

# WHALETEQ

## HECG100

### User Manual



Firmware Version 1.0.21  
Revision 2025-05-29

Copyright © 2013-2025, All Rights Reserved.  
WhaleTeq Co. LTD

No part of this publication may be reproduced, transmitted, transcribed, stored in a retrieval system, or translated into any language or computer language, in any form, or by any means, electronic, mechanical, magnetic, optical, chemical, manual or otherwise, without the prior written permission of WhaleTeq Co. LTD.

#### Disclaimer

WhaleTeq Co. LTD. provides this document and the programs "as is" without warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of merchantability or fitness for a particular purpose.

This document could contain technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in future revisions of this document. WhaleTeq Co. LTD. is under no obligation to notify any person of the changes.

The following trademarks are used in this document:



is a registered trademark of WhaleTeq Co. LTD

All other trademarks or trade names are property of their respective holders.

# Contents

|          |                                             |           |
|----------|---------------------------------------------|-----------|
| <b>1</b> | <b>Introduction .....</b>                   | <b>7</b>  |
| 1.1      | Overview .....                              | 7         |
| 1.2      | Hardware Overview .....                     | 8         |
| 1.3      | Specifications.....                         | 9         |
| <b>2</b> | <b>Installation and Settings.....</b>       | <b>14</b> |
| 2.1      | Installation.....                           | 14        |
| 2.2      | Home Screen .....                           | 15        |
| 2.3      | “Waveform” Function .....                   | 16        |
| 2.3.1    | “Wave” Parameter .....                      | 16        |
| 2.3.2    | “Frequency” Parameter .....                 | 17        |
| 2.3.3    | “Amplitude” Parameter .....                 | 17        |
| 2.3.4    | “DC offset” Parameter .....                 | 18        |
| 2.3.5    | “Noise” Parameter .....                     | 19        |
| 2.3.6    | “Load” Function .....                       | 20        |
| 2.3.7    | “Save” Function.....                        | 20        |
| 2.3.8    | “Reset” Function .....                      | 22        |
| 2.3.9    | “Screen off” Function.....                  | 23        |
| 2.4      | “ECG” Function .....                        | 24        |
| 2.4.1    | “Heart rate” Parameter .....                | 24        |
| 2.4.2    | “Frequency” Parameter .....                 | 24        |
| 2.4.3    | “ST Deviation” Parameter .....              | 25        |
| 2.4.4    | “Pacing” Parameter.....                     | 25        |
| 2.4.5    | “Drift test” Parameter.....                 | 27        |
| 2.4.6    | “Respiration” Parameter.....                | 27        |
| 2.4.7    | “DC offset” Parameter .....                 | 30        |
| 2.4.8    | “Noise” Parameter .....                     | 30        |
| 2.4.9    | “Load”, “Save”, and “Reset” Functions ..... | 32        |
| 2.5      | “Arrhythmia” Function .....                 | 33        |
| 2.6      | “More” Function .....                       | 36        |
| 2.6.1    | “Play Raw” Function.....                    | 36        |

|                                           |           |
|-------------------------------------------|-----------|
| 2.6.2 Settings .....                      | 37        |
| 2.6.2.1 Date/Time Settings .....          | 38        |
| 2.6.2.2 Backlight Settings .....          | 40        |
| 2.6.2.3 Battery Settings .....            | 40        |
| 2.6.2.4 Device Information .....          | 41        |
| 2.6.2.5 Firmware Update.....              | 42        |
| <b>3 Calibration and Validation .....</b> | <b>43</b> |
| <b>4 Cautions .....</b>                   | <b>43</b> |
| <b>5 Ordering Information .....</b>       | <b>44</b> |
| <b>6 Revision History.....</b>            | <b>45</b> |
| <b>7 Contact WhaleTeq .....</b>           | <b>45</b> |

# List of Tables

Table 1: HECG100 Hardware Overview ..... 8

Table 2: Technical Specifications ..... 9

Table 3: Signal Type ..... 11

Table 4: Signal Add-on ..... 12

Table 5: General Specifications ..... 12

Table 6: Compliance Specifications ..... 13

Table 7: HECG100 Home Screen..... 15

Table 8: Provided Waveforms of “Arrhythmia” Function..... 34

Table 9: HECG100 Standard Test System ..... 44

Table 10: Optional Accessories..... 44

Table 11: Optional Calibration Service and Warranty Extension .... 45

Table 12: Revision History ..... 45

## List of Figures

|                                                                                |    |
|--------------------------------------------------------------------------------|----|
| Figure 1: HECG100 Hardware Overview.....                                       | 8  |
| Figure 2: HECG100 Installation .....                                           | 14 |
| Figure 3: HECG100 Home Screen .....                                            | 15 |
| Figure 4: "Wave" Parameter .....                                               | 16 |
| Figure 5: "Frequency" Parameter .....                                          | 17 |
| Figure 6: "Amplitude" Parameter .....                                          | 17 |
| Figure 7: "On/Off" Options of "DC offset" Parameter .....                      | 18 |
| Figure 8: Options of "DC offset" Parameter .....                               | 18 |
| Figure 9: "On/Off" Options of "Noise" Parameter .....                          | 19 |
| Figure 10: "Main Noise" Options of "Noise" Parameter.....                      | 19 |
| Figure 11: "Amplitude" Options of "Noise" Parameter .....                      | 19 |
| Figure 12: "Load" Function .....                                               | 20 |
| Figure 13: Load Previously Saved Waveforms from the micro SD<br>Card .....     | 20 |
| Figure 14: "Save" Function.....                                                | 21 |
| Figure 15: Save Configured Waveforms to the HECG100 Internal<br>Storage .....  | 21 |
| Figure 16: Name the Configured Waveform .....                                  | 21 |
| Figure 17: "Successfully Saved" Message of Saving Configured<br>Waveforms..... | 22 |
| Figure 18: "Reset" Function .....                                              | 22 |
| Figure 19: "Screen off" Function.....                                          | 23 |
| Figure 20: "Heart rate" Parameter .....                                        | 24 |
| Figure 21: "Frequency" Parameter .....                                         | 24 |
| Figure 22: "ST Deviation" Parameter.....                                       | 25 |
| Figure 23: "On/Off" Options of "Pacing" Parameter .....                        | 25 |
| Figure 24: "Amplitude" Options of "Pacing" Parameter.....                      | 26 |
| Figure 25: "Duration" Options of "Pacing" Parameter .....                      | 26 |
| Figure 26: "Drift test" Parameter.....                                         | 27 |
| Figure 27: "On/Off" Options of "Respiration" Parameter .....                   | 27 |
| Figure 28: "Rate" Options of "Respiration" Parameter .....                     | 28 |
| Figure 29: "Baseline" Options of "Respiration" Parameter .....                 | 28 |
| Figure 30: "Variation" Options of "Respiration" Parameter .....                | 28 |
| Figure 31: "Apnea" Options of "Respiration" Parameter .....                    | 29 |
| Figure 32: "On/Off" Options of "DC offset" Parameter .....                     | 30 |
| Figure 33: Options of "DC offset" Parameter .....                              | 30 |
| Figure 34: "On/Off" Options of "Noise" Parameter.....                          | 31 |

|                                                                   |    |
|-------------------------------------------------------------------|----|
| Figure 35: "Main Noise" Options of "Noise" Parameter.....         | 31 |
| Figure 36: "Amplitude" Options of "Noise" Parameter .....         | 31 |
| Figure 37: "Load", "Save", and "Reset" Functions .....            | 32 |
| Figure 38: "Arrhythmia" Function.....                             | 33 |
| Figure 39: Select a Desired Arrhythmia Waveform for Testing ..... | 33 |
| Figure 40: Play the Desired Arrhythmia Waveform for Testing ..... | 34 |
| Figure 41: "Play Raw" Function .....                              | 36 |
| Figure 42: Raw Data Files for Playback.....                       | 37 |
| Figure 43: Settings .....                                         | 37 |
| Figure 44: Date/Time Settings .....                               | 38 |
| Figure 45: Date Setting .....                                     | 38 |
| Figure 46: Time Setting.....                                      | 39 |
| Figure 47: Date Format Setting .....                              | 39 |
| Figure 48: Time Format Setting .....                              | 39 |
| Figure 49: Backlight Settings .....                               | 40 |
| Figure 50: Battery Settings .....                                 | 40 |
| Figure 51: "Auto Power Off" Options .....                         | 41 |
| Figure 52: Device Information .....                               | 41 |
| Figure 53: Firmware Update (step 4) .....                         | 42 |
| Figure 54: Firmware Update (step 5) .....                         | 42 |

# 1 Introduction

## 1.1 Overview

The HECG100 is a handheld 12-lead ECG simulator that generates single-channel signals for testing a wide range of ECG devices, including ECG machines, patient monitors, Holter monitors, and others. Among different usage scenarios, the HECG100 features powerful functions to address the challenges during product development and verification.

### R&D

Engineers require specialized specification verification and regression tests for each design modification. Therefore, the HECG100 provides advanced functions to accelerate the verification process.

- ♦ **Raw Data Playback** — quickly verify designs with designated raw data
- ♦ **Automated Quick Testing** — streamline workflows and shorten test cycles by using custom test sequences without repetitive setups and coding
- ♦ **Advanced ECG and Add-on Signals** — provide a database of 32 arrhythmias, and a full suite of DC offset, noise, pacing, and respiration simulation for superimposing to configured ECG waveforms
- ♦ **Quick Test Launch** — reduce setup time from minutes to seconds

### Compliance Testing

In EMC test environments, engineers struggle with shielding workarounds to ensure stable ECG testing signals and mitigate mains frequency noise introduced by ECG simulators. Accordingly, the HECG100 comes with practical strategies to solve these challenges.

- ♦ **Battery-powered ECG Testing** — no mains frequency noise interference
- ♦ **EMI & EMS Compliant Design** — ensure stable signal output in high-EMI environments while eliminating testing uncertainty
- ♦ **ESD Protection** — handle errant electrostatic discharges without interrupting testing
- ♦ **12-hour Continuous Testing** — flexibility for extended compliance evaluations

## 1.2 Hardware Overview

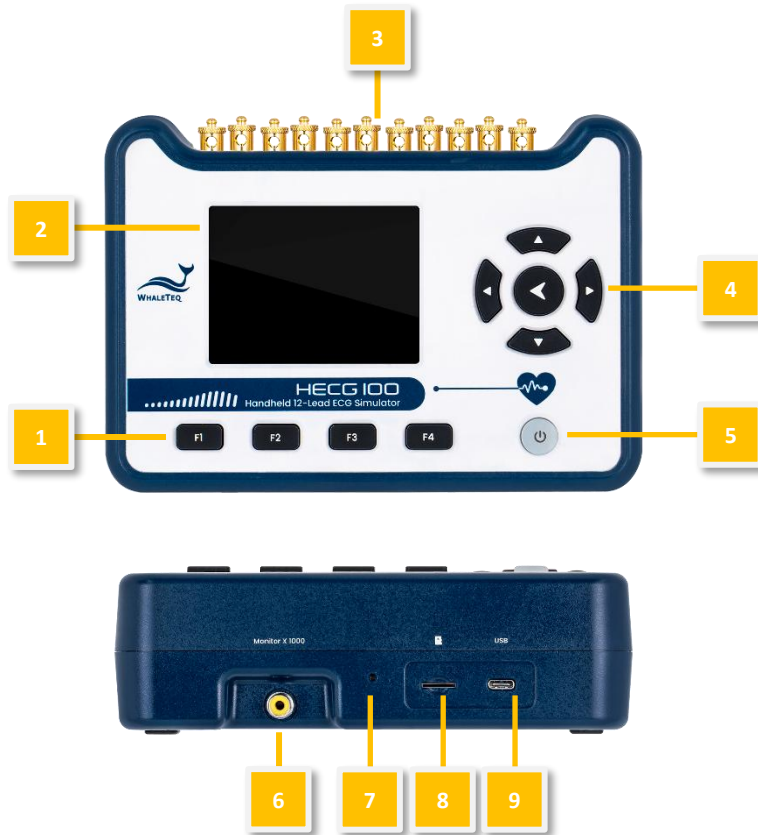


Figure 1: HECG100 Hardware Overview

Table 1: HECG100 Hardware Overview

| Item | Name                     | Description                                                                                                     |
|------|--------------------------|-----------------------------------------------------------------------------------------------------------------|
| 1    | Function Buttons         | To select "Waveform" (F1 button), "ECG" (F2 button), "Arrhythmia" (F3 button) and "More" (F4 button) functions. |
| 2    | LCD Screen               | To show parameter settings.                                                                                     |
| 3    | Electrode Terminals      | To connect to electrodes on DUT.                                                                                |
| 4    | Arrow Keys and Enter Key | To select and confirm parameter settings.                                                                       |
| 5    | Power Button             | To turn on and turn off the HECG100.                                                                            |

| Item | Name               | Description                                                                                   |
|------|--------------------|-----------------------------------------------------------------------------------------------|
| 6    | Monitor Port       | To connect to an oscilloscope to monitor the amplified ECG signal output (1mV=1000mV output). |
| 7    | Reset Button       | To reset the HECG100.                                                                         |
| 8    | micro SD Card Slot | To put the provided micro SDHC card.                                                          |
| 9    | USB-C Port         | To connect to a computer or an adaptor for charging.                                          |

### 1.3 Specifications

- Technical Specifications

Table 2: Technical Specifications

| Parameters                                 | Specifications                                                            |
|--------------------------------------------|---------------------------------------------------------------------------|
| Heart rate accuracy                        | $\pm 1\%$                                                                 |
| Amplitude accuracy                         | $\pm 2\%$                                                                 |
| Frequency / pulse repetition rate accuracy | $\pm 1\%$                                                                 |
| Pulse duration accuracy (excluding pacing) | $\pm 0.5\text{ms}$                                                        |
| ECG duration accuracy                      | $\pm 0.5\text{ms}$                                                        |
| Pacing pulse width accuracy                | $\pm 5\mu\text{s}$                                                        |
| Pacing pulse amplitude accuracy, range     | $\pm 2\text{mV}$ pulse: $\pm 0.3\%$<br>$>2\text{mV}$ pulse: $\pm 10\%$    |
| Pacing pulse characteristics               | Rise/fall time $5\mu\text{s}$<br>Overshoot $<1\%$<br>Settling time $<1\%$ |
| Capacitor tolerance                        | $\pm 5\%$                                                                 |

| Parameters                               | Specifications                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sample rate                              | 10kHz $\pm$ 0.05%                                                                                                                                                                                                                                                                                                                                        |
| RCA output amplitude range               | ECG electrode output x1000, max 10V                                                                                                                                                                                                                                                                                                                      |
| RCA output amplitude accuracy            | $\pm$ 1% for amplitudes of 0.5Vpp or higher                                                                                                                                                                                                                                                                                                              |
| Lead output ratio                        | Reference lead (lead II) in a certain ratio (calculated in percentage).<br>Lead I: 70 (if RA=100, LA=170)<br>Lead II: 100 (LL=200)<br>Lead III: 30<br>(CT=(100+170+200)/3=156.7)<br>Lead V1: 24 (V1=24+156.7=180.7)<br>Lead V2: 48 (V2=204.7)<br>Lead V3: 100 (V3=256.7)<br>Lead V4: 120 (V4=276.7)<br>Lead V5: 112 (V5=268.7)<br>Lead V6: 80 (V6=236.7) |
| Total harmonic distortion                | 5%                                                                                                                                                                                                                                                                                                                                                       |
| Signal noise ratio                       | $\geq$ 60dB                                                                                                                                                                                                                                                                                                                                              |
| DC offset                                | Setting $\pm$ 1%<br>(fixed, may include up to 50 $\mu$ Vpp noise)                                                                                                                                                                                                                                                                                        |
| <b>Respiration Simulation Accuracy</b>   |                                                                                                                                                                                                                                                                                                                                                          |
| Impedance baseline                       | $\pm$ 5%                                                                                                                                                                                                                                                                                                                                                 |
| Impedance variations ( $\Delta \Omega$ ) | $\pm$ (5% of setting) + 0.05 $\Omega$                                                                                                                                                                                                                                                                                                                    |

- **Signal Type**

**Table 3: Signal Type**

| Parameters      |              | Specifications                                                                               |
|-----------------|--------------|----------------------------------------------------------------------------------------------|
| ECG waveform    | Heart rate   | 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300BPM |
|                 | Amplitude    | 0.1, 0.5, 1, 2, 3, 4, 5mVpp                                                                  |
|                 | ST deviation | -0.6 — 0.6mV                                                                                 |
| Sine            | Frequency    | 0.1, 0.5, 0.67, 1, 2, 5, 10, 20, 40, 50, 60, 100, 150, 200Hz                                 |
|                 | Amplitude    | 0.1, 0.5, 1, 2, 3, 4, 5mVpp                                                                  |
| Triangle        | Frequency    | 1, 2Hz                                                                                       |
|                 | Amplitude    | 0.5, 1, 2mVpp                                                                                |
| Square          | Frequency    | 0.125, 1, 2Hz                                                                                |
|                 | Amplitude    | 0.1, 0.5, 1, 2, 3, 4, 5mVpp                                                                  |
| Rectangle pulse | Frequency    | 30, 60, 120BPM                                                                               |
|                 | Pulse width  | 40, 60, 100, 200ms                                                                           |
|                 | Amplitude    | 0.1, 0.5, 1, 2, 3, 4, 5mV                                                                    |
| Triangle pulse  | Frequency    | 30, 60, 120BPM                                                                               |
|                 | Pulse width  | 40, 60, 100, 200ms                                                                           |
|                 | Amplitude    | 0.1, 0.5, 1, 2, 3, 4, 5mV                                                                    |

- Signal Add-on

Table 4: Signal Add-on

| Parameters    |                                | Specifications                               |
|---------------|--------------------------------|----------------------------------------------|
| DC offset     |                                | $\pm 300, \pm 500, \pm 1000\text{mV}$        |
| Pacing        | Amplitude                      | 1, 2, 5, 10, 20, 50, 100mV                   |
|               | Duration                       | 0.1, 0.5, 1.0, 1.5, 2.0, 3ms                 |
|               | Pacing rate                    | Synchronization                              |
| Drift test    |                                | Triangle wave (0.1Hz, 4mVpp)                 |
| Noise         | Main noise                     | 50Hz, 60Hz, White noise                      |
|               | Amplitude                      | 1, 2, 5, 10mVpp                              |
| Respiration   | Frequency                      | 15, 20, 30, 40BrPM                           |
|               | Baseline                       | 500 $\Omega$ , 1000 $\Omega$ , 1500 $\Omega$ |
|               | Ratio (inspiration:expiration) | 1:1                                          |
|               | Variation                      | 1 $\Omega$ , 2 $\Omega$ , 5 $\Omega$         |
|               | Apnea                          | 12s, 22s, 32s, continuous, off               |
| Play raw data | Sample rate                    | Maximum: 10kHz (able to play repeatedly)     |

- General Specifications

Table 5: General Specifications

| Items          | Specifications                                                              |
|----------------|-----------------------------------------------------------------------------|
| Temperature    | Operating: 10°C — 40°C (50°F — 104°F)<br>Storage: 0°C — 50°C (32°F — 122°F) |
| Humidity       | 10% — 90% non-condensing                                                    |
| Altitude       | Up to 2000m                                                                 |
| Communications | USB Type-C connector                                                        |

| Items           | Specifications                                                                |
|-----------------|-------------------------------------------------------------------------------|
| Power           | 5V DC                                                                         |
| Battery charger | 5V, 1A                                                                        |
| Battery life    | 12 hours (continuous testing in power-saving mode)                            |
| Mechanical      | Housing: ABS Plastic<br>Size (L x W x H): 18.0 x 12.8 x 5.5cm<br>Weight: 950g |
| Data capacity   | 32GB micro SD card                                                            |

## • Compliance Specifications

Table 6: Compliance Specifications

| Items | Specifications                                                                                                                                                                                                                        |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FCC   | EMC P15B                                                                                                                                                                                                                              |
| CE    | <ul style="list-style-type: none"> <li>• EMC EN61326-1</li> <li>• ESD 8kV (contact), 15kV(air)</li> <li>• EMI Class A, Class B</li> <li>• Safety IEC/EN61010-1:2010 + A1:2016; Pollution degree 2</li> <li>61010-2-030:201</li> </ul> |

## 2 Installation and Settings

### 2.1 Installation



Figure 2: HECG100 Installation

1. Connect the electrodes of DUT respectively to the electrode terminals on the HECG100. For example, connect the RA, LA, and LL electrodes respectively to the RA, LA, and LL electrode terminals.
2. Press the power button on HECG100 to turn it on and start to test.

## 2.2 Home Screen

After powering on the HECG100, users will see the figure below on its screen.

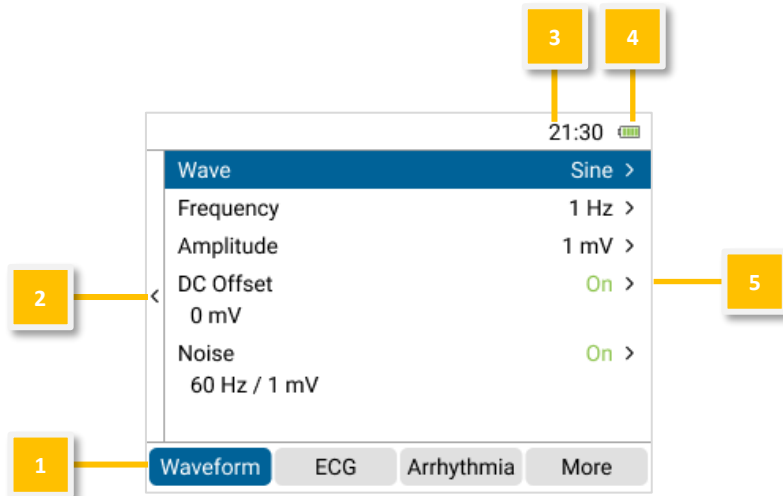


Figure 3: HECG100 Home Screen

Table 7: HECG100 Home Screen

| Item | Name          | Description                                                                                                        |
|------|---------------|--------------------------------------------------------------------------------------------------------------------|
| 1    | Functions     | Switch between "Waveform", "ECG", "Arrhythmia" and "More" functions using F1, F2, F3, and F4 buttons respectively. |
| 2    | Sidebar       | Use the arrow key (◀) on HECG100 to show the sidebar for "Load", "Save", "Reset" and "Screen off" functions.       |
| 3    | Time          | To show the current time.                                                                                          |
| 4    | Battery Level | To show the current battery level.                                                                                 |
| 5    | Parameters    | To show parameter selections according to the designated function.                                                 |

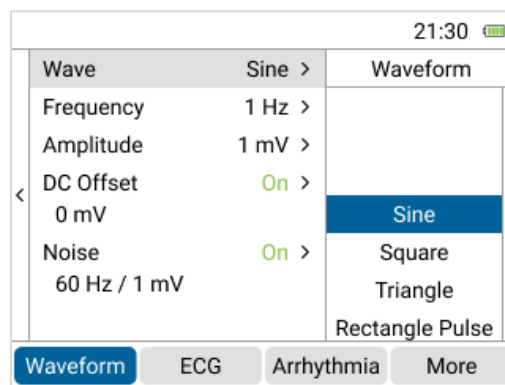
## 2.3 “Waveform” Function

Users can configure a desired standard waveform for testing through the “Waveform” function.

### 2.3.1 “Wave” Parameter

The HECG100 provides sine, triangle, square, rectangle pulse, and triangle pulse waveforms for users to select.

Note: If users select rectangle pulse and triangle pulse waveforms, the “Width” parameter will show under the “Frequency” parameter.



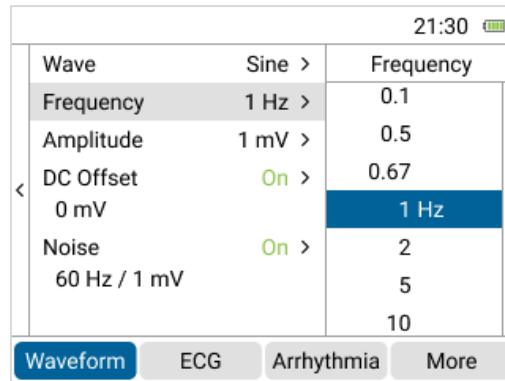
| Wave         | Sine > | Waveform        |
|--------------|--------|-----------------|
| Frequency    | 1 Hz > |                 |
| Amplitude    | 1 mV > |                 |
| DC Offset    | On >   |                 |
| 0 mV         |        | Sine            |
| Noise        | On >   | Square          |
| 60 Hz / 1 mV |        | Triangle        |
|              |        | Rectangle Pulse |

Waveform ECG Arrhythmia More

Figure 4: “Wave” Parameter

### 2.3.2 “Frequency” Parameter

The options under “Frequency” parameter vary according to the designated waveform.

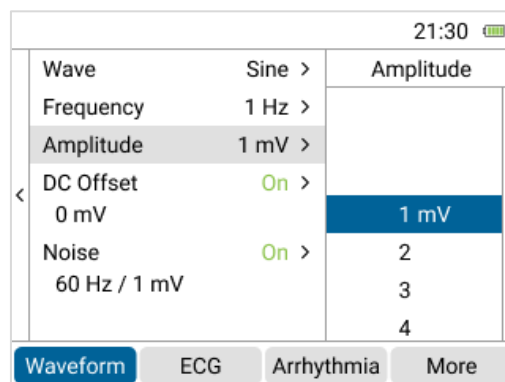


|              |        | 21:30  |
|--------------|--------|-----------------------------------------------------------------------------------------|
| Wave         | Sine > | Frequency                                                                               |
| Frequency    | 1 Hz > | 0.1                                                                                     |
| Amplitude    | 1 mV > | 0.5                                                                                     |
| DC Offset    | On >   | 0.67                                                                                    |
| 0 mV         |        | 1 Hz                                                                                    |
| Noise        | On >   | 2                                                                                       |
| 60 Hz / 1 mV |        | 5                                                                                       |
|              |        | 10                                                                                      |
| Waveform     |        | ECG Arrhythmia More                                                                     |

Figure 5: “Frequency” Parameter

### 2.3.3 “Amplitude” Parameter

The options under “Amplitude” parameter vary according to the designated waveform.



|              |        | 21:30  |
|--------------|--------|-------------------------------------------------------------------------------------------|
| Wave         | Sine > | Amplitude                                                                                 |
| Frequency    | 1 Hz > |                                                                                           |
| Amplitude    | 1 mV > |                                                                                           |
| DC Offset    | On >   |                                                                                           |
| 0 mV         |        | 1 mV                                                                                      |
| Noise        | On >   | 2                                                                                         |
| 60 Hz / 1 mV |        | 3                                                                                         |
|              |        | 4                                                                                         |
| Waveform     |        | ECG Arrhythmia More                                                                       |

Figure 6: “Amplitude” Parameter

### 2.3.4 “DC offset” Parameter

Users can select “On” to superimpose the DC offset signal to the designated waveform.

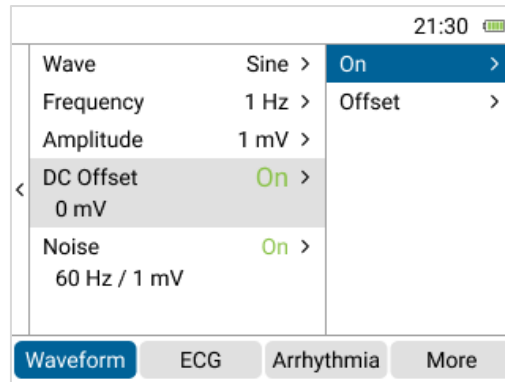


Figure 7: “On/Off” Options of “DC offset” Parameter

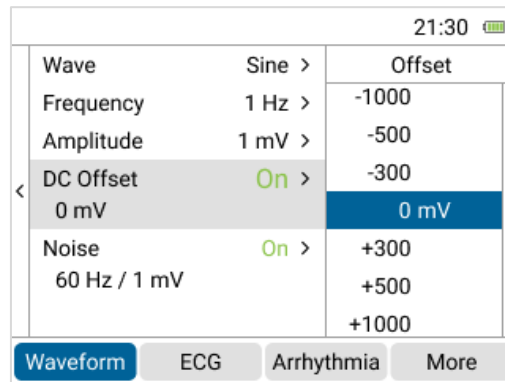


Figure 8: Options of “DC offset” Parameter

### 2.3.5 “Noise” Parameter

Users can select “On” to superimpose the noise signal with main noise and amplitude options to the designated waveform.

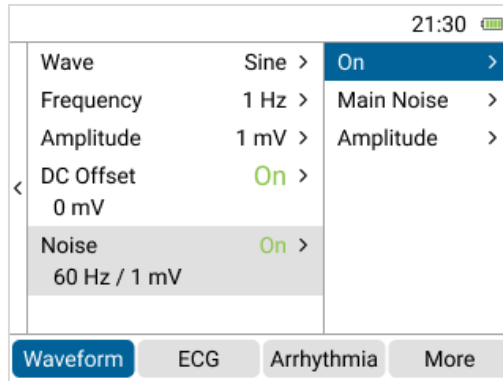


Figure 9: “On/Off” Options of “Noise” Parameter

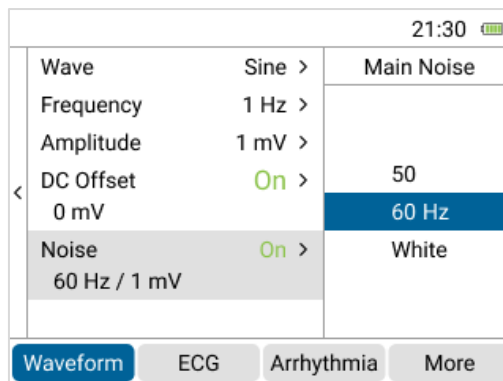


Figure 10: “Main Noise” Options of “Noise” Parameter

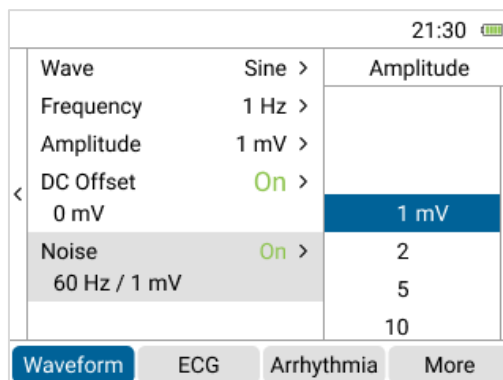


Figure 11: “Amplitude” Options of “Noise” Parameter

### 2.3.6 “Load” Function

Users can load previously saved waveforms from the HECG100 internal storage or the micro SD card for testing.

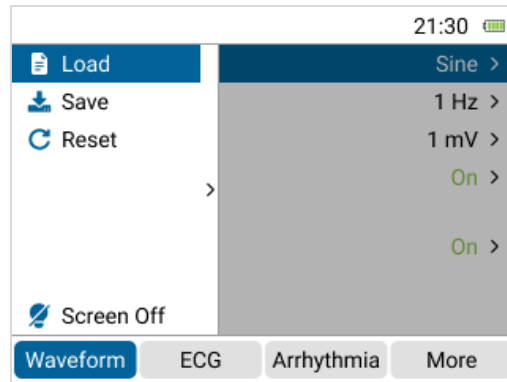


Figure 12: “Load” Function

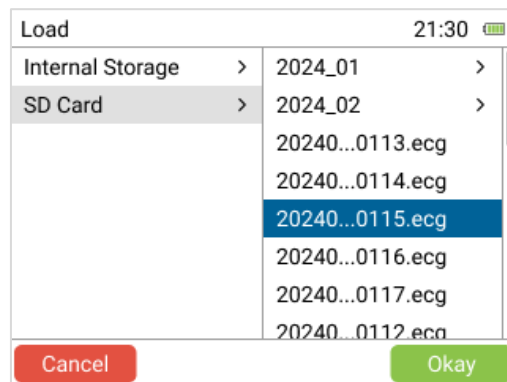


Figure 13: Load Previously Saved Waveforms from the micro SD Card

### 2.3.7 “Save” Function

Users can save configured waveforms to the HECG100 internal storage or the micro SD card for future testing.

Note: Users can create new folders for the internal storage and micro SD card to categorize waveforms.

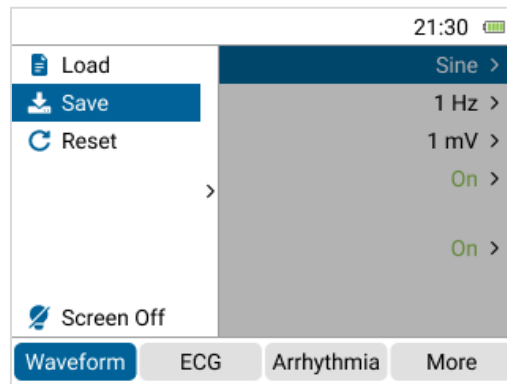


Figure 14: "Save" Function

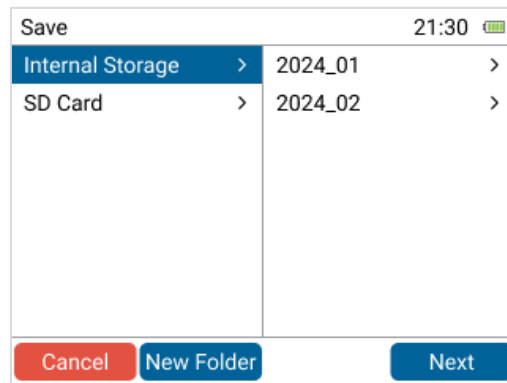


Figure 15: Save Configured Waveforms to the HECG100 Internal Storage



Figure 16: Name the Configured Waveform



Figure 17: “Successfully Saved” Message of Saving Configured Waveforms

### 2.3.8 “Reset” Function

Users can reset the settings of a configured waveform.

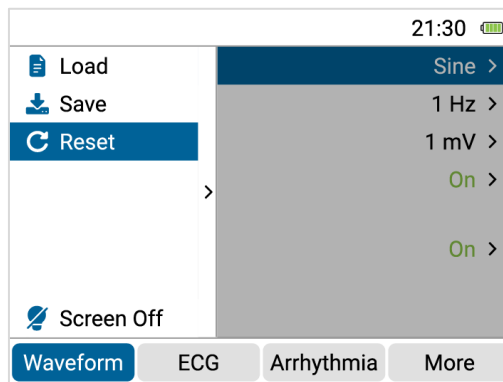


Figure 18: “Reset” Function

### 2.3.9 "Screen off" Function

If users select the "screen off" function, the HECG100 will be in power-saving mode.

By pressing any button on the HECG100, it will return to normal operation.

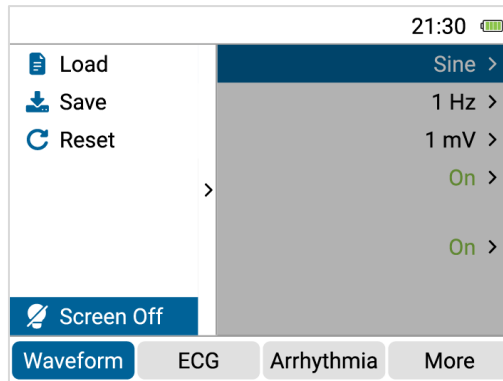


Figure 19: "Screen off" Function

## 2.4 “ECG” Function

Users can configure a desired ECG waveform for testing through the “ECG” function.

### 2.4.1 “Heart rate” Parameter

Select the desired heart rate value for the ECG waveform.

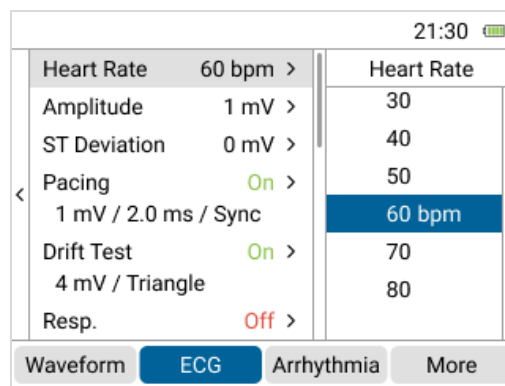


Figure 20: “Heart rate” Parameter

### 2.4.2 “Frequency” Parameter

Select the desired frequency value for the ECG waveform.

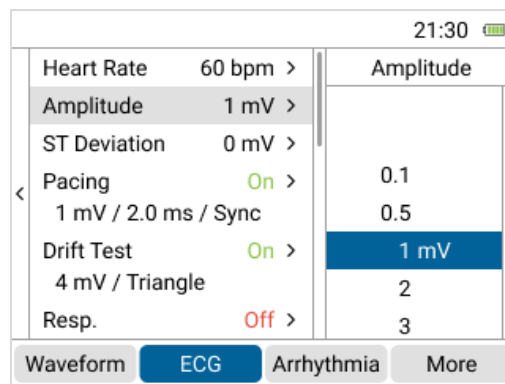


Figure 21: “Frequency” Parameter

### 2.4.3 “ST Deviation” Parameter

Select the desired ST deviation value for the ECG waveform.

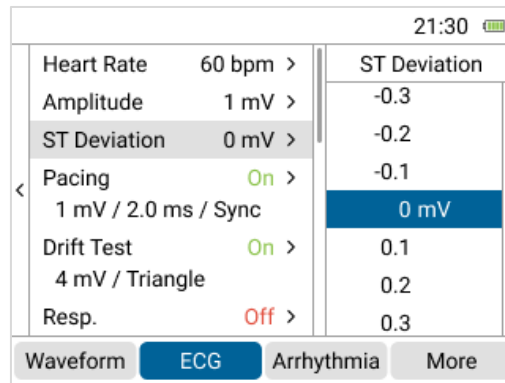


Figure 22: “ST Deviation” Parameter

### 2.4.4 “Pacing” Parameter

Users can select “On” to superimpose the pacing signal with amplitude and duration options to the configured waveform.

Note: When using the pacing signal, users need to disable the respiration simulation.

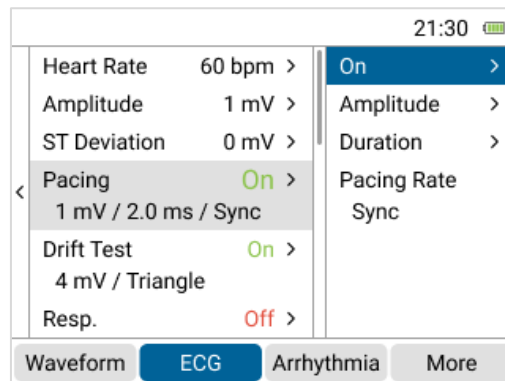


Figure 23: “On/Off” Options of “Pacing” Parameter

21:30 

|                      |          |           |
|----------------------|----------|-----------|
| Heart Rate           | 60 bpm > | Amplitude |
| Amplitude            | 1 mV >   |           |
| ST Deviation         | 0 mV >   |           |
| < Pacing             | On >     |           |
| 1 mV / 2.0 ms / Sync |          | 1 mV      |
| Drift Test           | On >     | 2         |
| 4 mV / Triangle      |          | 5         |
| Resp.                | Off >    | 10        |

Waveform
ECG
Arrhythmia
More

Figure 24: "Amplitude" Options of "Pacing" Parameter

21:30 

|                      |          |          |
|----------------------|----------|----------|
| Heart Rate           | 60 bpm > | Duration |
| Amplitude            | 1 mV >   | 0.5      |
| ST Deviation         | 0 mV >   | 1.0      |
| < Pacing             | On >     | 1.5      |
| 1 mV / 2.0 ms / Sync |          | 2.0 ms   |
| Drift Test           | On >     | 3        |
| 4 mV / Triangle      |          |          |
| Resp.                | Off >    |          |

Waveform
ECG
Arrhythmia
More

Figure 25: "Duration" Options of "Pacing" Parameter

### 2.4.5 “Drift test” Parameter

Users can select “On” to superimpose a triangle waveform (0.1Hz, 4mVpp) to the configured waveform for testing baseline drift.

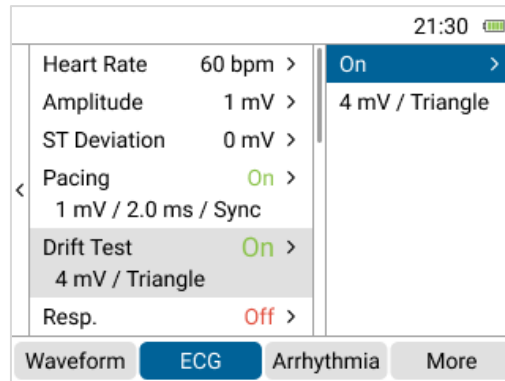


Figure 26: “Drift test” Parameter

### 2.4.6 “Respiration” Parameter

Users can select “On” to superimpose the respiration signal with rate, baseline, variation and apnea options to the configured waveform.

Note: When using the respiration signal, users need to disable the pacing and DC offset simulation.

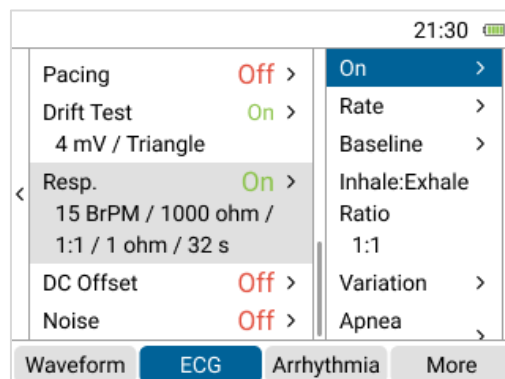


Figure 27: “On/Off” Options of “Respiration” Parameter

| 21:30  |         |
|-----------------------------------------------------------------------------------------|---------|
| Pacing <span>Off</span> >                                                               | Rate    |
| Drift Test <span>On</span> >                                                            |         |
| 4 mV / Triangle                                                                         |         |
| < Resp. <span>On</span> >                                                               |         |
| 15 BrPM / 1000 ohm /                                                                    | 15 BrPM |
| 1:1 / 1 ohm / 32 s                                                                      | 20      |
| DC Offset <span>Off</span> >                                                            | 30      |
| Noise <span>Off</span> >                                                                | 40      |
| Waveform <span>ECG</span> Arrhythmia More                                               |         |

Figure 28: "Rate" Options of "Respiration" Parameter

| 21:30  |          |
|-----------------------------------------------------------------------------------------|----------|
| Pacing <span>Off</span> >                                                               | Baseline |
| Drift Test <span>On</span> >                                                            |          |
| 4 mV / Triangle                                                                         |          |
| < Resp. <span>On</span> >                                                               | 500      |
| 15 BrPM / 1000 ohm /                                                                    | 1000 ohm |
| 1:1 / 1 ohm / 32 s                                                                      | 1500     |
| DC Offset <span>Off</span> >                                                            |          |
| Noise <span>Off</span> >                                                                |          |
| Waveform <span>ECG</span> Arrhythmia More                                               |          |

Figure 29: "Baseline" Options of "Respiration" Parameter

| 21:30  |           |
|-------------------------------------------------------------------------------------------|-----------|
| Pacing <span>Off</span> >                                                                 | Variation |
| Drift Test <span>On</span> >                                                              |           |
| 4 mV / Triangle                                                                           |           |
| < Resp. <span>On</span> >                                                                 | 1         |
| 15 BrPM / 1000 ohm /                                                                      | 2 ohm     |
| 1:1 / 1 ohm / 32 s                                                                        | 5         |
| DC Offset <span>Off</span> >                                                              |           |
| Noise <span>Off</span> >                                                                  |           |
| Waveform <span>ECG</span> Arrhythmia More                                                 |           |

Figure 30: "Variation" Options of "Respiration" Parameter

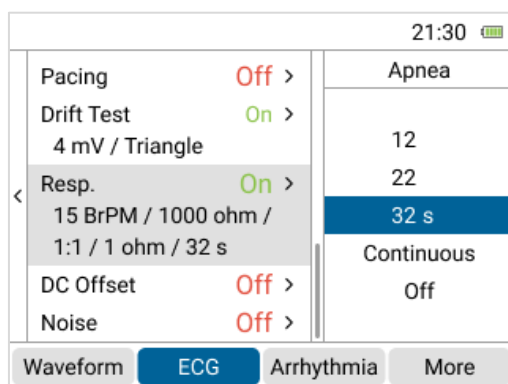


Figure 31: "Apnea" Options of "Respiration" Parameter

### 2.4.7 “DC offset” Parameter

Users can select “On” to superimpose the DC offset signal to the configured waveform.

Note: When using the DC offset signal, users need to disable the respiration simulation.

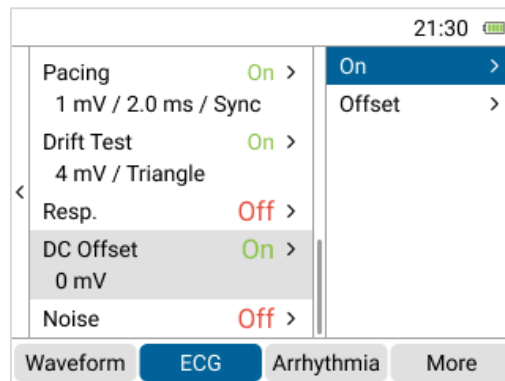


Figure 32: “On/Off” Options of “DC offset” Parameter

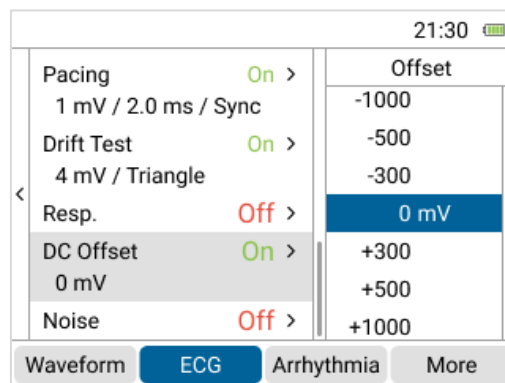


Figure 33: Options of “DC offset” Parameter

### 2.4.8 “Noise” Parameter

Users can select “On” to superimpose the noise signal with main noise and amplitude options to the configured waveform.

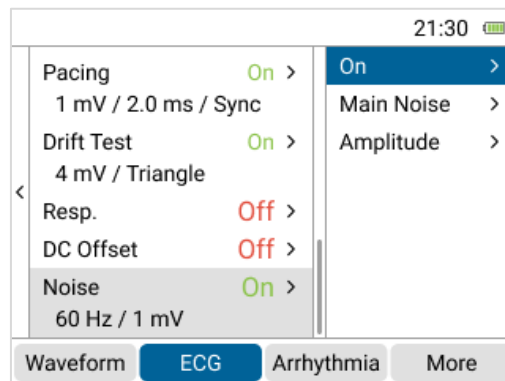


Figure 34: "On/Off" Options of "Noise" Parameter

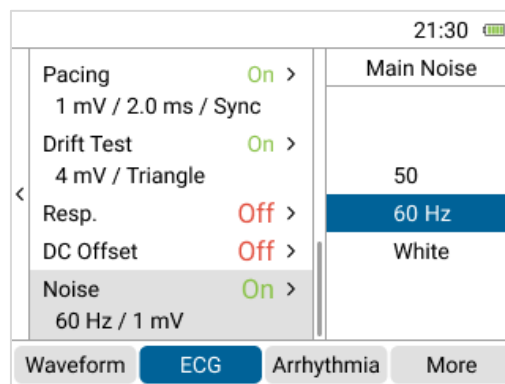


Figure 35: "Main Noise" Options of "Noise" Parameter

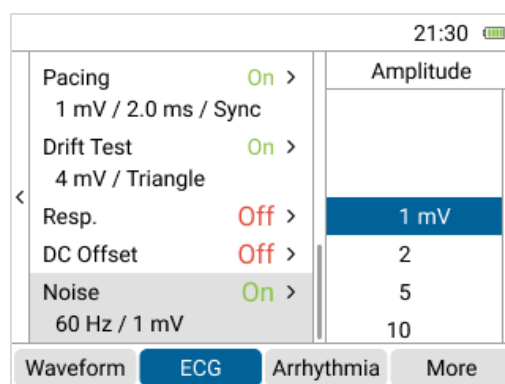


Figure 36: "Amplitude" Options of "Noise" Parameter

## 2.4.9 “Load”, “Save”, and “Reset” Functions

In the sidebar of ECG function, user can also load, save, and reset configured waveforms.

Please refer to “2.3.6“Load” Function”, “2.3.7 “Save” Function”, and “2.3.8“Reset” Function” for more information.

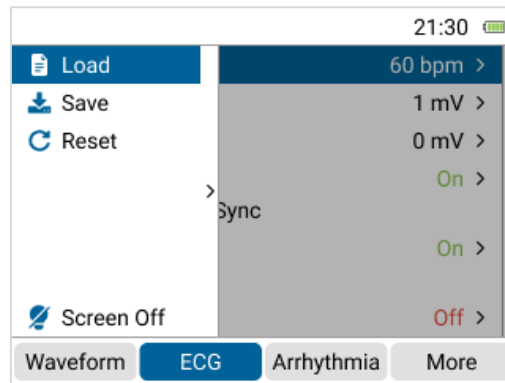


Figure 37: “Load”, “Save”, and “Reset” Functions

## 2.5 “Arrhythmia” Function

The HECG100 provides a database of 32 arrhythmia waveforms categorized as sinus rhythm, premature beat, flutter and fibrillation, conduction block, and bundle branch block for testing.

Note: The HECG100 includes the CAL20110 waveform required for IEC 60601-2-25 testing. However, because HECG100 outputs a single-channel ECG signal and derives signals for other leads as fixed ratios of Lead II, users must adjust the pass/fail criteria accordingly. For example, Lead I is output at 70% of Lead II’s amplitude, so test thresholds should be scaled to reflect this ratio. This testing method is permitted under the standard. For detailed lead output ratios, please refer to the [technical specifications](#).

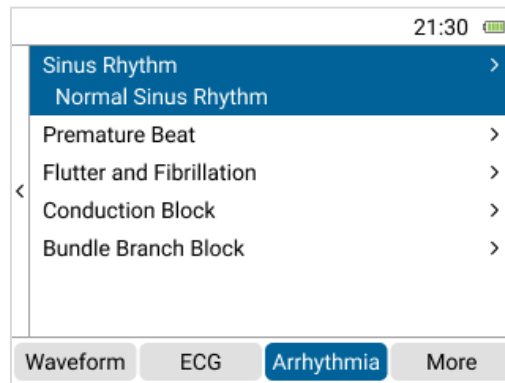


Figure 38: “Arrhythmia” Function

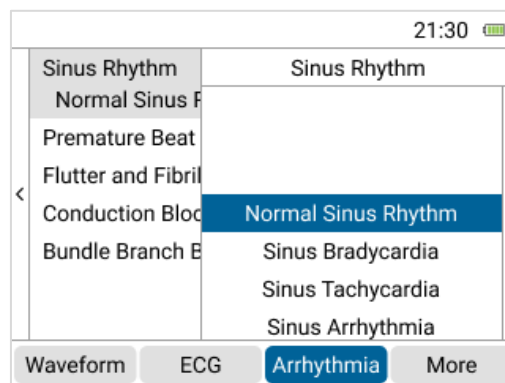


Figure 39: Select a Desired Arrhythmia Waveform for Testing

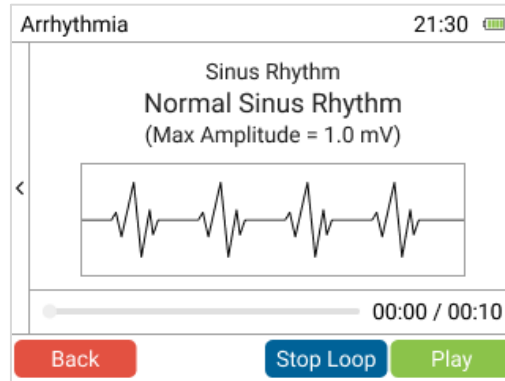


Figure 40: Play the Desired Arrhythmia Waveform for Testing

Table 8: Provided Waveforms of “Arrhythmia” Function

| Categories               | Waveforms                           |
|--------------------------|-------------------------------------|
| Sinus Rhythm             | Normal Sinus Rhythm-1               |
|                          | Normal Sinus Rhythm-2               |
|                          | Sinus Bradycardia-1                 |
|                          | Sinus Bradycardia-2                 |
|                          | Sinus Tachycardia-1                 |
|                          | Sinus Tachycardia-2                 |
|                          | Sinus Arrhythmia-1                  |
|                          | Sinus Arrhythmia-2                  |
| Premature Beat           | Premature Ventricular Contraction-1 |
|                          | Premature Ventricular Contraction-2 |
|                          | Premature Ventricular Contraction-3 |
|                          | Premature Ventricular Contraction-4 |
|                          | Atrial Premature Contraction-1      |
|                          | Atrial Premature Contraction-2      |
|                          | Junctional Premature Contraction    |
| Flutter and Fibrillation | Atrial Flutter-1                    |
|                          | Atrial Flutter-2                    |
|                          | Atrial Fibrillation-1               |
|                          | Atrial Fibrillation-2               |
|                          | Atrial Fibrillation-3               |
|                          | Ventricular Fibrillation (Coarse)-1 |
|                          | Ventricular Fibrillation (Coarse)-2 |
|                          | Ventricular Fibrillation (fine)-1   |

| Categories          | Waveforms                         |
|---------------------|-----------------------------------|
|                     | Ventricular Fibrillation (fine)-2 |
| Conduction Block    | First-Degree AV Block             |
|                     | Second-Degree AV Block I          |
|                     | Second-Degree AV Block II         |
|                     | Third-Degree AV Block             |
| Bundle Branch Block | Right Bundle Branch Block-1       |
|                     | Right Bundle Branch Block-2       |
|                     | Left Bundle Branch Block-1        |
|                     | Left Bundle Branch Block-2        |
| Others              | CAL20110                          |
|                     | EMG-1                             |
|                     | EMG-2                             |
|                     | EMG-3                             |

## 2.6 “More” Function

In the “More” function, users can perform the play raw data function and configure general settings of the HECG100.

### 2.6.1 “Play Raw” Function

The play raw data function allows users to test using their own waveforms. Please follow the steps below to perform this function:

1. Store waveforms in the provided micro SD card.
2. Insert the micro SD card to the HECG100 for reading and testing.

Note:

- (1) The micro SD card supports storage of at least 100 raw data files with each file containing 20 seconds of data sampled at 10kHz. The number of files that can be stored may vary depending on the file length.
- (2) If users encounter any issues when enabling this function, please contact WhaleTeq.

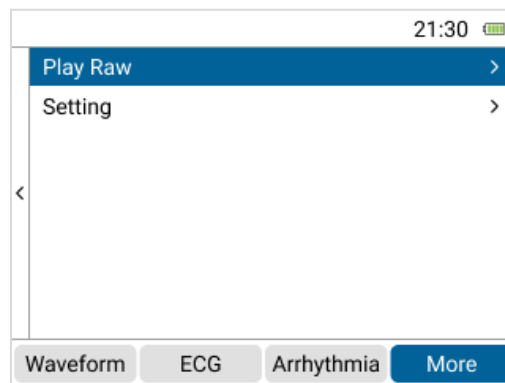


Figure 41: “Play Raw” Function

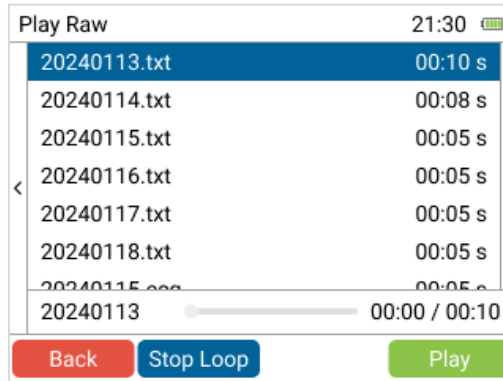


Figure 42: Raw Data Files for Playback

## 2.6.2 Settings

In the “Settings” function, users can configure “Date/Time” and “Backlight”, and check “Battery”, “Device Information”, and “Firmware Update” information.

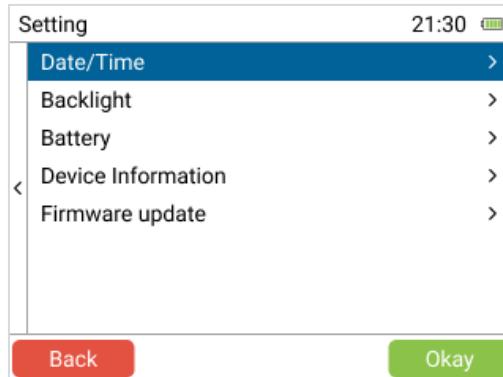
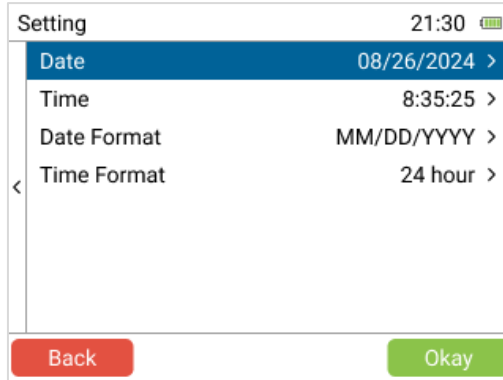


Figure 43: Settings

### 2.6.2.1 Date/Time Settings

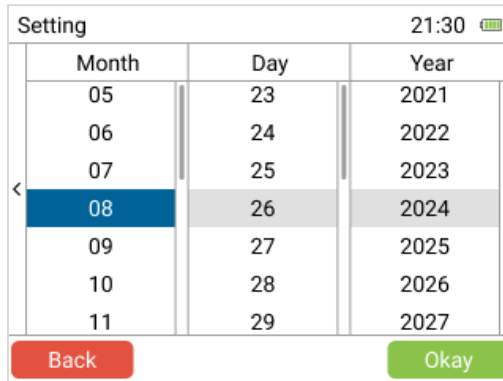
In the “Date/Time” settings, users can configure “Date”, “Time”, “Date Format”, and “Time Format” of the HECG100.



| Setting     |            | 21:30 |
|-------------|------------|-------|
| Date        | 08/26/2024 | >     |
| Time        | 8:35:25    | >     |
| Date Format | MM/DD/YYYY | >     |
| Time Format | 24 hour    | >     |

Back Okay

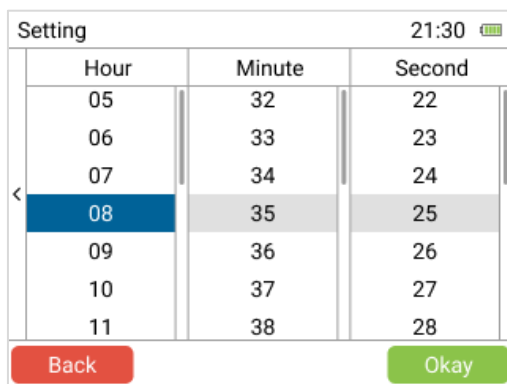
Figure 44: Date/Time Settings



| Setting |     | 21:30 |
|---------|-----|-------|
| Month   | Day | Year  |
| 05      | 23  | 2021  |
| 06      | 24  | 2022  |
| 07      | 25  | 2023  |
| 08      | 26  | 2024  |
| 09      | 27  | 2025  |
| 10      | 28  | 2026  |
| 11      | 29  | 2027  |

Back Okay

Figure 45: Date Setting

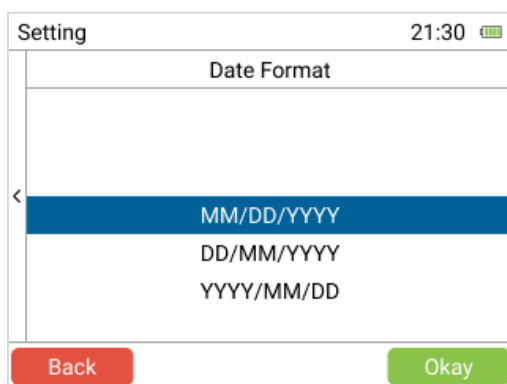


Setting 21:30 

| Hour | Minute | Second |
|------|--------|--------|
| 05   | 32     | 22     |
| 06   | 33     | 23     |
| 07   | 34     | 24     |
| 08   | 35     | 25     |
| 09   | 36     | 26     |
| 10   | 37     | 27     |
| 11   | 38     | 28     |

Back Okay

Figure 46: Time Setting



Setting 21:30 

Date Format

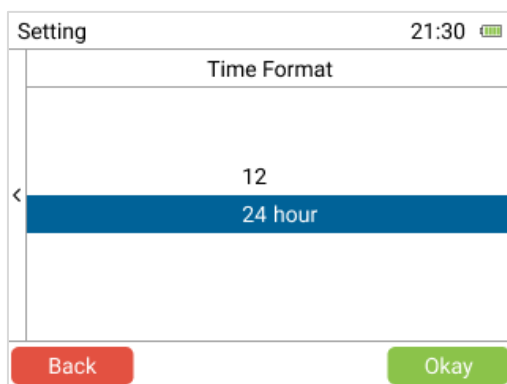
MM/DD/YYYY

DD/MM/YYYY

YYYY/MM/DD

Back Okay

Figure 47: Date Format Setting



Setting 21:30 

Time Format

12

24 hour

Back Okay

Figure 48: Time Format Setting

### 2.6.2.2 Backlight Settings

In the “Backlight” settings, users can select “Low”, “Medium”, and “High” for the LCD screen brightness.

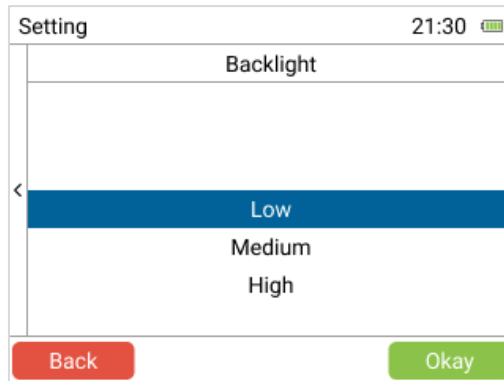


Figure 49: Backlight Settings

### 2.6.2.3 Battery Settings

In the “Battery” settings, users can select the time for “Auto Power Off” and check the percentage of battery level.

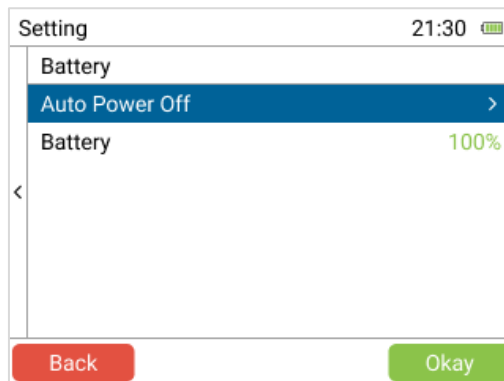


Figure 50: Battery Settings

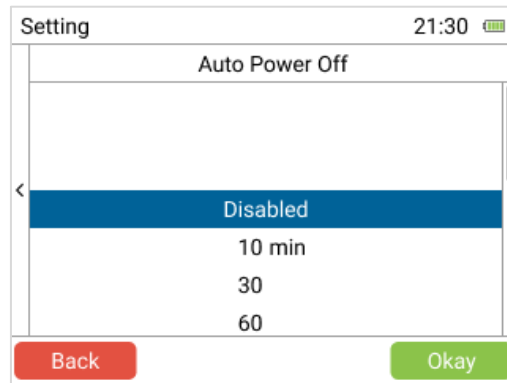


Figure 51: "Auto Power Off" Options

#### 2.6.2.4 Device Information

Users can check information such as model, firmware version, serial number, last calibration date, and play raw data license in this section.

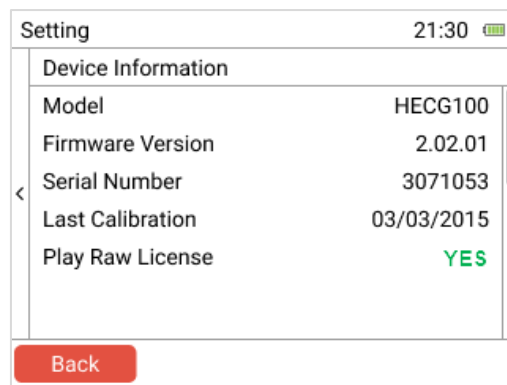


Figure 52: Device Information

### 2.6.2.5 Firmware Update

Please follow the steps below to update the firmware:

1. Visit the [HECG100 product page](#) to download the firmware update tool.
2. Install the tool to your computer and connect HECG100 to the computer.
3. Activate the tool.
4. Right click on the title bar and select "Check for Updates" to check whether a new firmware version is available.
5. The "Update" window will show "A new version is available" if a new firmware version is detected. Click "Yes" to update.
6. Reboot the HECG100 after updating the firmware.

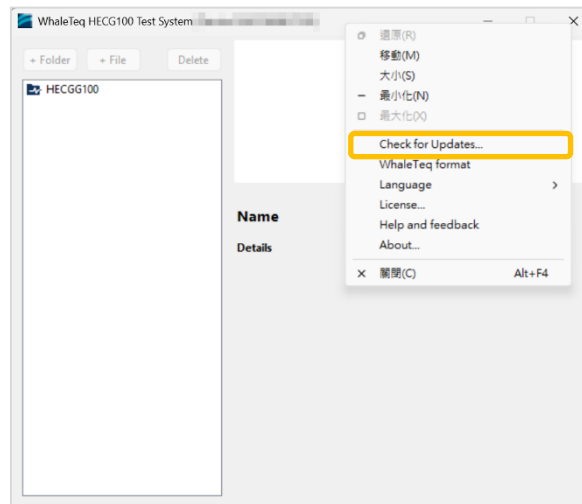


Figure 53: Firmware Update (step 4)



Figure 54: Firmware Update (step 5)

### 3 Calibration and Validation

It is recommended to calibrate the HECG100 annually. Calibration and validation both require traceable equipment. Steps for calibration and validation methods are available upon request. Please contact WhaleTeq for more details (see section 7).

### 4 Cautions

1. Before using the HECG100 for the first time, please charge it for at least 3 hours.
2. When the battery level icon displays “”, the HECG100 has a low battery. Please charge it as soon as possible.
3. The built-in battery must be kept from high temperatures (above 60°C) and open flames. Do not disassemble or short-circuit the HECG100.
4. The HECG100 is designed with ESD protection; however, when ESD testing is performed on the DUT, electrostatic discharge should not be applied directly to the HECG100 using the ESD gun.
5. For routine cleaning, use a slightly damp cloth with a neutral soap solution to wipe the external casing, and avoid getting moisture inside the HECG100. Do not use corrosive agents, isopropyl alcohol, or solvents for cleaning.

## 5 Ordering Information

### Standard Test System

Table 9: HECG100 Standard Test System

| Part No.    | Image                                                                             | Description                                                                                                                                                                                                                                                                                                                          | Quantity |
|-------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 100-EC00007 |  | <b>Model No.:</b> HECG100<br><b>Model Name:</b> Handheld 12-lead ECG Simulator<br><br>Package contents: <ul style="list-style-type: none"> <li>• HECG100 x 1</li> <li>• RCA male to BNC cable (74cm, black) x 1</li> <li>• USB Type-C to Type-C cable (male to male, 60cm, black) x 1</li> <li>• 32GB micro SDHC card x 1</li> </ul> | 1        |

### Optional Accessories

Table 10: Optional Accessories

| Part No.    | Image                                                                               | Description                                              | Quantity |
|-------------|-------------------------------------------------------------------------------------|----------------------------------------------------------|----------|
| K21-0738302 |  | RCA male to BNC cable (74cm) (black)                     | 1        |
| K27-0600301 |  | USB Type-C to Type-C cable (male to male) (60cm) (black) | 1        |
| S71-0201011 |  | 32GB micro SDHC card                                     | 1        |

## Optional Calibration Service and Warranty Extension

Table 11: Optional Calibration Service and Warranty Extension

| Part No. | Description                                                                                                                                                                 |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| YY0007   | <b>Model No.: C3</b><br>Provides (3) years of calibration service coverage. WhaleTeq equipment can be calibrated to original performance on the basis of (1) year interval. |
| YY0008   | <b>Model No.: R3</b><br>Extends the limited warranty from (1) year to (3) years.                                                                                            |

## 6 Revision History

Table 12: Revision History

| Version    | Description                      | Issue Date |
|------------|----------------------------------|------------|
| 2025-03-06 | First version                    | 2025-03-31 |
| 2025-05-13 | Update 2.5 "Arrhythmia" Function | 2025-05-15 |
| 2025-05-29 | Update 2.5 "Arrhythmia" Function | 2025-05-29 |

## 7 Contact WhaleTeq

|                                                                                      |
|--------------------------------------------------------------------------------------|
| WHALETEQ Co., LTD                                                                    |
| <a href="mailto:service@whaleteq.com">service@whaleteq.com</a>   (O)+886 2 2517 6255 |
| 8F., No. 125, Songjiang Rd., Zhongshan Dist., Taipei City 104474, Taiwan             |