seconds on ultrasound image (at any depth) at the right of depth scale line to show TGC curve. Then, while TGC curve is visible, do horizontal sweeps on ultrasound image at desired to change TGC control points (depth) that are painted as small circular markers. Software will automatically hide TGC curve when it is not changed for some time.

Relations to other controls

To adjust the overall gain use the B mode Gain control. After adjusting the Depth you may need to adjust the TGC.

9.2. Adjusting M Mode Controls

Line Position 37	Sweep Speed : 4.00 s	Rejection 5
Map : 1	Gamma 1.00	Brightness 0 %
Contrast 0 %	Negative No	

9.2.1. M-line Position

Description

The M-line (M-cursor) position determines which scan line is used for M mode information obtained.

Adjustment

Click at desired position on B mode image when M-line is painted on it and when controls of other scanning parameters are not active.

9.2.2. Sweep Speed

Description

Sweep speed determines how fast the M mode image (timeline) sweeps and changes the frequency of acquisition of the M mode beams. Smaller time values mean that the M image will be filled at a faster rate while greater time values mean that the M image will be filled at a slower rate.

Values

Values depend on the used scanner and ultrasound output width. Measurement units used - seconds (s).

Adjustment

Click "Sweep Speed" button and do sweeps on ultrasound image.

9.2.3. Rejection

Description

Ultrasonic signal rejection is a type of processing that changes a range of values of the ultrasonic signal received. Generally speaking, this processing is used to reduce the visibility of ultrasonic image noise.

Values

The range of values normally available is 0-32. The level 0 means that rejection is not used.

Adjustment

Click "Rejection" button and do sweeps on ultrasound image.

9.2.4. Map**Description**

The software allows to select gray/color map that defines how 256 input grayscale values from the interval [0;255] are transformed to output values. When is used linear map, output values are the same as input values (that is, no mapping is used).

Values

The software displays indexes of available maps. "1" means linear map.

Adjustment

Click "Map" button and do sweeps on ultrasound image.

9.2.5. Gamma, Brightness, Contrast**Description**

The software allows you to adjust the ultrasound image palette using gamma, brightness and contrast controls. Gamma adjustment changes the gray scale values of the ultrasound image in a non-linear manner by raising the normalized values to the power of the chosen gamma value. To make the entire ultrasound image appear lighter you can increase the brightness value. By increasing the contrast value you can increase the difference between the image gray scale values and make the ultrasound image appear sharper.

Adjustment

Click "Palette", "Gamma", "Brightness" or "Contrast" button and do sweeps on ultrasound image. Gamma correction is not used if the level 1 is selected, brightness correction is not used if the level 0 is selected and contrast correction is not used if the level 0 is selected.

Hints

Before adjusting the ultrasound image Gamma, Brightness or Contrast, it is recommended that you perform the correct ultrasound image adjustment using the Gain, TGC, Power, and Dynamic Range controls.

9.2.6. Negative**Description**

In order to invert the palette of the ultrasound image (change the dark gray scale values to light and vice versa) you can use the Negative control.

Adjustment

Click "Negative" button.

9.3. Adjusting Pulsed Wave (PW) Doppler Mode Controls

Auto	PRF : 3.0 kHz	Gain 80 %
Power -20 dB	Steering Angle : 0 %	Correction Angle 0 %
Baseline 128	Invert No	Sweep Speed : 2.0 s
Scale : 5	Wall Filter : 4 %	Frequency : 5.3 MHz
Line Position	SVL Size : 3 mm	SVL Position 8 mm
Dynamic Range : 50 dB	Smoothing : 0	Spectral Averaging No
Map 1	Negative No	Sound Volume : 64 %

9.3.1. Sample Volume Position and Size

Description

The sample volume position and size controls allow to adjust the location and size of the PW Doppler region being examined so that you can place it at position where the anatomical structure of interest is located. The sample volume is displayed along the scan line as two parallel lines. Smaller sample volume gates produce accurate sampling results because it is more sensitive. You can also enlarge the gate to hear the Doppler audio better or for sampling large vessels or areas.

Values

Sample volume size values are usually in the interval 1-10 mm but this may vary depending on the beamformer and probe used. Sample volume size measurement units used - millimeters (mm).

Adjustment

To change sample volume position, press-move-release on B mode image when PW-line is painted on it and scanning controls are not active.

Position also can be changed by clicking “Line Position” or “SVL Position” controls and doing sweeps on ultrasound image.

To change sample volume size, click “SVL Size” button and do sweeps on ultrasound image.

Relations to other controls

Changes to the PW sample volume size and position may automatically change the Power value and the available list of PRF values.

When a sample volume position or size is changed, the cine memory is cleared.

9.3.2. PRF (Pulse Repetition Frequency)

Description

Pulse Repetition Frequency (PRF) adjustment changes the displayed velocity range. The velocity range is shown in kHz. The PRF should be set high enough to prevent aliasing. If the blood is moving faster than the pulse repetition rate the Doppler display will alias, or wraparound the baseline. If the PRF is set too high, low velocity flows may not be visible. It may be necessary to vary the PRF during an examination depending on the speed of the blood flow.

Values

PRF values available are in the interval 1-10 kHz. The values available depend on the scanning mode and depth. Measurement units used - kilohertz (kHz).

Adjustment

To change value, click "PRF" button and do sweeps on ultrasound image. If are required higher PRF values, in B+PW mode click "B+PW" button to make B frozen and PW running or use PW mode where only PW image is shown. When scanning controls are not active, PW PRF also can be changed by doing vertical sweeps at the right of vertical PW velocity scale line.

Relations to other controls

Changing the PRF may affect the frame rate, the Power and the Wall Filter. When the PRF is changed, the cine memory is cleared.

To perform automatic PW PRF and Baseline adjustment, click "Auto" button. During image optimization hold the probe still on a vessel and do not move it.

Hints

Always optimize acoustical Power output after increasing the PRF.

9.3.3. Gain

Description

Gain adjustments increase or decrease the amplification of the returning ultrasound echo signal. The Gain should be set high enough in order to achieve a sufficiently bright spectral waveform but not too high in order to avoid Doppler image noise.

Values

Gain values available are usually in the interval 10-100%. Measurement units used - percentages (%).

Adjustment

Click "Gain" button and do sweeps on ultrasound image.

Relations to other controls

After adjusting the Gain you may need to adjust the Power. If you increase the gain, the power level can usually be reduced to produce equivalent image quality.

Hints

Always optimize gain before increasing the power.

9.3.4. Power

Description

Power adjustments increase or decrease the acoustic power of the ultrasound signal.

Values

Power values available are usually in the interval from -20 to 0 dB. Measurement units used - decibels (dB).

Adjustment

Click "Power" button and do sweeps on ultrasound image.

Relations to other controls

After adjusting the Power you may need to adjust the Gain. If you decrease the power you may need to increase the gain. If you increase the power you may need to decrease the gain.

Hints

Always optimize the gain before increasing the power. Use Power values that are as low as possible.

9.3.5. Correction Angle

Description

The Correction Angle adjusts the accuracy of the displayed flow velocity values. The direction of the correction angle marker must correspond with the blood flow direction. Before performing any PW measurements you must at first set the correct Correction Angle value.

Values

Values are in the interval [-84, 84]. Measurement units used - degrees (^o).

Adjustment

Click "Correction Angle" button and do sweeps on ultrasound image.

Relations to other controls

Changes to the Correction Angle values also change the velocity scale line of the PW image. The Correction Angle must be adjusted before performing any PW measurements.

Hints

It is recommended that you use probe positions that require that you use absolute correction angle values less than 60 degrees in order to get more accurate measurement and calculation results.

9.3.6. Steering Angle

Description

Steering Angle adjustment for linear probe steers the Doppler cursor by selected number of degrees to the left/right. This steering may be used to achieve the desired angle between the Doppler beam and the flow.

Values

Available Steering Angle values depend on the used hardware. Usually available values are from 0 to ± 25 degrees. Measurement units used - degrees ($^{\circ}$).

Adjustment

Click "Steering Angle" button and do sweeps on ultrasound image.

9.3.7. Invert**Description**

Invert performs vertical inversion of the spectral waveform. After inversion positive velocities will be displayed below the baseline and negative velocities will be displayed above the baseline.

Adjustment

Click "Invert" button.

9.3.8. Baseline**Description**

Baseline adjustments increase or decrease the part of the PW Doppler data displayed as corresponding to positive (forward flow) or negative (reverse flow) velocity. The change to the Baseline allows you to minimize aliasing by displaying a greater range of forward flow with respect to reverse flow, or vice versa. The default baseline is at the midpoint of the spectrum. Baseline is displayed as a horizontal line along the PW waveform.

Values

Baseline values available are usually in the interval 0-255. This value is non-dimensional.

Adjustment

Click "Baseline" button and do sweeps on ultrasound image. When scanning controls are not active, PW baseline also can be changed by doing vertical sweeps along vertical PW scale line.

Relations to other controls

To perform automatic PW PRF and Baseline adjustment click "Auto" button.

9.3.9. Dynamic Range**Description**

Dynamic Range controls how echo intensities are converted into various shades of gray.

Values

Available Dynamic Range values are usually in the interval 10-80 dB. Measurement units used - decibels (dB).

Adjustment

To change value, click "Dynamic Range" control and do sweeps on the ultrasound image.

Relations to other controls

After adjusting the Dynamic Range you may need to adjust the Gain or the Scale. If you increase the Dynamic Range you may need to decrease the Gain or the Scale in the case of noisy Doppler images.

9.3.10. Wall Filter**Description**

Wall Filter adjustments increase or decrease the cut-off frequency of the Wall Filter (High Pass Frequency Filter) which eliminates the unwanted low-frequency, high-intensity signals from tissues or wall motion. Increasing the wall filter reduces the display of low velocity tissue motion. Lowering the wall filter displays more information but more wall tissue motion will however be displayed.

Values

Wall Filter available values are usually in the interval 2-20% of PRF. Measurement units used - percentages (%) of PRF.

Adjustment

Click "Wall Filter" button and do sweeps on ultrasound image.

Hints

Use a wall filter level that is high enough to remove clutter but low enough to display sufficient Doppler information.

9.3.11. Sweep Speed**Description**

Sweep speed determines how fast the PW mode image (timeline) is swept and changes the frequency of acquisition of PW mode beams. Smaller time values mean that the PW image will be filled at a faster rate, and larger time values mean that the PW image will be filled at a slower rate. Fast speeds display fewer waveforms over time but waves with more detail.

Values

Values depend on the scanner and display settings used (that change ultrasound output width). Measurement units used - seconds (s). Smaller values mean faster updating of PW image.

Adjustment

Click "Sweep Speed" button and do sweeps on ultrasound image.

Relations to other controls

When the Sweep Speed value is changed, the cine memory is cleared.

9.3.12. Scale**Description**

Scale adjustments increase or decrease the level of power that is visualized.

Values

Scale values available are usually in the interval 0-15. This value is non-dimensional.

Adjustment

Click "Scale" button and do sweeps on ultrasound image.

Relations to other controls

After adjusting the Scale you may need to adjust the Gain. If you reduce the scale you may need to increase the gain. If you increase scale you may need to reduce the gain.

9.3.13. *Sound Volume***Description**

The Sound Volume control allows you to adjust the level of audio output. In order to hear sound, you mobile device (phone/tablet) must have speakers, and media sounds must not be muted.

Values

The Sound Volume values available are in the interval 10-100%. Measurement units used - percentages (%).

Adjustment

Click "Sound Volume" button and do sweeps on ultrasound image.

9.3.14. *Frequency***Description**

Frequency is a characteristic that defines the resolution of an ultrasonic signal. Higher frequencies increase the resolution of the incoming ultrasonic signal but reduce visibility of examined tissues at greater depths. To examine tissues at smaller depths use greater frequencies and to examine tissues which are at greater depths use smaller frequencies.

Values

Available frequency values depend on the type of probe and beamformer used. Measurement units used - megahertz (MHz).

Adjustment

Click "Frequency" button and do sweeps on ultrasound image.

9.3.15. *Smoothing***Description**

Smoothing allows you to obtain smoother Doppler images. Larger values mean smoother images.

Values

The values available depend on the beamformer and probe used. This value is non-dimensional.

Adjustment

To adjust the smoothing level, click “Smoothing” control and do sweeps on the ultrasound image.

9.3.16. *Spectral Averaging*

Description

Spectral averaging allows to obtain smoother Doppler images.

Adjustment

In order to turn on/off spectral averaging,click “Spectral Averaging” button.

9.3.17. *Color Map*

Description

Allows you to select a specific PW color map.

Adjustment

Click “Color Map” button and do sweeps on ultrasound image. To invert colors of a current color map, click “Negative” button.


9.3.18. *Auto*

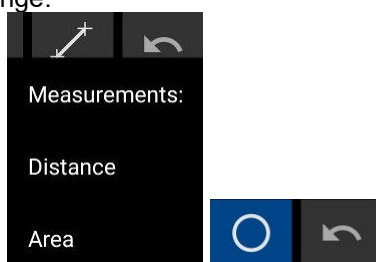
To perform automatic PW PRF and Baseline adjustment click "Auto" button. During image optimization hold the probe still on a vessel and do not move it.

10. Measurements and Calculations

This section describes the user interface for measurements and calculations. For equations and references please see the "Echo Wave A Software Reference Manual".



In order to perform measurements, scan ultrasound image of desired mode, freeze ultrasound by clicking "Freeze/Run" button, click measurement button , do measurement by clicks/moves on the ultrasound as will be described in next sections. To change measurement type, press and hold measurement button and from appeared "Measurements" menu select desired measurement type (e.g., Area). Button image and measurement type will change.





For equations of calculations please see software Reference Manual.

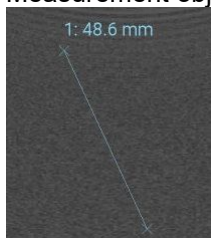
10.1. B Mode Measurements

10.1.1. Distance

To measure distance, perform the following actions:

1. Click "Distance" button . Button color is changed .
2. Press and move with finger on the B mode ultrasound image in order to set position of first point. When done, release finger. That is, do operation that in the future will be called press-move-release.
3. Press-move-release on the B mode ultrasound image to set second point and finish measurement.
4. Optionally, perform another measurement of the same type by repeating steps 2-3.

Measurement object and result:





At first endpoint is displayed measurement number ("1:") and measurement result ("48.6 mm").

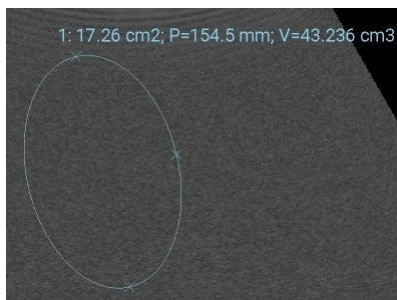
Please note that when measurement operation is in progress, painted measurement object has different color than when measurement is finished.

10.1.2. Area, Circumference and Volume using Ellipse

To measure area, circumference and volume using ellipse, perform the following actions:

1. Click “Area (Ellipse)” button  (or select it from measurements menu). Button color is changed .
2. Press-move-release on the B mode ultrasound image to set first point (long axis).
3. Press-move-release to set second point (long axis).
4. Press-move-release to set third point (short axis) and finish measurement.
5. Optionally, perform another measurement of the same type by repeating steps 2-4.

Measurement object (ellipse) and result:





At first endpoint is displayed measurement number (“1:”) and measurement result: “17.26 cm²” area, “P=154.5 mm” circumference and “V=43.236 cm³” volume.

Please note that for ellipse long axis (first axis) are marked two endpoint markers, while for short axis (second axis) is marked only one endpoint.

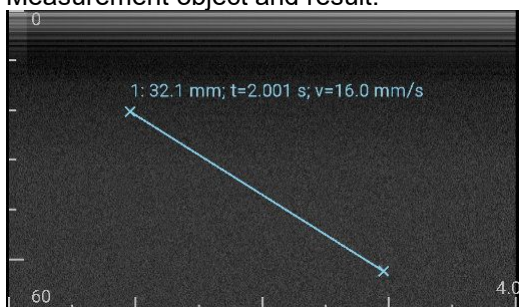
10.2. M Mode Measurements

10.2.1. Distance, Time, Velocity

To measure distance, perform the following actions:

1. Click “Distance” button . Button color is changed .
2. Press and move with finger on the M mode ultrasound image in order to set position of first point. When done, release finger. That is, do operation that in the future will be called press-move-release.
3. Press-move-release on the M mode ultrasound image to set second point and finish measurement.
4. Optionally, perform another measurement of the same type by repeating steps 2-3.

Measurement object and result:




At first endpoint is displayed measurement number (“1:”) and measurement result (“32.1 mm; t=2.001 s; v=16.0 mm/s”), where 32.1 mm is depth along y axis, t=2.001 s is time along x axis, and v=16.0 mm/s is velocity.

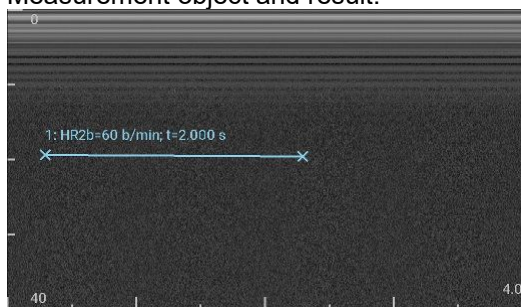
Please note that when measurement operation is in progress, painted measurement object has different color than when measurement is finished.

10.2.2. Heart Rate

To measure Heart Rate (HR), perform the following actions:

1. Click “Heart Rate” button  or select Heart Rate from measurements menu.
2. Press-move-release on the M mode ultrasound image to set position of first point.
3. Press-move-release on the M mode ultrasound image to set second point to span two beats interval.
4. Optionally, perform another measurement of the same type by repeating steps 2-3.

Measurement object and result:




At first endpoint is displayed measurement number (“1:”) and measurement result (“HR2b=60 b/min; t=2.000 s”), where 60 b/min is calculated heart rate (“HR”) assuming that was measured 2 beats interval (“2b”), t=2.000 s is measured time along x axis.

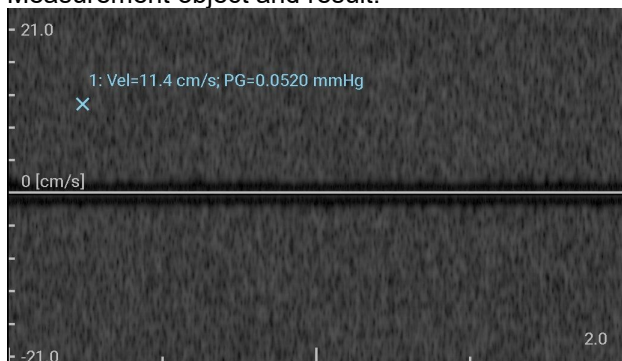
10.3. PW Mode Measurements

10.3.1. Velocity and Pressure Gradient (PG) using One Point

To measure Velocity and Pressure Gradient (PG) perform the following actions:

1. In “Measurements” menu click PW “Point”  menu item.
2. Press-move-release on the PW mode ultrasound image to set point and finish measurement.
3. Optionally, perform another measurement of the same type by repeating step 2.


Measurement object and result:



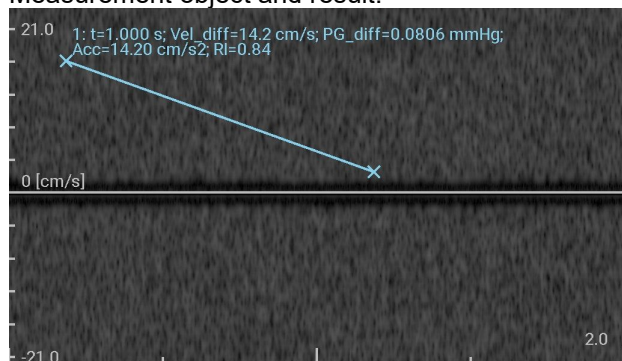
At first endpoint is displayed measurement number (“1:”) and measurement results: velocity Vel=11.4 cm/s and pressure gradient PG=0.0520 mmHg.

10.3.2. Velocities difference, Pressure Gradients (PG) difference, Times difference, Acceleration, and Resistivity Index (RI) using One Distance (Two Points)

To measure times difference, velocities difference, Pressure Gradients (PG) difference, acceleration, and Resistivity Index (RI), perform the following actions:

1. In “Measurements” menu click PW “Distance”  menu item.
2. Press-move-release on the PW mode ultrasound image to set first distance point.
3. Press-move-release to set second distance point and finish measurement.
4. Optionally, perform another measurement of the same type by repeating steps 2-3.


Measurement object and result:



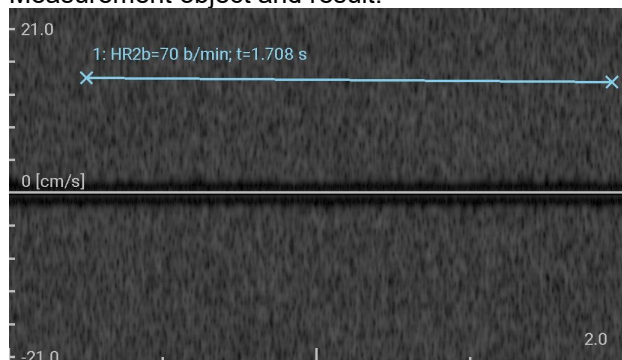
At first endpoint is displayed measurement number (“1:”) and measurement results: time difference along horizontal time axis $t=1.000$ s, the difference of endpoints velocities along vertical velocity axis $Vel_diff=14.2$ cm/s, endpoints pressure gradients difference $PG_diff=0.0806$ mmHg, acceleration $Acc=14.20$ cm/s², resistivity index $RI=0.84$.

10.3.3. Heart Rate (HR) using One Distance (Two Points)

To measure Heart Rate (HR), perform the following actions:


1. Click “Heart Rate” button  or select Heart Rate from measurements menu.
2. Press-move-release on the PW mode ultrasound image to set position of first point.
3. Press-move-release on the PW mode ultrasound image to set second point to span two beats interval.
4. Optionally, perform another measurement of the same type by repeating steps 2-3.

Measurement object and result:






At first endpoint is displayed measurement number (“1:”) and measurement result (“HR2b=70 b/min; $t=1.708$ s”), where 70 b/min is calculated heart rate (“HR”) assuming that was measured 2 beats interval (“2b”), and $t=1.708$ s is a measured time along x axis.

10.4. Deleting Performed Measurements

To delete measurement, click “Delete” (“Undo”) button . Measurements are deleted one by one starting from last done measurement.

11. Saving and Loading Images and Cines


To save ultrasound image, click "Save Image" button . Images (in JPG format) are saved to "Internal Storage>Pictures".

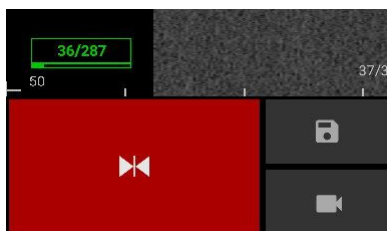
To record cine, unfreeze ultrasound, click "Record" button . To stop recording, click "Stop" button . Video files (in MP4 format) are saved to "Internal Storage>Movies".

While recording, the software shows indicator with the number of recorded frames (e.g., 105) in cine buffer and buffer fill progress bar in red color. Recording is done to cine memory. When buffer is full, recording is stopped. Buffer size is specified at options ("MP4 video recording buffer size").



In M/PW modes, while recording, are counted M/PW frames that consist of several lines (e.g., 20).

After click on "Stop" button , the software saves data from cine memory to disk. Saving progress is shown as the number of saved frames (e.g., 36), the number of recorded frames (e.g., 287) and progress bar in green color.



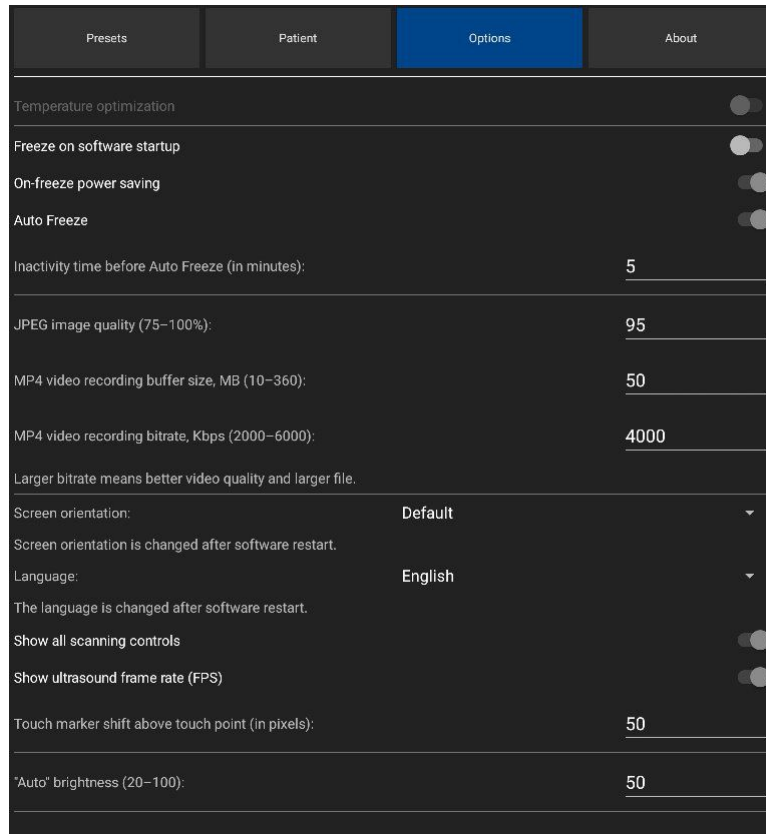
After writing file to disk, indicator disappears.


Please note that both JPG and MP4 formats are lossy.

Maximal allowed cine buffer size is calculated taking into account how much memory (e.g., 512 MB) in Android operating system can be used by the app.

Saved images and videos can be viewed using Android Gallery (when ultrasound scanning software is closed) and any viewer that supports above mentioned image/video formats. File names are generated by patient ID (if entered) and saving/recording date and time.

12. Options



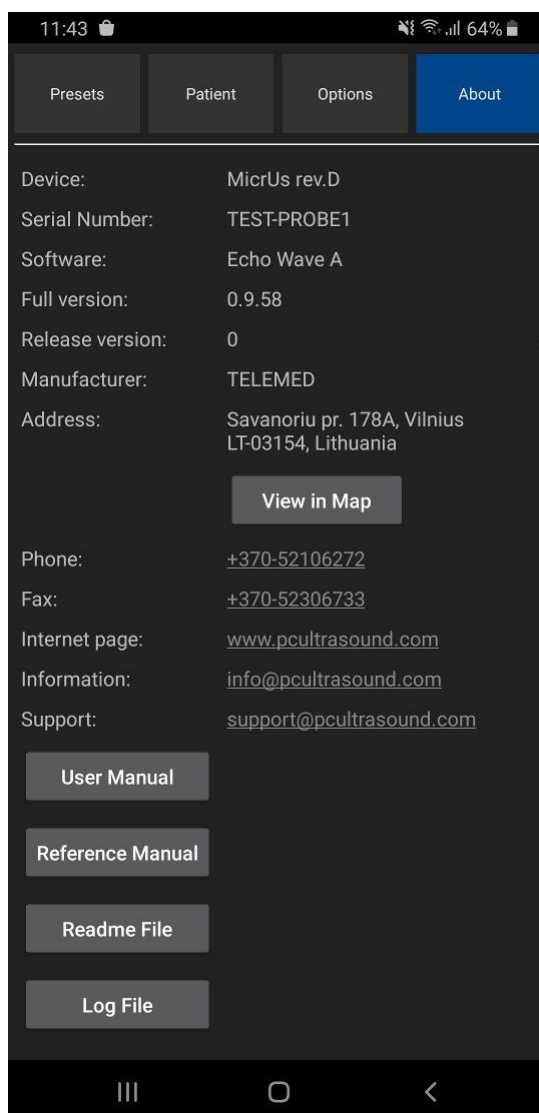
To adjust software options, open the Settings window by clicking on the "Settings" button , then click "Options" button at the top.


Below is description of options.

- **Temperature optimization**
Turns on/off temperature optimization if connected device supports this feature.
- **Freeze on software startup**
If turned on, freezes ultrasound scanning on software startup. Otherwise after software startup ultrasound scanning is running.
- **On-freeze power saving**
If this option is turned on and is clicked button to freeze ultrasound scanning, software turns off power of ultrasound device. After clicking button to run ultrasound scanning, device is powered on.
This feature allows to save mobile device battery power and prolong scanning, but requires longer time to unfreeze ultrasound.
- **Auto Freeze**
If this feature is turned on, ultrasound scanning is automatically frozen after some time of inactivity. Inactivity means that the user does not perform any clicks/adjustments. Required inactivity time before automatic freeze is entered in textbox below. This feature allows to save power and prolong probe lifetime.
- **JPEG image quality**
This option allows to adjust the quality of saved JPEG images. Larger value means better quality, but larger file size. Smaller value means smaller file size, but also worse image quality.
- **MP4 video recording buffer size**
This option allows to specify cine buffer size in megabytes (MB).

- **MP4 video recording bitrate**
This option allows to adjust the quality of recorded MP4 video files. Larger value means better quality, but larger file size. Smaller value means smaller file size, but also worse quality.
- **Screen orientation**
This option allows to fix screen orientation and software layout in portrait or landscape position (“Portrait” and “Landscape” selections) or change layout during operation if is rotated mobile device (“Default” selection). “Reverse” selections change at what device border is assumed bottom.
This option takes effect after software restart.
- **Language**
This option allows to change software user interface language. The option takes effect after software restart.
- **Show all scanning controls**
If this option is turned on, the software shows all scanning controls. Otherwise are shown several basic controls and control that can be customized.
- **“Auto” brightness**
If this option allows to fine tune image brightness when is used automatic image optimization (“Auto” button).
- **Fix scan direction**
This option allows to make on-screen scan direction marker match on-probe marker if by default they differ.
- **GPU Speckle Reduction**
If this option is turned on, for speckle reduction is used GPU (Graphics Processing Unit). Otherwise is used CPU (Central Processing Unit).
- **Start app on device connection**
If this option is turned on, the app is started when ultrasound scanner is connected to USB port. Otherwise to start the app you need to click its icon.

13. About



To view software "About" information (version, manufacturer, readme file), open the Settings window by clicking on the "Settings" button , then click "About" button at the top. In this window is also shown ultrasound device name and serial number.

By clicking buttons in this window you can view software user manual, reference manual, readme file, software operation log file.

For viewing user manual and reference manual, mobile device must have installed software that is registered to open PDF files.

14. Error Messages

This section contains the list of software error messages and their descriptions.

- **No Probe**
This text is displayed instead of probe name if the software cannot detect connected device/probe.
- **Probe Data Error**
This text is displayed instead of probe name if read probe data contains errors. This means that either happened errors during USB communication or probe data is really corrupted.
- **Unsupported Probe**
This text is displayed instead of probe name if the probe is not supported by software or its current version. Please use supported probes or check for updated software that supports your probe.
- **Cannot find connected USB devices**
The list of connected USB devices, that software received from Android system, is empty. Please use mobile devices that are listed in software readme as supporting ultrasound scanner.
- **Cannot find supported USB device**
The software does not support connected USB device. Please use devices that are supported by software or update software if device should be supported.
- **Device initialization error**
This error means that either happened errors in USB communication or device needs repair.
- **USB data communication error**
This error message means that happened ultrasound data transfer errors.
- **Probe not connected or cannot read its data**
This message means that failed attempt to read data from probe either because the probe is disconnected or happened some reading error.
- **USB control communication error**
This error message means that happened errors when passing USB control commands to device. May be shown if device was disconnected from USB port while scanning.
- **Error. Cannot save image.**
Image cannot be saved to disk. This can happen if the software does not have write permissions or there is not enough space on disk.
- **Saving will not work. For proper software operation is required write permission.**
This message appears if software request for write permissions was canceled by the user. For saving to work, please grant write permissions when requested.
- **Error. Cannot save preset.**
Preset cannot be saved to disk. This message appears when is saved preset. Error can happen if the software does not have write permissions or there is not enough space on disk.
- **Error. Preset name cannot be empty.**
This message appears if is clicked preset saving button without entering preset name. Please enter preset name and only then save it.
- **Error. Cannot overwrite built-in preset.**
The software has built-in scanning presets that cannot be overwritten. When saving custom preset, please enter its name that differs from the names of built-in presets.
- **Recording is not supported**
This message appears when recording is started if the software does not have write permissions or cannot initialize video encoder.

- **Recording Error**
Error happened while recording video. This may happen if there is not enough disk space. Please free up some space on disk to be able to record videos.
- **Error. Cannot view file.**
This error is shown if the system does not have software that is registered to view PDF files. Please install required software (e.g., Acrobat Reader).

15. System Requirements

Requirements for system operation are as follows:

- Mobile phone or tablet computer
- Android operating system (versions from 9.0 to 13.0)
- OpenGL ES 3.2 support
- USB OTG (USB On-The-Go) port (Type-C or Micro USB)
- Quad-core (> 2 GHz) or faster CPU
- 4 GB or more RAM
- 32 GB or larger storage
- 4000 mAh or larger capacity battery
- 5-inch 1080x1920 pixels or larger display
- Connected MicrUs EXT-1H ultrasound scanner with supported probe or MicrUs Pro series USB probe

Note. The software by default is used in portrait screen orientation.

16. Troubleshooting

In the event of any problems when using the "Echo Wave A" software, please do the following:

1. Make software screenshot (check user manual of your phone/tablet how to do this) or photo.
2. Copy software log file "log.txt" from "Internal Storage>Documents>EchoWaveA".
3. Write down serial numbers of used ultrasound scanner and probe.
4. Write down phone/tablet model.
5. Describe the problem and steps to reproduce it.
6. Send all above mentioned information to support@pcultrasound.com

17. Frequently Asked Questions (FAQ)

This section contains answers to the most commonly asked questions regarding the "Echo Wave A" software.

17.1. Opening "Echo Wave A" and setting its patient ID from other app

Question:

How to open "Echo Wave A" and set its patient ID from my own app?

Answer:

If you develop your own app and want to open "Echo Wave A" and pass patient ID, use the following Java code:

```
try
{
    JSONObject patient_obj = new JSONObject();
    patient_obj.put("id", "ABC123"); // here ABC123 is patient ID
    JSONObject main_obj = new JSONObject();
    main_obj.put("patient", patient_obj);

    String str = main_obj.toString();

    Intent sendIntent = new Intent();
    sendIntent.setAction(Intent.ACTION_SEND);
    sendIntent.putExtra(Intent.EXTRA_TEXT, str);
    sendIntent.setType("text/json");
}
```

```

//Intent shareIntent = Intent.createChooser(sendIntent, null);
//startActivity(shareIntent);

String type = "echowavea";
boolean found = false;
List<ResolveInfo> resInfo = getPackageManager().queryIntentActivities(sendIntent, 0);
if (!resInfo.isEmpty())
{
    for (ResolveInfo info : resInfo)
    {
        if (info.activityInfo.packageName.toLowerCase().contains(type)
            || info.activityInfo.name.toLowerCase().contains(type) )
        {
            sendIntent.setPackage(info.activityInfo.packageName);
            found = true;
            break;
        }
    }
    if (!found)
        return;

    startActivity(Intent.createChooser(sendIntent, null));
}
}
catch (Exception e)
{
    e.printStackTrace();
}

```

On Android 11 and later, to you application manifest you will need to add the following query:

```

<manifest ...>
...
<queries>
<package android:name="It.Telemed.EchoWaveA"/>
</queries>
...
</manifest>

```

18. References

1. Echo Wave A Software Reference Manual.
File: "EchoWaveA_Software_Reference_Manual.*".

19. Revision History

Revision	Revision Date	Description of Revision	Revision Author
1.0.0	2019.10.07	Initial Release	V.Perlibakas
1.1.0	2020.02.11	Added information about speckle reduction.	V.Perlibakas
1.1.1	2020.05.14	Changed first page photo.	V.Perlibakas
1.2.0	2020.06.18	Added information about "Settings" window.	V.Perlibakas
1.2.1	2020.07.02	Updated "About" image and its description.	V.Perlibakas
1.3.0	2020.07.23	Added section "Automatic image optimization"	V.Perlibakas
1.4.0	2020.08.11	Added information about M mode, its controls and measurements.	V.Perlibakas
1.4.1	2020.08.13	Added section "Heart Rate".	V.Perlibakas
1.4.2	2020.08.14	Updated images of scanning mode buttons.	V.Perlibakas

Revision	Revision Date	Description of Revision	Revision Author
1.5.0	2020.08.25	Added section "Error Messages".	V.Perlibakas
1.6.0	2020.09.14	Updated information related to GUI layout and options.	V.Perlibakas
1.6.1	2020.09.18	Added information about View Area control.	V.Perlibakas
1.6.2	2021.06.10	Updated "About" information, internet page, E-mail.	V.Perlibakas
1.7.0	2022.09.29	Added information about PW mode.	V.Perlibakas
1.7.1	2022.12.08	Updated company information.	V.Perlibakas
1.7.2	2023.02.13	Updated section "Selecting Ultrasound Scanning Mode".	V.Perlibakas
1.7.3	2023.02.23	Added information about "Fix scan direction" option.	V.Perlibakas
1.7.4	2023.03.16	Added information about "Start app on device connection" option. Added section "Adjusting Mobile Device not to be Disturbed While Scanning".	V.Perlibakas
1.7.5	2023.03.30	Added "Frequently Asked Questions (FAQ)" section.	V.Perlibakas

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