WHALETEQ

HECG100

User Manual

Firmware Version 1.0.21
Revision 2025-05-13

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

List of Tables

List of Figures

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

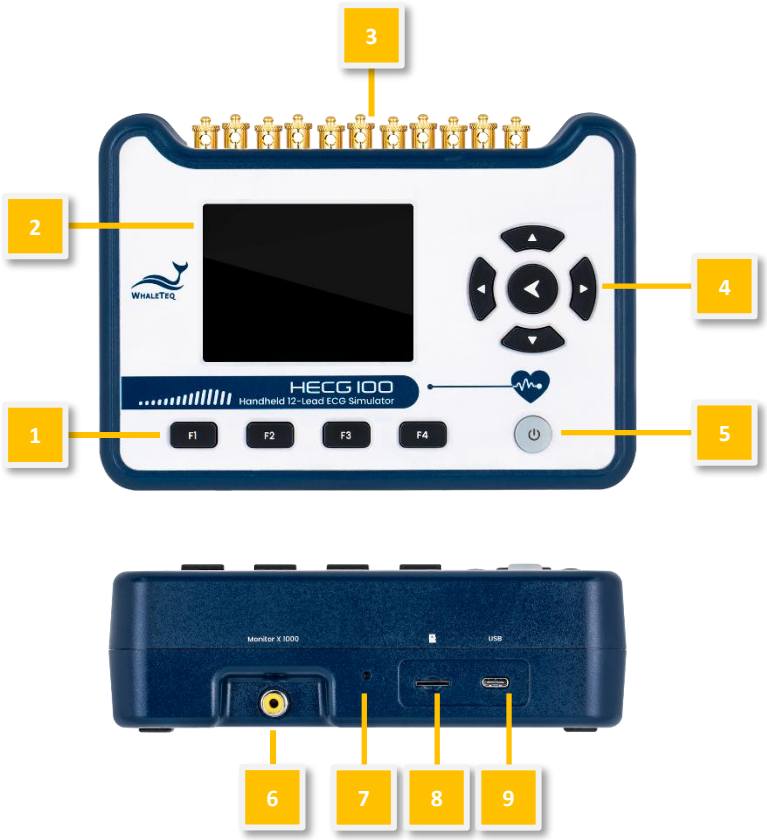

Figure 1: HECG100 Hardware Overview

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	±1%
Amplitude accuracy	±2%
Frequency / pulse repetition rate accuracy	±1%
Pulse duration accuracy (excluding pacing)	±0.5ms
ECG duration accuracy	±0.5ms
Pacing pulse width accuracy	±5µs
Pacing pulse amplitude accuracy, range	±2mV pulse: ±0.3% >2mV pulse: ±10%
Pacing pulse characteristics	Rise/fall time 5µs Overshoot <1% Settling time <1%
Capacitor tolerance	±5%

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

- **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		±300, ±500, ±1000mV
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	500Ω, 1000Ω, 1500Ω
	Ratio (inspiration:expiration)	1:1
	Variation	1Ω, 2Ω, 5Ω
	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) 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 Size (L x W x H): 18.0 x 12.8 x 5.5cm Weight: 950g
Data capacity	32GB micro SD card

- **Compliance Specifications**

Table 6: Compliance Specifications

Items	Specifications
FCC	EMC P15B
CE	• EMC EN61326-1 • ESD 8kV (contact), 15kV(air) • EMI Class A, Class B • Safety IEC/EN61010-1:2010 + A1:2016; Pollution degree 2 61010-2-030:201

2 Installation and Settings

2.1 Installation

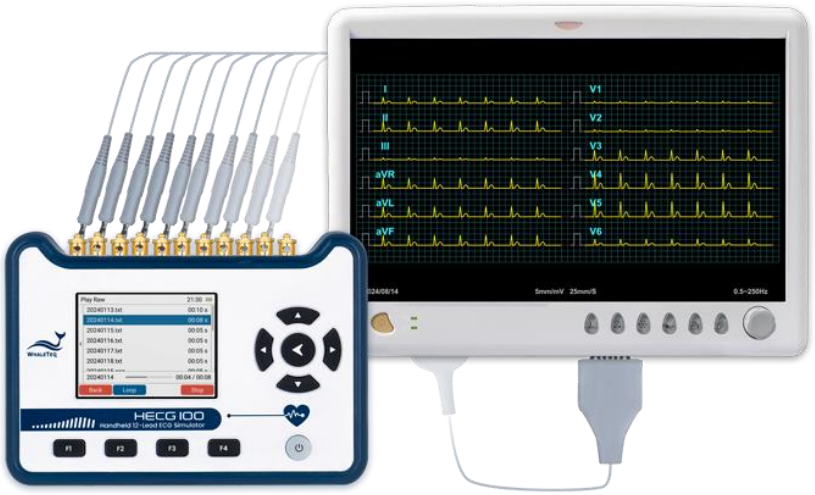

Figure 2: HECG100 Installation

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.

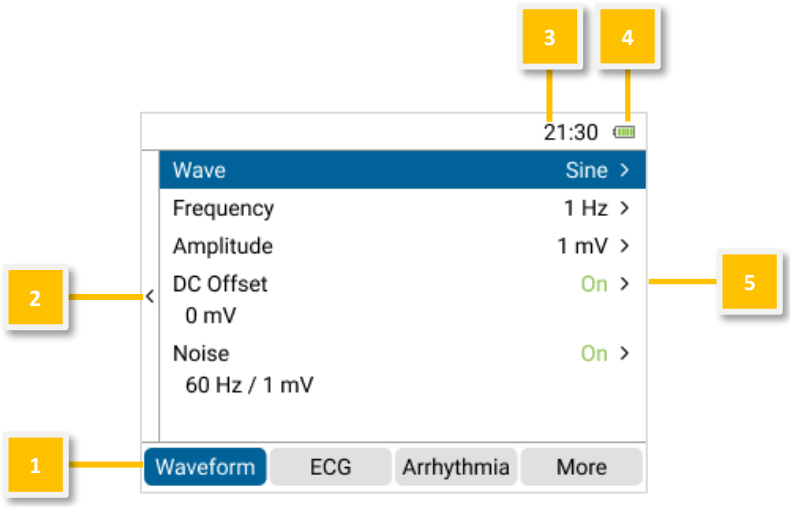

Figure 3: HECG100 Home Screen

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.

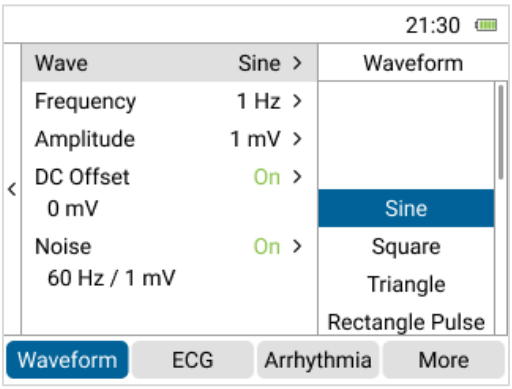

Figure 4: ‘’Wave’’ Parameter

2.3.2 ''Frequency'' Parameter

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

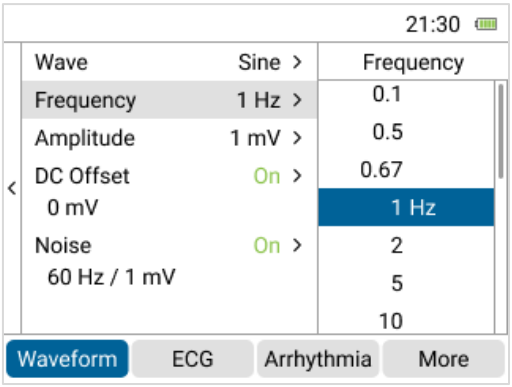

Figure 5: ''Frequency'' Parameter

2.3.3 ''Amplitude'' Parameter

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

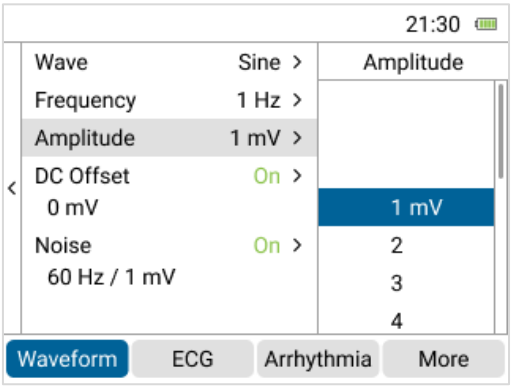

Figure 6: ''Amplitude'' Parameter

2.3.4 ''DC offset'' Parameter

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

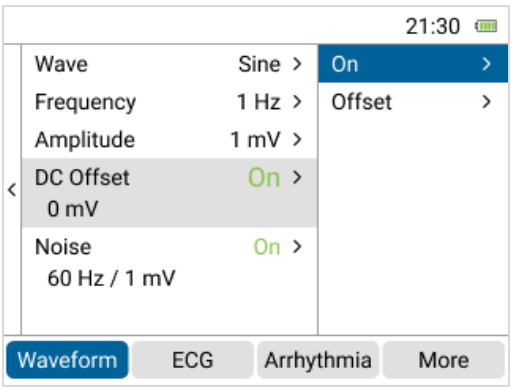

Figure 7: ''On/Off'' Options of ''DC offset'' Parameter

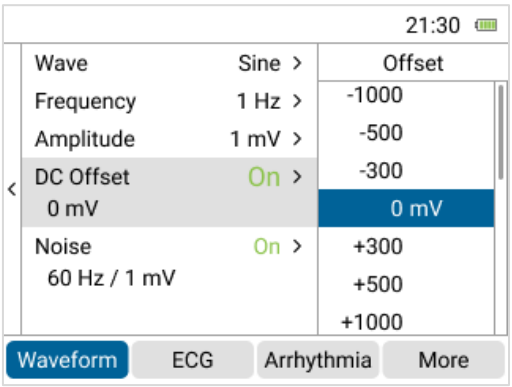

Figure 8: Options of ''DC offset'' Parameter

2.3.5 ''Noise'' Parameter

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

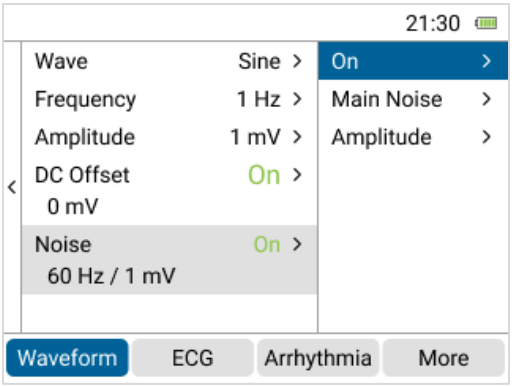

Figure 9: ''On/Off'' Options of ''Noise'' Parameter

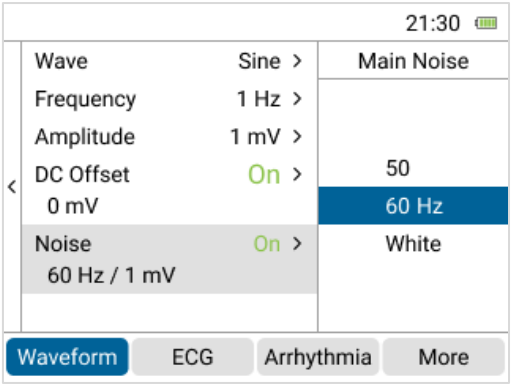

Figure 10: ''Main Noise'' Options of ''Noise'' Parameter

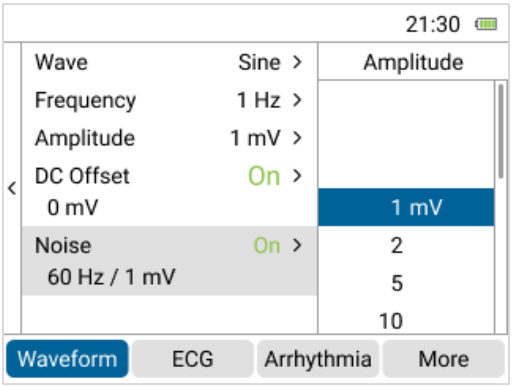

Figure 11: ''Amplitude'' Options of ''Noise'' Parameter

2.3.6 ''Load'' Function

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

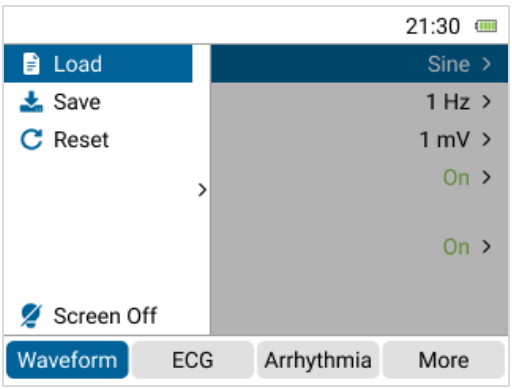

Figure 12: ''Load'' Function

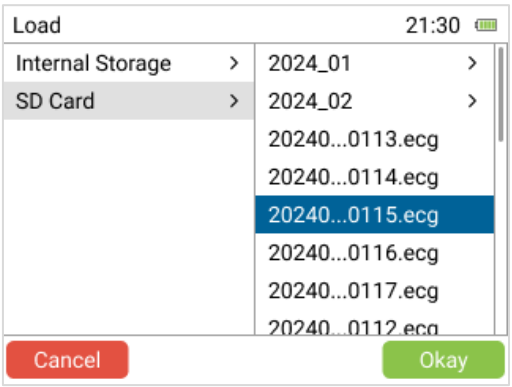

Figure 13: Load Previously Saved Waveforms from the micro SD Card

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.

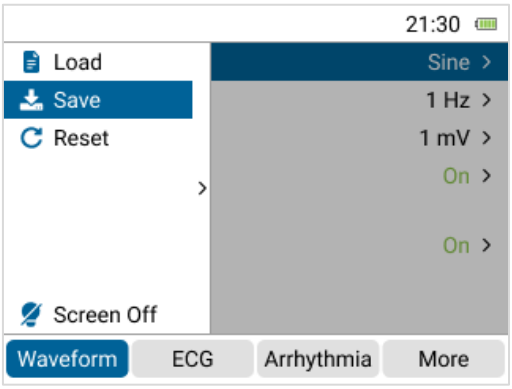

Figure 14: "Save" Function

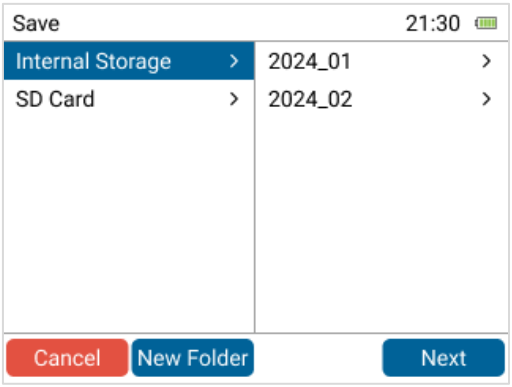

Figure 15: Save Configured Waveforms to the HECG100 Internal Storage

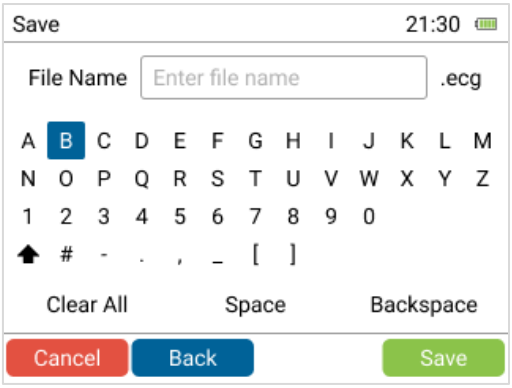

Figure 16: Name the Configured Waveform

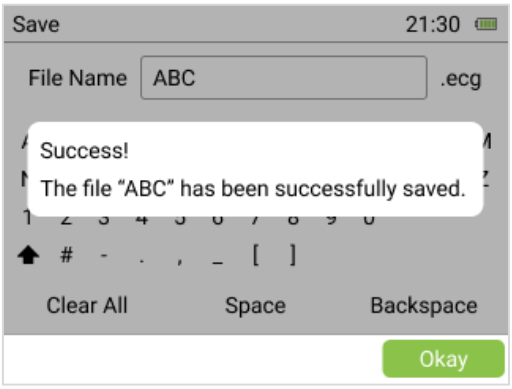

Figure 17: ''Successfully Saved'' Message of Saving Configured Waveforms

2.3.8 ''Reset'' Function

Users can reset the settings of a configured waveform.

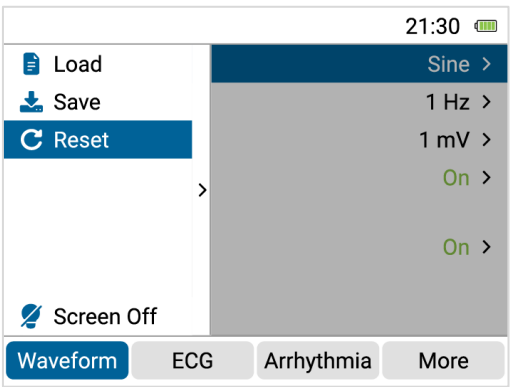

Figure 18: ''Reset'' Function

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.

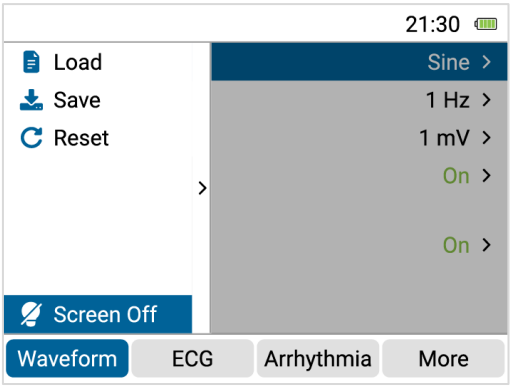

Figure 19: ''Screen off'' Function

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.

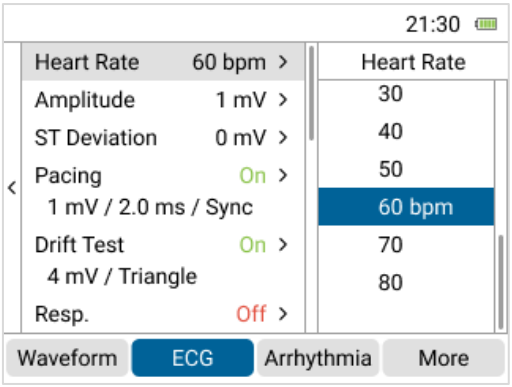

Figure 20: ‘’Heart rate’’ Parameter

2.4.2 ‘’Frequency’’ Parameter

Select the desired frequency value for the ECG waveform.

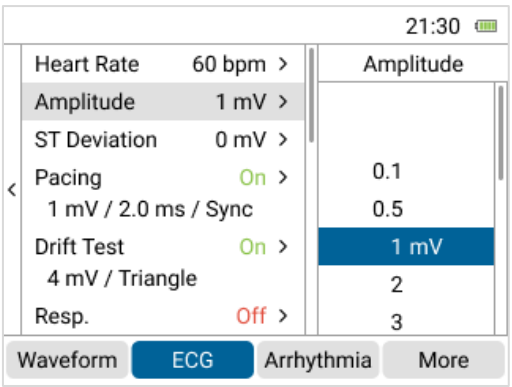

Figure 21: ‘’Frequency’’ Parameter

2.4.3 ''ST Deviation'' Parameter

Select the desired ST deviation value for the ECG waveform.

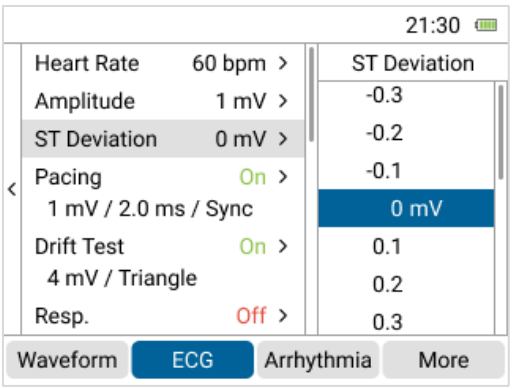

Figure 22: ''ST Deviation'' Parameter

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.

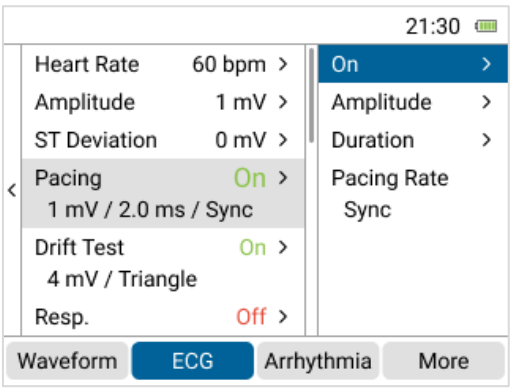

Figure 23: ''On/Off'' Options of ''Pacing'' Parameter

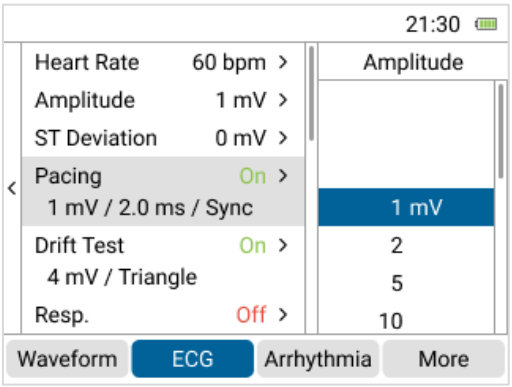

Figure 24: ''Amplitude'' Options of ''Pacing'' Parameter

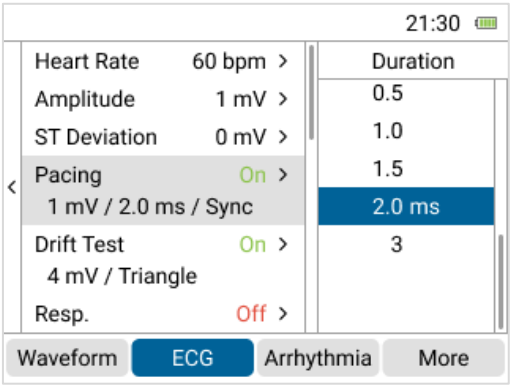

Figure 25: ''Duration'' Options of ''Pacing'' Parameter

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.

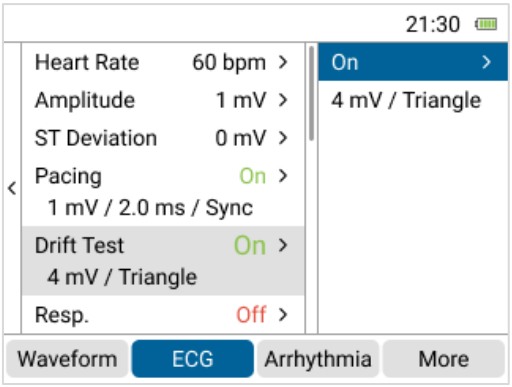

Figure 26: ''Drift test'' Parameter

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.

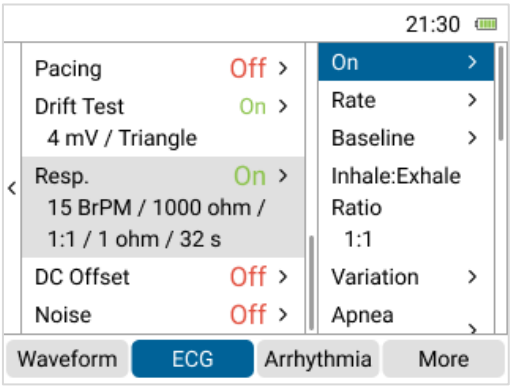

Figure 27: ''On/Off'' Options of ''Respiration'' Parameter

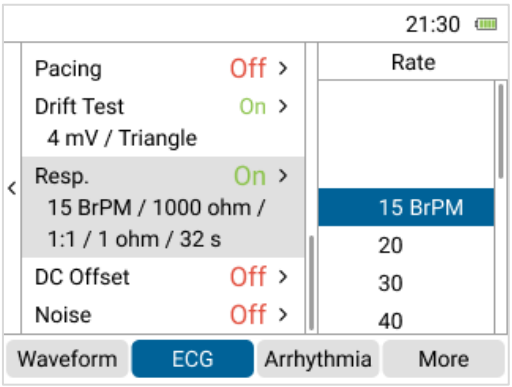

Figure 28: ''Rate'' Options of ''Respiration'' Parameter

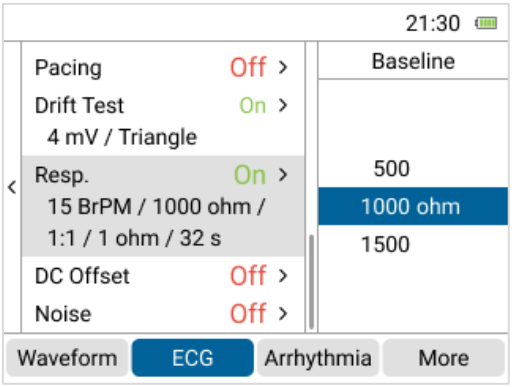

Figure 29: ''Baseline'' Options of ''Respiration'' Parameter

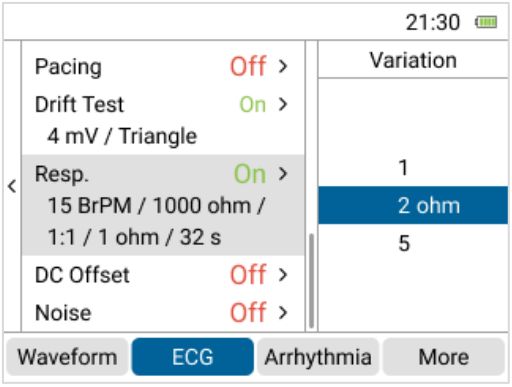

Figure 30: ''Variation'' Options of ''Respiration'' Parameter

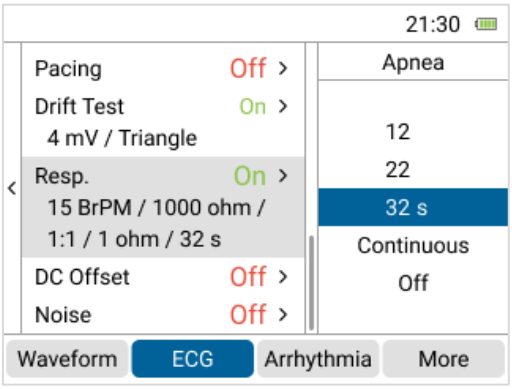

Figure 31: ''Apnea'' Options of ''Respiration'' Parameter

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.

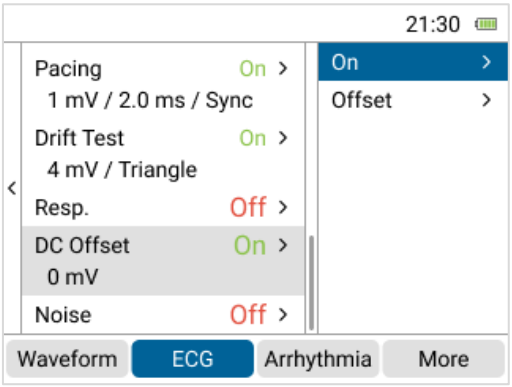

Figure 32: ''On/Off'' Options of ''DC offset'' Parameter

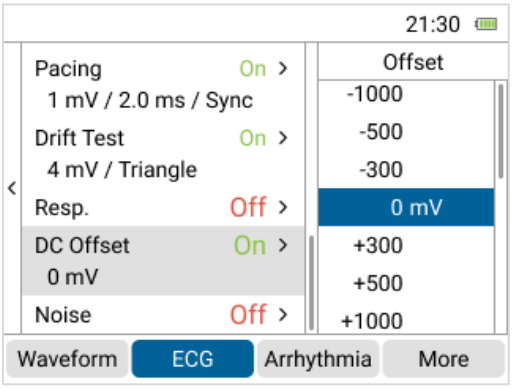

Figure 33: Options of ''DC offset'' Parameter

2.4.8 ''Noise'' Parameter

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

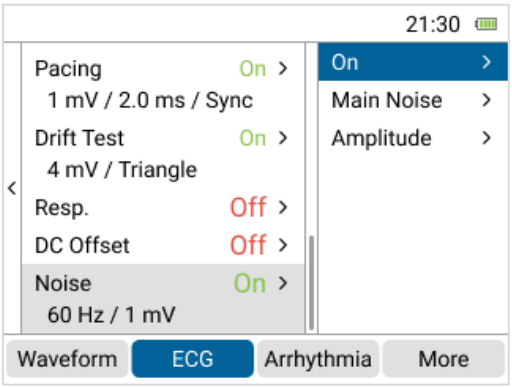

Figure 34: ''On/Off'' Options of ''Noise'' Parameter

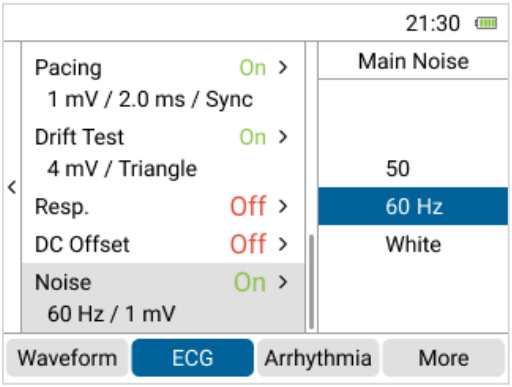

Figure 35: ''Main Noise'' Options of ''Noise'' Parameter

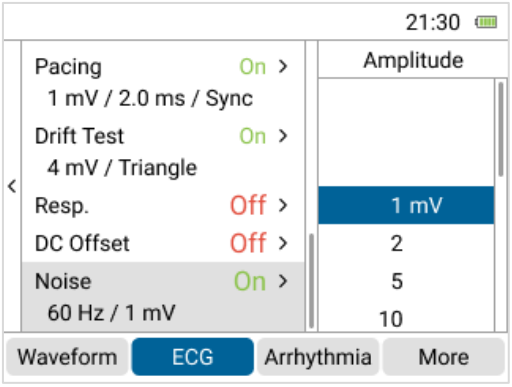

Figure 36: ''Amplitude'' Options of ''Noise'' Parameter

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.

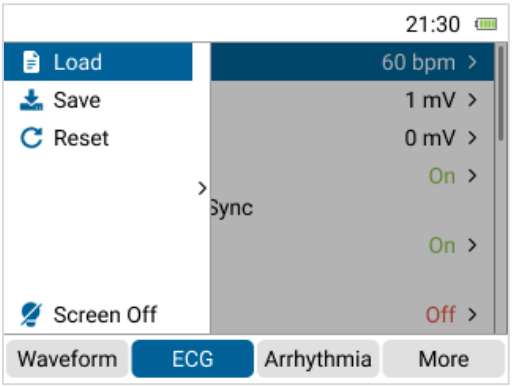

Figure 37: ‘’Load’’, ‘’Save’’, and ‘’Reset’’ Functions

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.

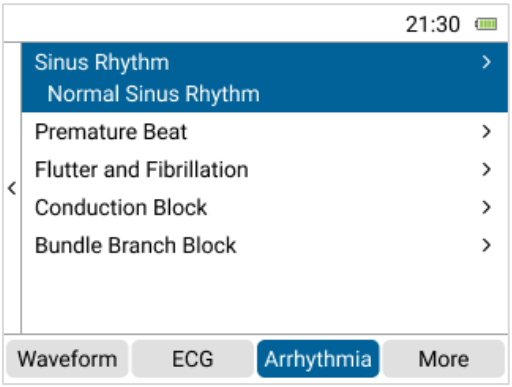

Figure 38: "Arrhythmia" Function

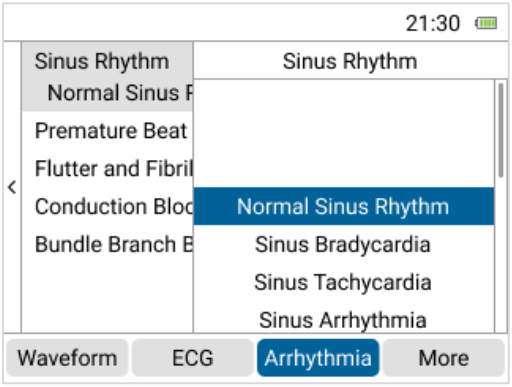

Figure 39: Select a Desired Arrhythmia Waveform for Testing

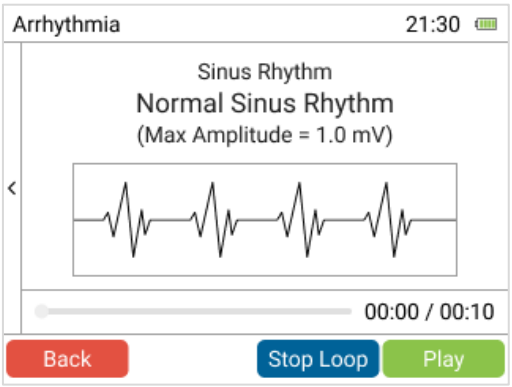

Figure 40: Play the Desired Arrhythmia Waveform for Testing

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.

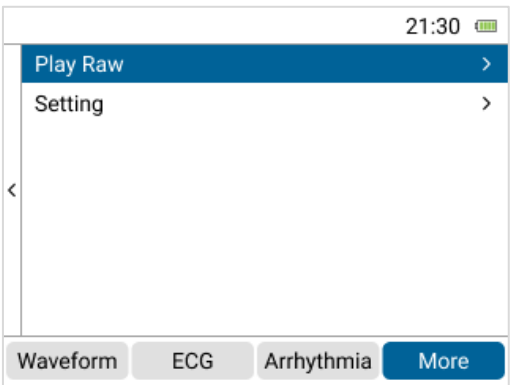

Figure 41: ‘’Play Raw’’ Function

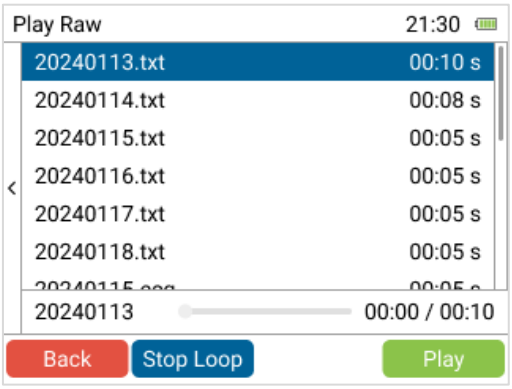

Figure 42: Raw Data Files for Playback

2.6.2 Settings

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

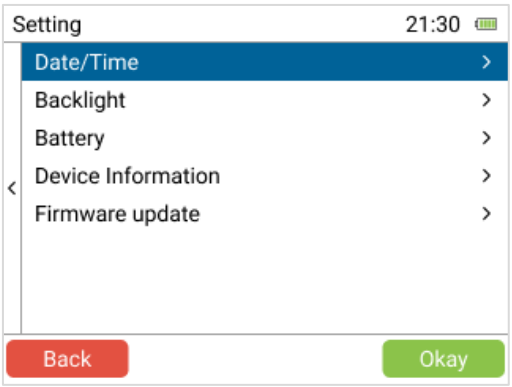

Figure 43: Settings

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.

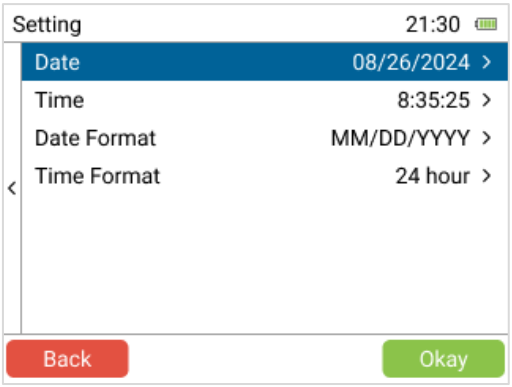

Figure 44: Date/Time Settings

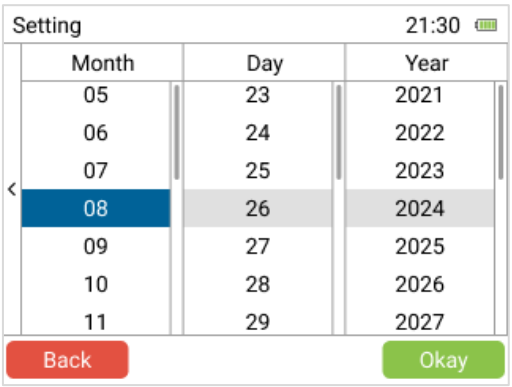

Figure 45: Date Setting

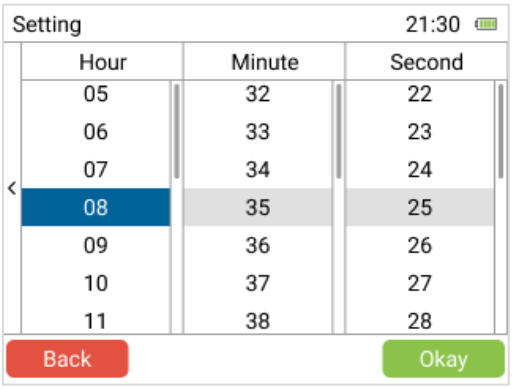

Figure 46: Time Setting

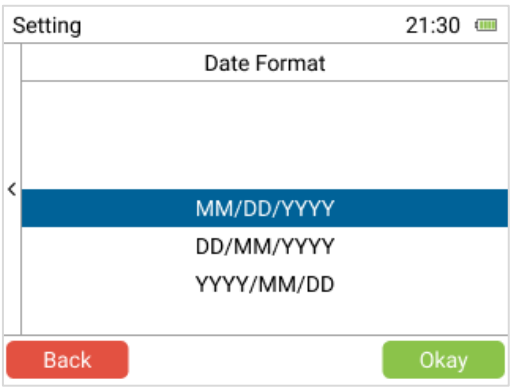

Figure 47: Date Format Setting

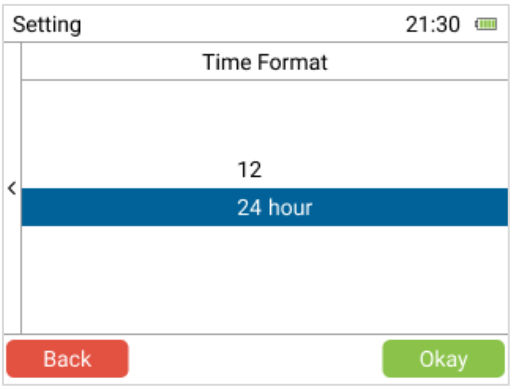

Figure 48: Time Format Setting

2.6.2.2 Backlight Settings

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

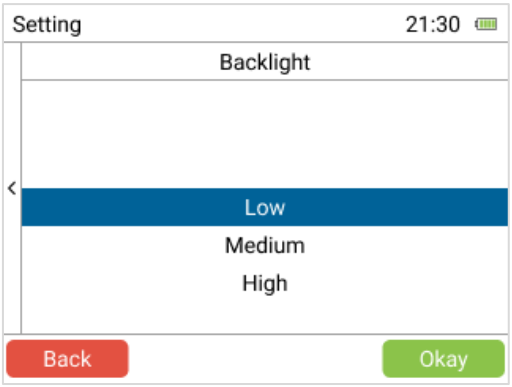

Figure 49: Backlight Settings

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.

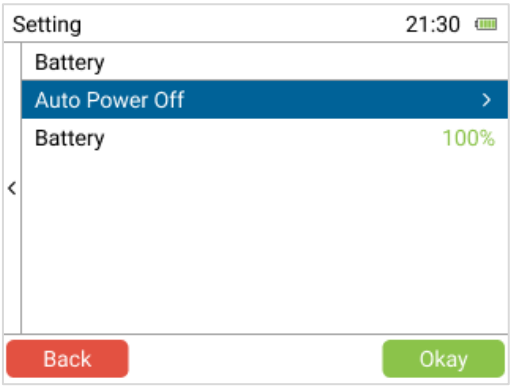

Figure 50: Battery Settings

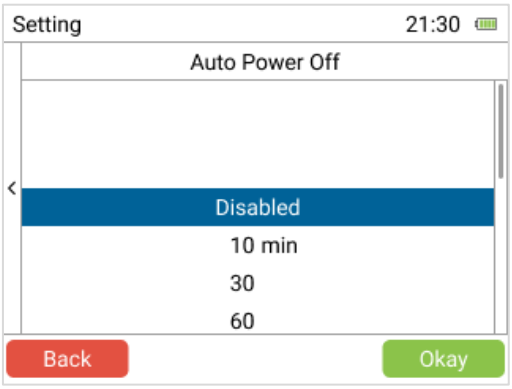

Figure 51: "Auto Power Off" Options

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.

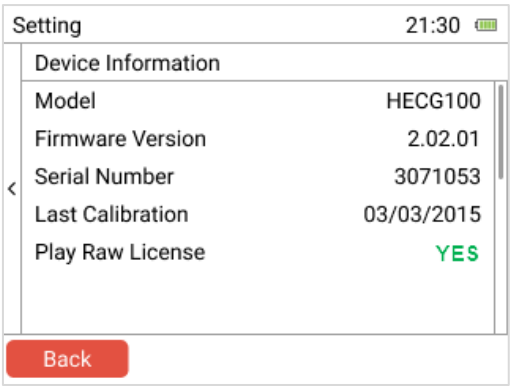

Figure 52: Device Information

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.

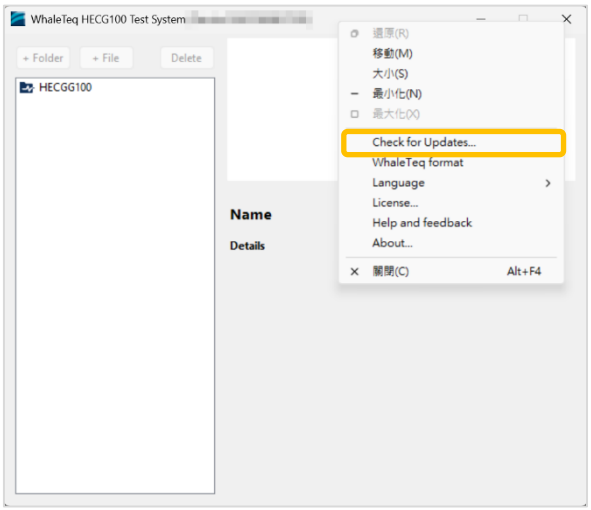

Figure 53: Firmware Update (step 4)

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		**Model No.**: HECG100 **Model Name**: Handheld 12-lead ECG Simulator Package contents: • HECG100 x 1 • RCA male to BNC cable (74cm, black) x 1 • USB Type-C to Type-C cable (male to male, 60cm, black) x 1 • 32GB micro SDHC card x 1	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	**Model No.**: C3 Provides (3) years of calibration service coverage. WhaleTeq equipment can be calibrated to original performance on the basis of (1) year interval.
YY0008	**Model No.**: R3 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

7 Contact WhaleTeq

WHALETEQ Co., LTD
service@whaleteq.com | (O)+886 2 2517 6255
8F., No. 125, Songjiang Rd., Zhongshan Dist., Taipei City 104474, Taiwan