

# MicrUs and MicrUs Pro Series Ultrasound Systems

## Echo Wave A Software

### User Manual



**TELEMED**  
Ultrasound Medical Systems

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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" or simply "software".

**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.**

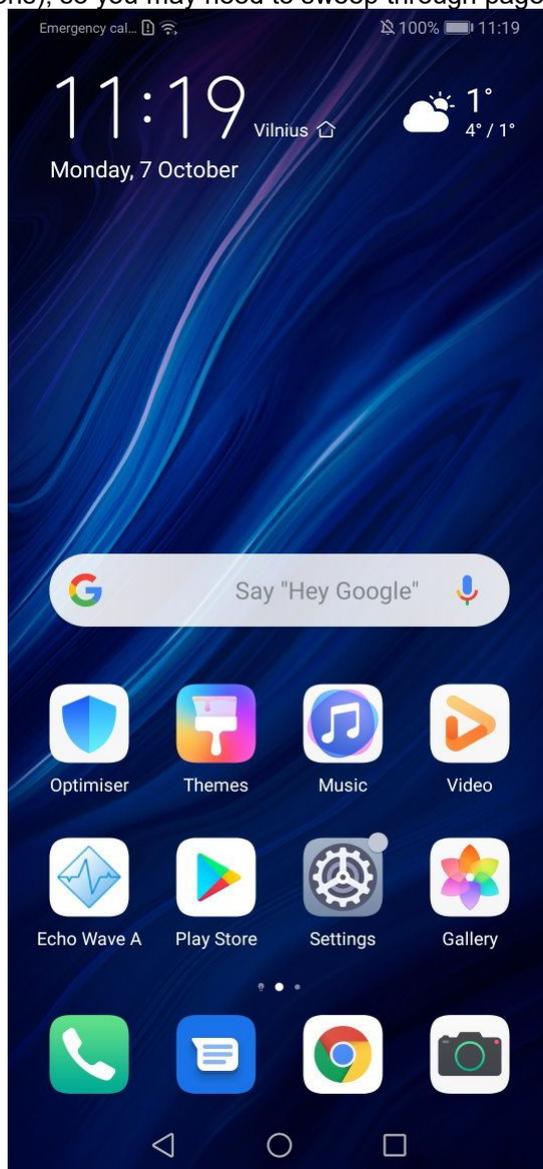
**In addition, before using this software you must be familiar with the use of Android 6.0 or more recent operating system and mobile phone or tablet computer that has installed this operating system.**

## 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.



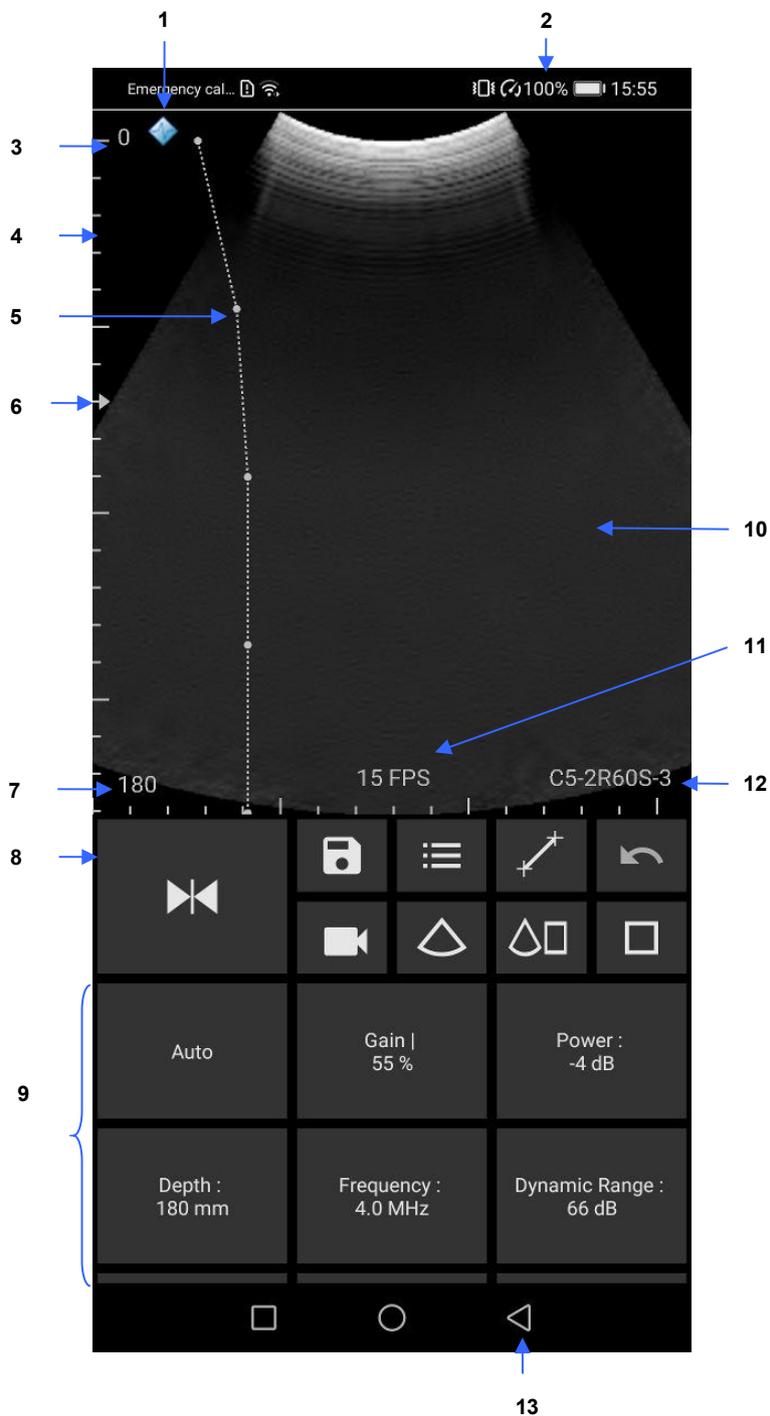
3. After click you should see ultrasound software user interface.

### 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".

### 3. Software User Interface Structure

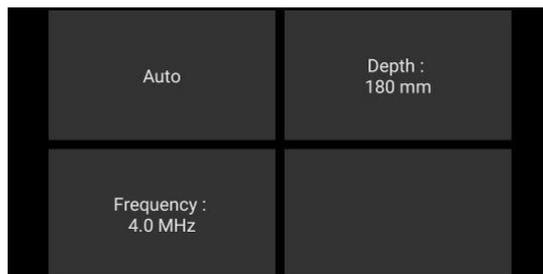
#### 3.1. Main Window



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, measure area (using ellipse), delete measurements, change scanning modes.
9	Ultrasound scanning controls (Gain, Power, Depth and others). This area can be scrolled up/down.
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.

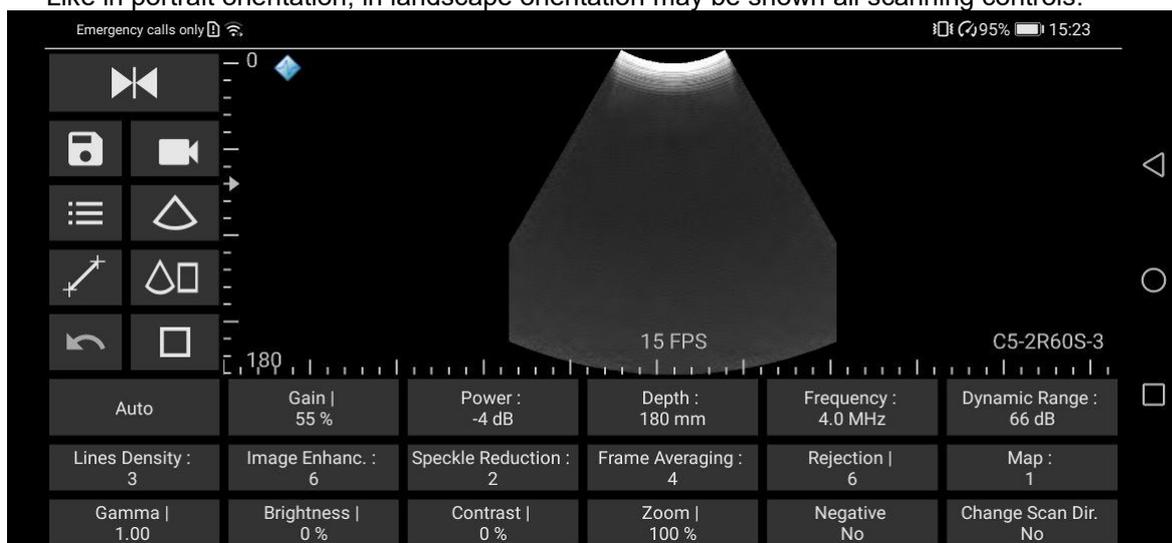


Control at right-bottom corner is customizable. To set its value, press and hold this button and from appeared menu select desired to control parameter.

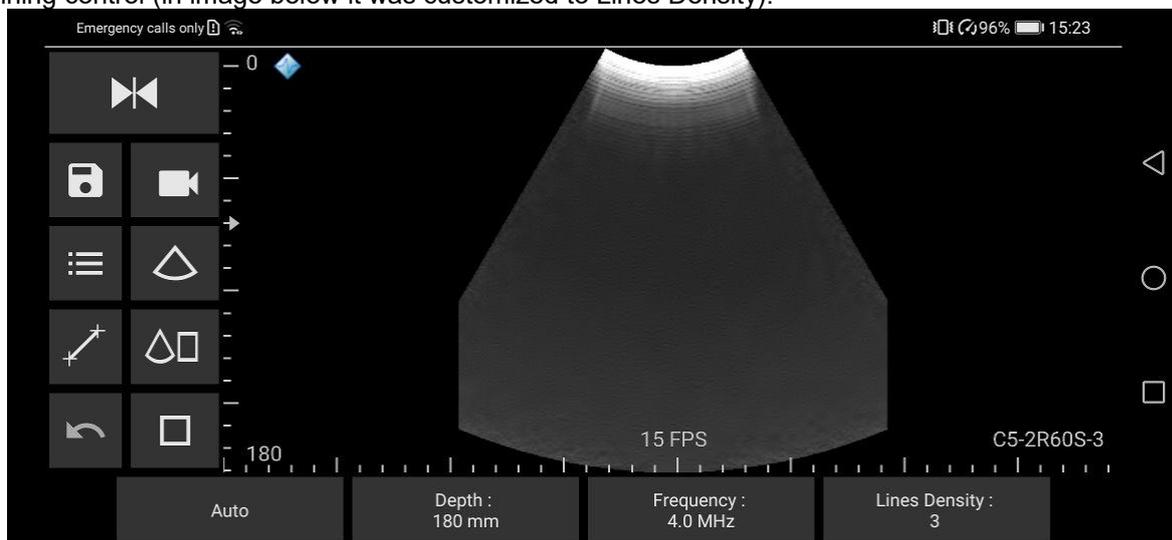


If is used landscape screen orientation, software user interface slightly differs from portrait interface, but basic functionality is similar to portrait.

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

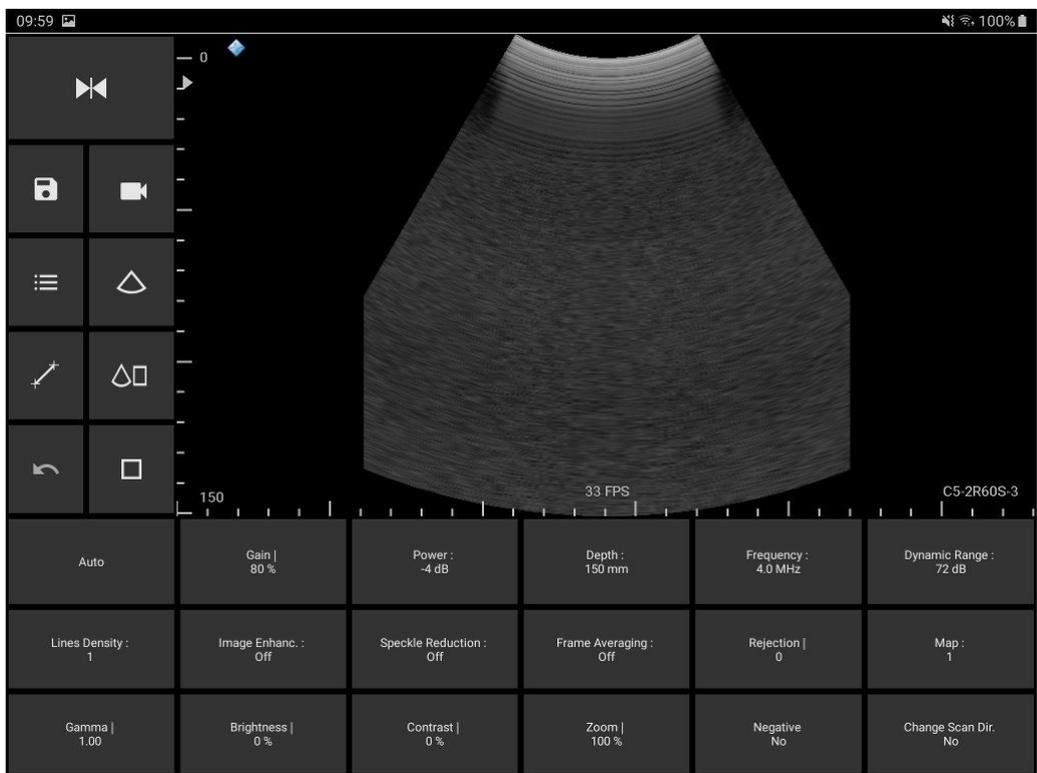
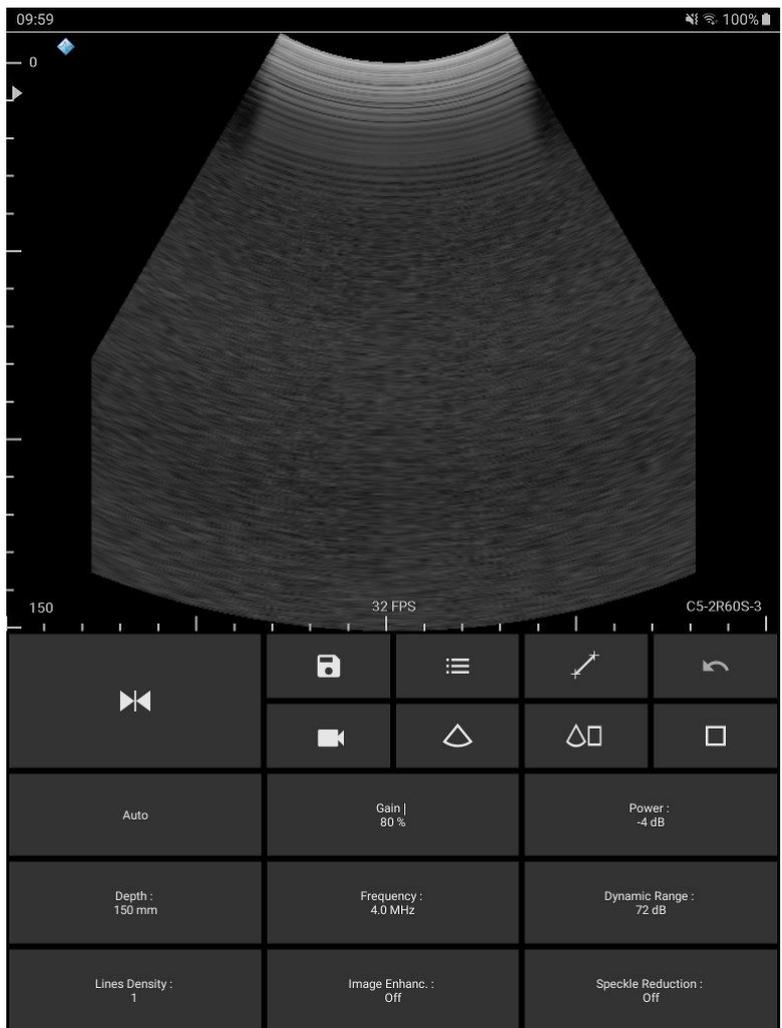


Or in landscape orientation may be shown smaller number of controls with customizable right most scanning control (in image below it was customized to Lines Density).



The software supports different screen sizes/resolutions and, depending on display, controls may look slightly different. Above screenshots correspond to 6.1 inch, 1080x2340 pixels, 480 DPI display.

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



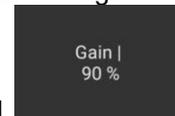
### 3.2. Types of Controls

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

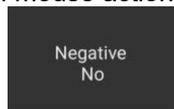


some time of inactivity, parameter change mode is turned off and button color is restored. While parameter change mode is turned on, the same button can be clicked once again to turn change mode off.

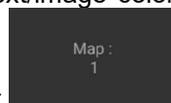
Depending on scanning parameter, the value may be changed either continuously during movement (sweep) action (e.g., Gain value) or only when finger is released (e.g., Depth value). Required mouse movement type can be determined by observing hint image ("|" or ":") at the right of parameter name. For 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, and buttons



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.

## 4. 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. 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".

## 5. 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

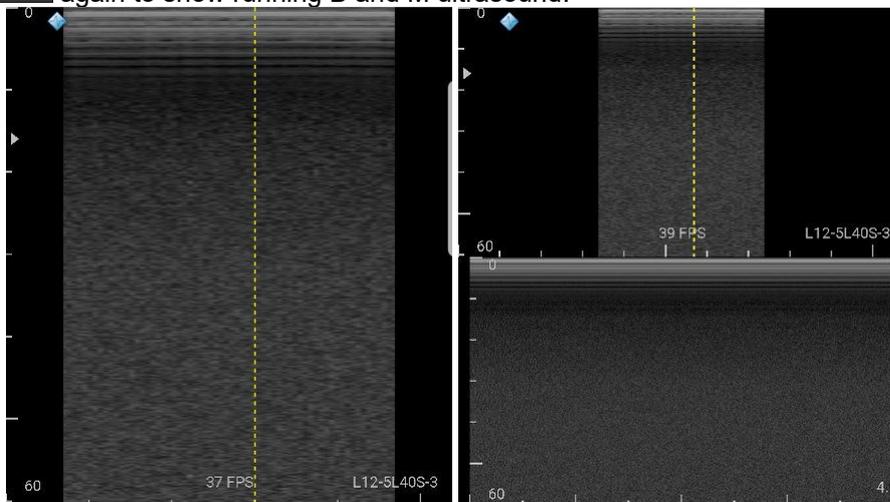
scanning is frozen, click Freeze/Run button  to run ultrasound scanning.

Controls that change scanning mode are located at horizontal toolbar.



To enter B+M mode, click “B+M” button , set M-line by clicking on B mode ultrasound image,

click “B+M” button  again to show running B and M ultrasound.



M line

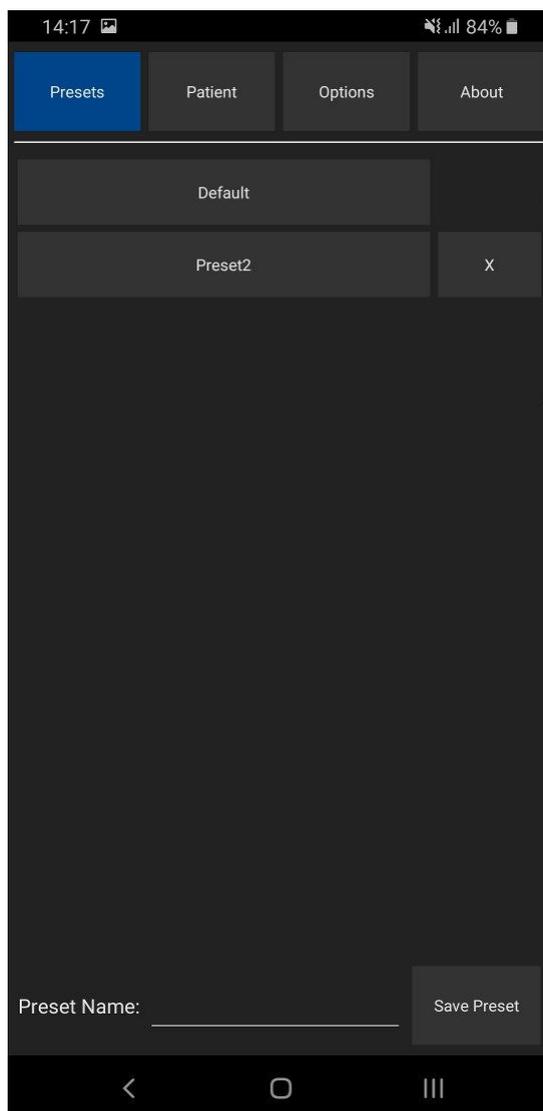
B+M

To enter M mode, click “M” button , set M-line by clicking on B mode ultrasound image, click “M” button  again 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, 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.

## 6. Using Ultrasound Scanning Presets



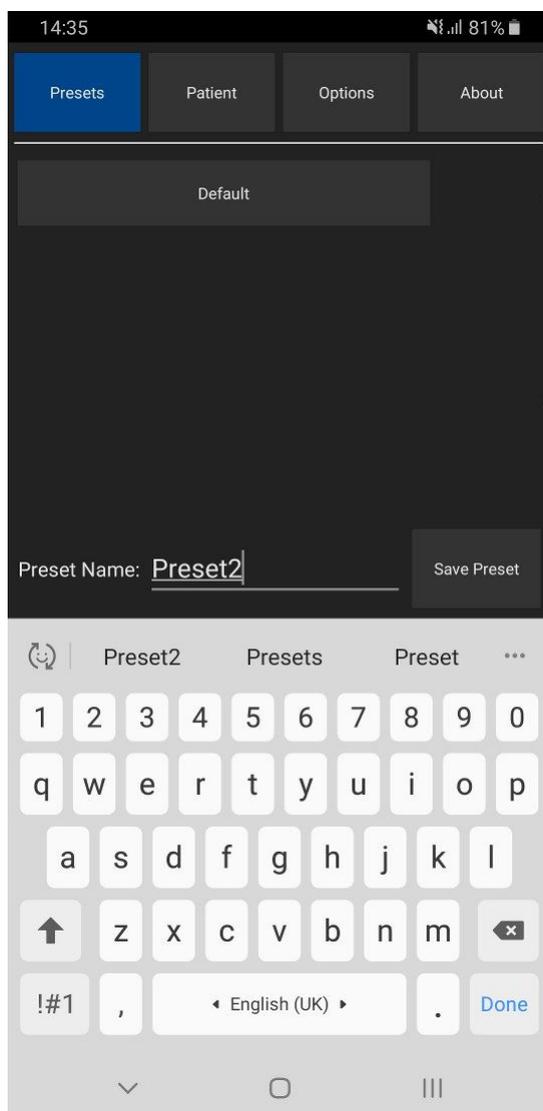
In order to apply ultrasound scanning preset, unfreeze ultrasound scanning (if now it is frozen) by clicking "Freeze/Run" button and perform the following actions:

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.

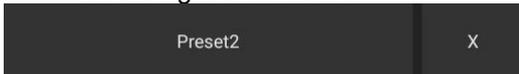
To save current ultrasound scanning parameters as preset for future use, please perform the following actions:

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".



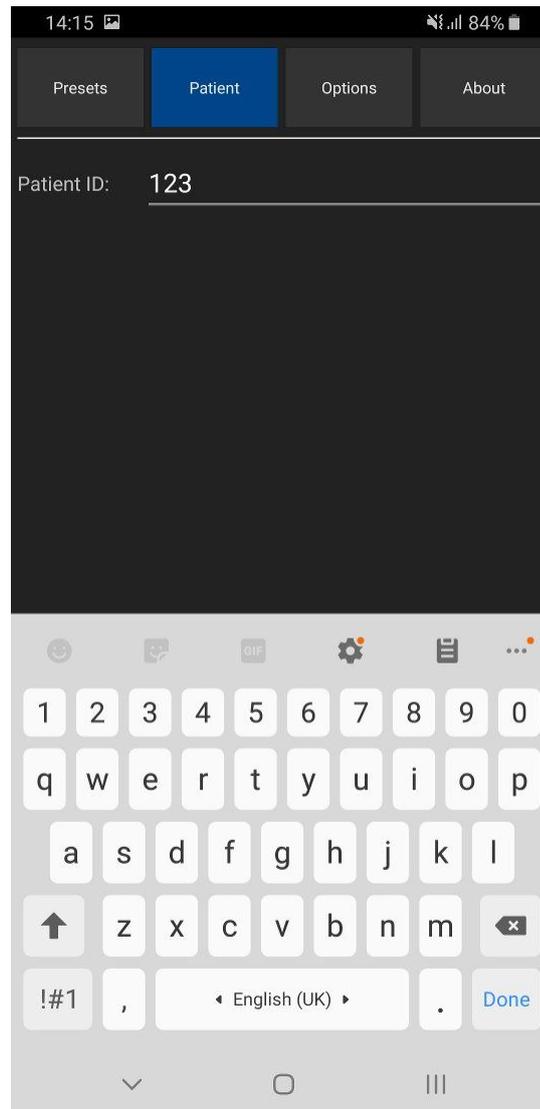
To delete ultrasound scanning preset, please perform the following actions:

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).

## 7. 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.

## 8. 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.

### 8.1. 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	

#### 8.1.1. 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.

#### 8.1.2. 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.

### 8.1.3. 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).

### 8.1.4. 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.

### 8.1.5. 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.

### 8.1.6. 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.

### 8.1.7. 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.

### 8.1.8. 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.

### 8.1.9. 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.

### 8.1.10. *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.

### 8.1.11. *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.

### 8.1.12. *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.

**8.1.13.      *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.

**8.1.14.      *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.

**8.1.15.      *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.

## 8.1.16. *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.

## 8.1.17. *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.

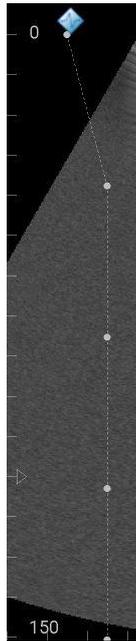
### **Adjustment**

Click "Negative" button.

## 8.1.18. *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.

### 8.1.19. 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.

## 8.2. 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	

### 8.2.1. 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.

### 8.2.2. 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.

### 8.2.3. 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.

**8.2.4. 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.

**8.2.5. 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.

**8.2.6. 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. Measurements and Calculations

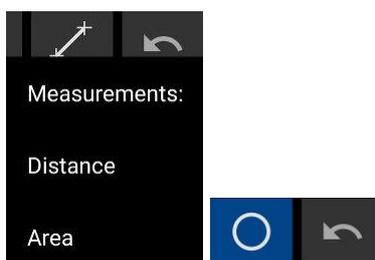
This section describes the user interface for measurements and calculations. For equations and references please see the "Echo Wave A Software Reference Manual".



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 menu select desired measurement type (e.g., Area). Button image and measurement type will change.



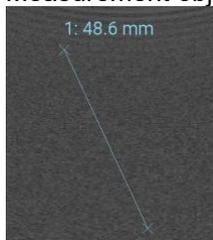
### 9.1. B Mode Measurements

#### 9.1.1. 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”).

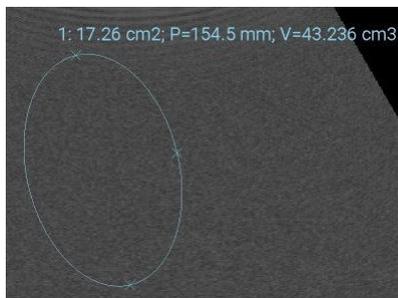
Please note that when measurement operation is in progress, painted measurement object has different color than when measurement is finished.

#### 9.1.2. 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 cm<sup>2</sup>” area, “P=154.5 mm” circumference and “V=43.236 cm<sup>3</sup>” 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.

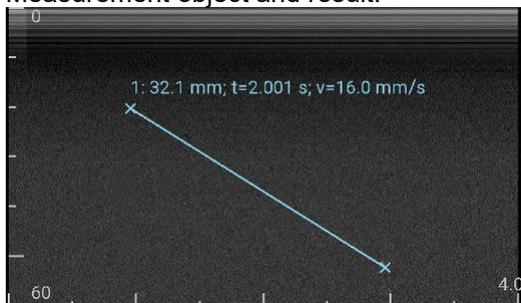
## 9.2. M Mode Measurements

### 9.2.1. 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.

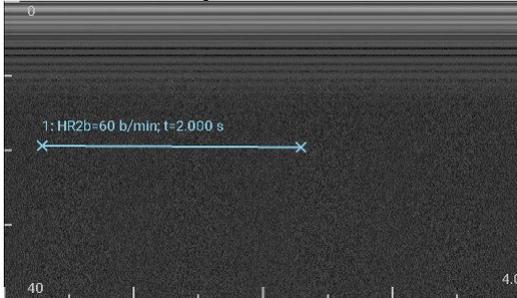
Please note that when measurement operation is in progress, painted measurement object has different color than when measurement is finished.

## 9.2.2. 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.

## 9.3. Deleting Performed Measurements

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

## 10. Saving and Loading Images and Cines

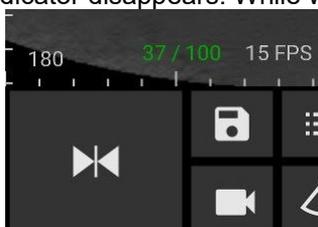
To save ultrasound image, click "Save Image" button . Images (in JPG format) are saved to "Internal Storage>Pictures".

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 the number of recorded frames (e.g., 34) in cine buffer and total buffer size (e.g., 500) in red color. Recording is done to cine memory. Cine is organized as cyclic frames buffer. That is, in it we always have last recorded frames. Buffer size is specified at options ("MP4 video recording buffer size"). In M mode are counted M frames that consist of several M lines (e.g., 20).



After click on "Stop" button , the software saves frames from cine memory to disk. Saving progress is shown as the number of saved frames (e.g., 37) and the number of recorded frames (e.g., 100) in green color. After writing file to disk, indicator disappears. While writing, ultrasound is not updated.

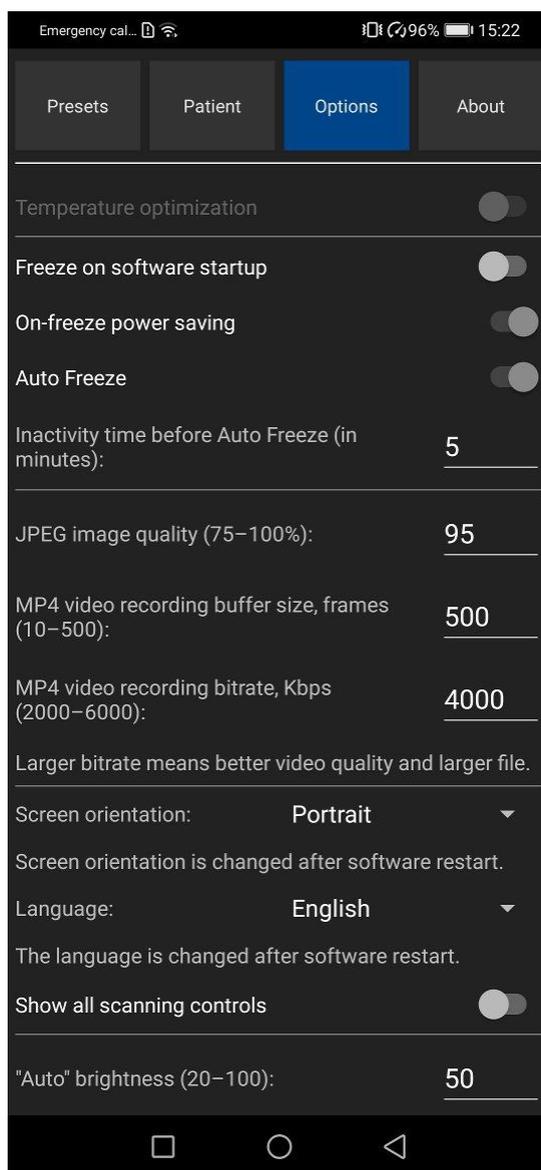


Please note that both JPG and MP4 formats are lossy.

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.

## 11. 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 how many frames must be hold in recording buffer.
- **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**

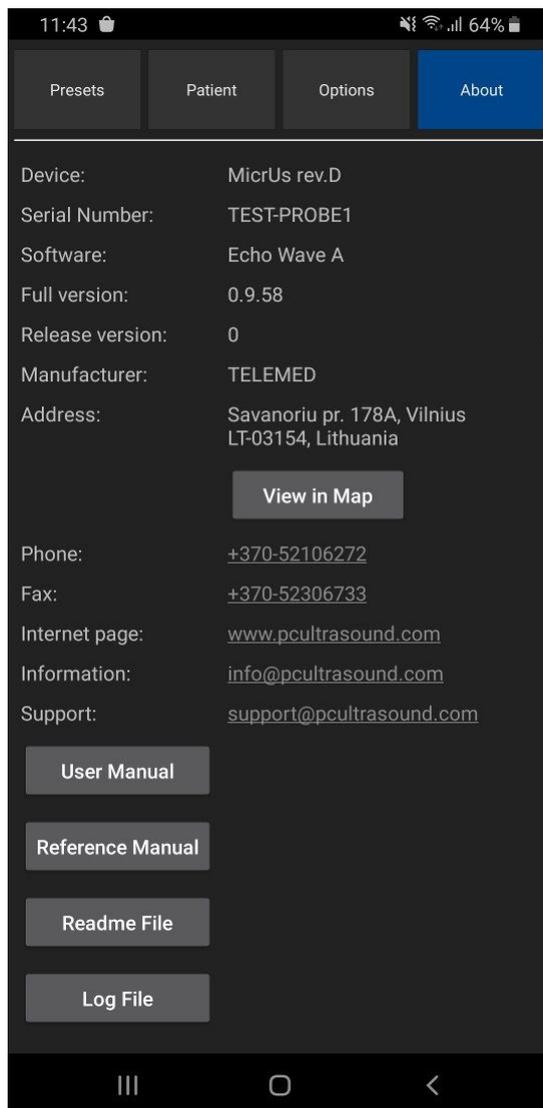
This option allows to change software user interface language. The option takes effect after software restart.
- **Show all scanning controls**

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**

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.

## 12. 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.

## 13. Error Messages

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

- **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).

## 14. System Requirements

Requirements for system operation are as follows:

- Mobile phone or tablet computer
- Android 6.0 or more recent Android operating system
- 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.

## 15. 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

## 16. References

1. Echo Wave A Software Reference Manual.  
File: "EchoWaveA\_Software\_Reference\_Manual.\*".

## 17. 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
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
1.6.3	2022.05.20	Added information about "Fix scan direction" option.	V.Perlibakas
1.6.4	2022.12.08	Updated company information.	V.Perlibakas

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