

# MicrUs and MicrUs Pro Series Ultrasound Systems

## Echo Wave A Software

### Measurements and Calculations Reference Manual



**TELEMED**  
**Ultrasound Medical Systems**

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## Content

Echo Wave A Software Measurements and Calculations Overview.....	3
1 B mode general measurements and calculations.....	4
1.1 B Distance.....	4
1.2 B Area (Ellipse).....	4
1.3 B Volume (1 ellipse).....	5
2 M mode general measurements and calculations.....	6
2.1.1 Two-points M measurements.....	6
2.1.1.1 M Distance.....	6
2.1.1.2 M Time.....	7
2.1.1.3 M Velocity.....	7
2.1.1.4 M Heart Rate (HR).....	7
3 Revision History.....	8

## Echo Wave A Software Measurements and Calculations Overview

This document presents equations that are used for Echo Wave A measurements and calculations.

- B mode measurements and calculations

Distance

Area (method: 1 ellipse)

Circumference(method: 1 ellipse)

Volume (method: 1 ellipse)

- M mode measurements and calculations

Distance

Time

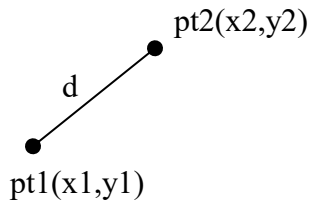
Velocity

Heart Rate (method: 2 beats distance)

## 1 B mode general measurements and calculations

In this section are presented basic equations that are used both for general measurements and calculations. **Please note that not all here described measurements may have control items in software user interface, but they may be used in other calculations.**

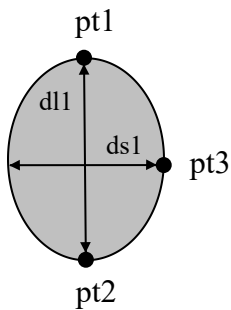
### 1.1 B Distance



Distance  $d$  between points  $pt1$  and  $pt2$  is calculated using the following equation:

$$d(pt1, pt2) = \sqrt{(x1 - x2)^2 + (y1 - y2)^2} .$$

### 1.2 B Area (Ellipse)

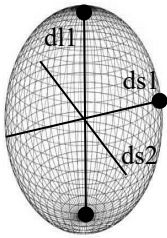


During measurements and calculations we assume that ellipse axis between two circular marker points  $pt1$  and  $pt2$  is "long axis", and axis with one circular endpoint marker  $pt3$  is "short axis". And this "long axis" and "short axis" notation remains unchanged no matter what are real lengths of these axes.

Area  $S$  and circumference  $P$  (perimeter) of an ellipse with long axis length  $dl1$  and short axis length  $ds1$  are calculated using the following equations:

$$S = \frac{\pi \cdot dl1 \cdot ds1}{4} , P = \pi \cdot \sqrt{\frac{1}{2}((dl1)^2 + (ds1)^2)} .$$

Volume  $V$  of an ellipsoid with axes lengths  $d11$ ,  $ds1$ , and  $ds2=ds1$  is calculated using the following equation:



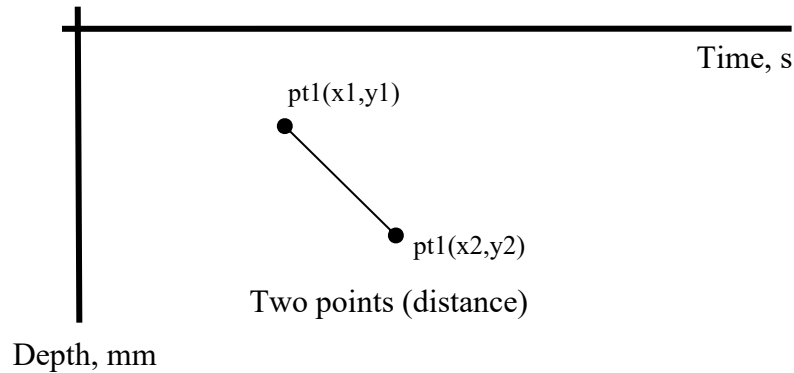
$$V = \frac{\pi \cdot d11 \cdot ds1 \cdot ds2}{6}.$$

### 1.3 **B Volume (1 ellipse)**

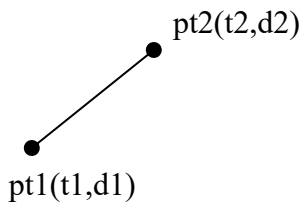
See "B Area (Ellipse)" section.

## 2 M mode general measurements and calculations

Usually in M mode ultrasound image horizontal axis (x-axis) represents time (in seconds), and vertical axis (y-axis) represents depth (in millimeters). On M mode image are usually performed two-point -based measurements and calculations. For measurements and calculations we use (time [s], depth [mm]) coordinate system, where each point can be described by its time (in seconds [s]) and depth (in millimeters [mm]). For example, notation  $pt1(x1,y1)=(5,120)$  means that coordinates of point  $pt1$  are  $x1=5s$  and  $y1=120mm$ .



### 2.1.1 Two-points M measurements



For two-point M measurements we use coordinates (time,depth) of two end-points  $pt1$  and  $pt2$  of one line (distance).

#### 2.1.1.1 M Distance

Distance between points  $pt1$  and  $pt2$  is calculated using the following equation:

$$d = \text{abs} ( d1 - d2 ),$$

here

- $d$  [mm] - distance,
- $d1$  [mm] - depth at point  $pt1$ ,
- $d2$  [mm] - depth at point  $pt2$ ,
- $\text{abs}(\dots)$  means that is calculated absolute value.

### 2.1.1.2 *M Time*

Time interval (difference) between points pt1 and pt2 is calculated using the following equation:

$$t = \text{abs} ( t1 - t2 ),$$

here

- t [s] - time interval (difference),
- t1 [s] - time at point pt1,
- t2 [s] - time at point pt2.

### 2.1.1.3 *M Velocity*

Velocity between points pt1 and pt2 is calculated using the following equation:

$$\text{Vel} = \text{abs} ( d2 - d1 ) / \text{abs} ( t2 - t1 ),$$

here

- Vel [mm/s] - velocity,
- t1 [s] - time at point pt1,
- d1 [mm] - depth at point pt1,
- t2 [s] - time at point pt2,
- d2 [mm] - depth at point pt2.

### 2.1.1.4 *M Heart Rate (HR)*

Heart Rate (HR) using markers pt1 and pt2 is calculated according to the following equation:

$$\text{HR} = 60 * \text{beats\_num} / \text{abs}(t2-t1),$$

here

- HR [beats/min] - Heart Rate in beats per minute,
- abs(t2-t1) [s] - time interval between markers pt1 and pt2,
- beats\_num [beats] - the number of heart beats (e.g., 2) in measured time interval.

### 3 Revision History

<b>Revision</b>	<b>Revision Date</b>	<b>Description of Revision</b>	<b>Revision Author</b>
1.0.0	2019.10.07	Initial Release	V.Perlibakas
1.0.1	2020.05.14	Changed first page photo.	V.Perlibakas
1.2.0	2020.08.11	Added information about M mode measurements.	V.Perlibakas
1.2.1	2020.08.13	Added section “M Heart Rate”.	V.Perlibakas
1.2.2	2022.12.08	Updated company information.	V.Perlibakas



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