

***ECG 401***

**3-LEADS PERSONAL ELECTROCARDIOGRAPH**

**OPERATING MANUAL**

September 2014

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## 1. INTRODUCTION

*ECG 401* is personal device for recording the electrocardiogram (ECG) based on up to date trends in the electronics and informatics. This device records 3 leads of and represents a part of *ECGMobile System* that is used in urgent telemedicine. Besides that, the system includes also *ECG 1401* Calibration Unit and *ECGMobile Center*. In the *ECGMobile Center* complete 12-channel ECG is reconstructed using *ECGMobile Center* software package.

A patient carries the *ECG 401* personal device with himself/herself. In the case of medical need, the device is used for recording the ECG signal. After that, the recorded ECG signals are transferred to the *ECGMobile Center* using mobile phone. Based on previously recorded signals using *ECG 1401* unit, in the *ECGMobile Center* all 12 leads of conventional ECG are reconstructed.

*ECG 401* personal device requires minimal user's intervention. After switching on, the device is used for recording of the ECG signals. The device uses a software program that verifies the integrity of the recorded ECG signals. When the integrity of the record is verified, it is automatically transferred to *ECGMobile Center*, using embedded mobile phone device. After successfully transferring the ECG signals in the *ECGMobile Center*, the contact with cardiologist on call is established. Using the reconstructed ECG signals, the cardiologist establishes the diagnosis and takes other necessary steps.

*ECG 401* personal device is supplied with rechargeable battery that allows autonomous work of the device during prolonged time.

## 2. DESCRIPTION OF THE DEVICE

Device is packed in a proprietary designed plastic box of dimension 121x71x13 mm, Fig 1. On the topside of the device, the electrodes for recording the ECG signals from the fingers are situated, left hand – the upper electrode and right hand – the bottom electrode. Between the electrodes is the three-color (red, blue, green) LED (Light Emitting Diode), speaker (buzzer) and the label of the device type: *ECG 401*.



Fig 1. Topside view of the *ECG 401* device.



Fig 2. Bottom side view of the *ECG 401* device.

Taster at box side is used for turning *ECG 401* on and off as well as regulate intensity of buzzer.

Near the taster is red LED and micro USB connector, used for external battery charger.

On the bottom side of the device box, Fig 2, are electrodes for recording ECG signal from the chest of the patient. The recording is performed when holding the electrodes against the chest of the patient.

## 3. BASIC TECHNICAL DATA

Table 1.

|  |   |
|--|---|
| Battery charging   | 220V±10% using AC/DC adapter 5V                           |
| Battery capacity   | Li-Ion 4.2V, 1100mAh                                      |
| Battery charging current   | max 450mA   |
| Protection class   | DIN 40050: IP 20  |
| Electrical protection  | Protection class I /unit has its own battery power supply |
| Dimensions   | length 121mm, width 71mm, height 13mm.                    |
| Weight   | 142g  |
| Working mode 1   | Battery charging, when device is not functional           |
| Working mode 2   | Using internal battery power supply                       |
| Number of ECG record and send cycles, without charging the battery | 100   |
| Working environment temperature                                    | +10°C do +35°C  |
| Max working environmental humidity                                 | 95%   |
| Storage temperature  | –25°C do +55°C  |
| Storage environmental humidity                                     | 10% do 95%, non-condensing                                |

## 4. SWITCHING ON AND PUTTING THE DEVICE TO SERVICE

### 4.1. Charging internal battery

Device Internal battery is recharged for the first time before the use, and then occasionally, as needed, but not less than once a month.

Internal battery is recharged by connecting the battery charger to power grid network of 220VAC, 50Hz, while the other end is connected to the connector on the rear side of the device box. Recharging has to be maintained 1 hour minimally. If the recharging time is longer than recommended time, prolonged charging will not affect the device.

After each charging it is advisable to switch on the device and make a functionality check.

### 4.2. Switching on and switching off the device

To switch the *ECG 401* on push the taster once.

To force the *ECG 401* into off state push the taster until LED goes white, then release the taster.

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After switching the device on all LEDs are on for short time, one after another: blue, green, red.

If battery is full enough green LED is constantly on and repetitive audio ton is generated. ECG recording will start as soon the user properly puts the device on his/her body.

If red LED is on, accompanied with audio ton battery must be recharged.



Fig 3. Switching on the device.

### 4.3. Putting the device in mode of recording ECG signals

Recording the ECG signals is done, with the device previously switched on, with holding the device against the thorax of the user, Fig 4, in the way that the centre point between the three electrodes is in line with nipples of the thorax, symmetrically on the body axis.



Fig 4. Recording the ECG signals.

Middle finger of the left arm lies on the upper button of the front plate of the device, while the middle finger of the right hand lies on the lower button of the device. Recording of

the ECG signal is started as soon as the device is properly positioned (all contacts with his/her body established).

### 4.4. Recording the ECG signals

If user has put on the device correctly, meaning all leads are in place, ECG recording is started. While recording is taking place, there is no sound indication, and green LED is constantly on. If user is calm, and does not lose contact with leads, recording takes about 10 seconds. If contact is lost, sound indication will start and green LED will start to flash, which means recording can start again. While recording user should be still and in lying or semi vertical position, and should not speak.

If recording is successful device will play pleasant tone and after that it will connect to mobile network and start sending the recording.

### 4.5. Transfer of the ECG signals to the ECGMobile Center

Sending recorded ECG signal to *ECGMobile Center* is done automatically. While device is sending recording, user should keep track of signalization so he/she would know if recording is sent properly. Quick flashing of blue LED indicates that connecting to mobile network is in progress. If connection with mobile network is successfully established blue LED will flash slower, and it indicates that recording is being sent. At the end, if ECG recording is successfully sent to *ECGMobile Center*, device will play pleasant melody, as sign of successful ECG signal recording and it will automatically turn itself off. If error has occurred while transferring recording or connection to mobile network is lost, which is possible, device will save last recorded ECG signal, it will automatically turn off, and the next time it's turned on, it will first send the last recording.

### 4.6 Audio tone volume change

Changing tone volume is possible before user has started ECG recording. To change volume push button, for 0.5 to 2 seconds, then release it. There are 10 volume levels (0-9), and device is by default on volume level 5. By pushing the button, volume will increase by one level. When you reach volume level 9, next push of the button will set level to 0. Last used tone volume level will be saved.

### 4.7 Turning the device off

When device is turned on it can be turned off by following the procedure from section 4.2. Device will automatically turn itself off if battery is empty or after the communication with *ECGMobile Center* via mobile network is finished.

## 5. EXAMPLES OF USING THE DEVICE

- After ECG 401 is turned on, the following sequence of colour change of the LED takes place: blue, green, red, flashing green,



- While green LED is flashing put the device on left side of his/her thorax, as shown on Fig 4. Breaking audio ton is produced.
- User must put his/her finger from left hand to contact designated as “L” and a finger from right hand to contact ”R”. Hands and fingers muscles must be relaxed as much as possible.
- If everything is properly set, green LED will be continuously let and audio ton will be silent. This indicates that signal recording is in progress.
- End of signal recording is signalled by specific audio ton and blue LED is flashing quickly. Device is trying to connect to mobile network.
- After the connection is established, during data transfer, blue LED flashes slowly.
- When data transfer is over specific tone is generated, white LED is on and the device goes off.

If ECG signal, from any reason, has not been sent to ECGMobile Center (connection to mobile network failed, forced device off by user, etc), after the device is switched on, the following action is taking place:

- the following sequence of colour change of the LED takes place: blue, green, red, flashing green,
- blue LED is flashing quickly. Device is trying to connect to mobile network.
- After the connection is established, during data transfer, blue LED flashes slowly.
- When data transfer is over specific tone is generated, white LED is on and the device goes off.

So, if recorded ECG signal was not sent, it has been stored in ECG 401's internal memory. The first action after device goes on is attempt to send the previously recorded ECG signal to ECGMobile Center.

ECG 401 should be turned on and new recording can start.

If red LED is constantly on after the device is turned on, battery is almost empty. Battery charger must be connected to the device. ECG recording is not possible while battery charging.