

WHALETEQ

HECG100

User Manual



Firmware Version 1.0.33
Revision 2025-09-16

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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), "Bio-Signals" (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.

Note: Supported SD card types are SD (Secure Digital) and SDHC (Secure Digital High Capacity). Only the FAT32 file system is supported. It is recommended to use cards with a capacity of 2GB to 32GB. SDXC (Secure Digital Extended Capacity) cards are not supported.

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%
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)

Parameters	Specifications
	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 ($\Delta \Omega$)	±(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

Parameters		Specifications
	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
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

- **EMC Specifications**

Table 6: EMC Specifications

Items		Specifications
FCC		EMC P15B
CE		<ul style="list-style-type: none"> • 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
IEC 60601-1-2:2014/A1:2020	Test Items	Names
	IEC 61000-4-2	Electrostatic discharge
	IEC 61000-4-3	Radiated RF electromagnetic fields
	IEC 61000-4-6	Conducted RF
	IEC 61000-4-8	Rated power frequency magnetic fields

Note:

- (1) The HECG100 can operate alongside the DUT in the EMC test environment during the four IEC 60601-1-2:2014/A1:2020 electromagnetic compatibility tests listed above.
- (2) Operate HECG100 in battery-powered mode for these four EMC compliance tests with the DUT.
- (3) It is recommended to wrap the connection cables between HECG100 and DUT with foil to reduce noise interference.

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.

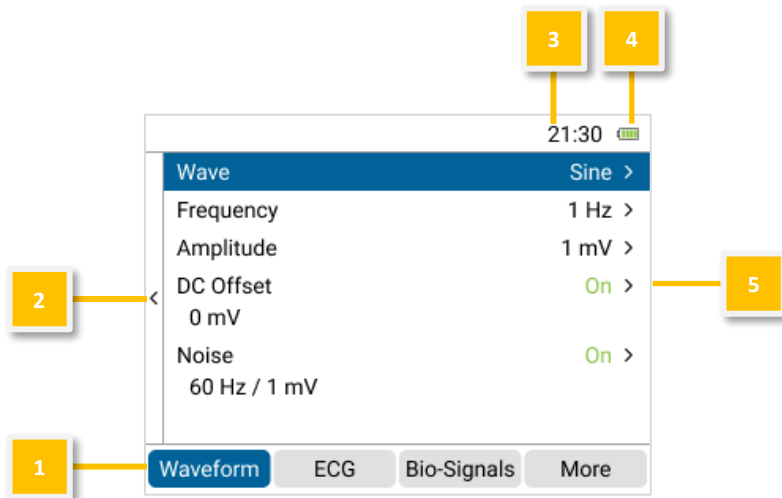


Figure 3: HECG100 Home Screen

Table 7: HECG100 Home Screen

Item	Name	Description
1	Functions	Switch between "Waveform", "ECG", "Bio-Signals" 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 .Wav", "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.

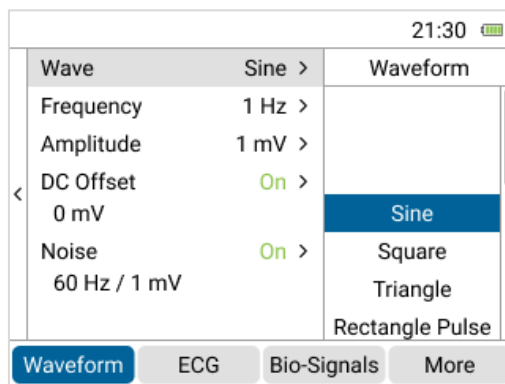


Figure 4: “Wave” Parameter

2.3.2 “Frequency” Parameter

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


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 Bio-Signals 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 Bio-Signals 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.

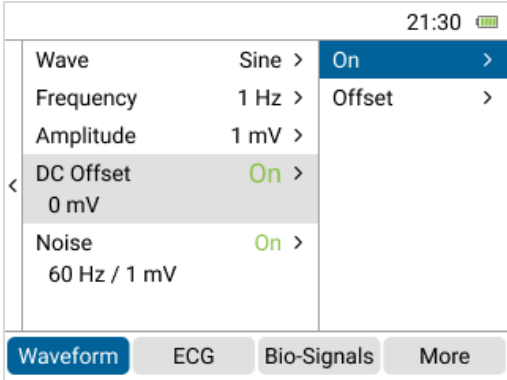


Figure 7: "On/Off" Options of "DC offset" Parameter

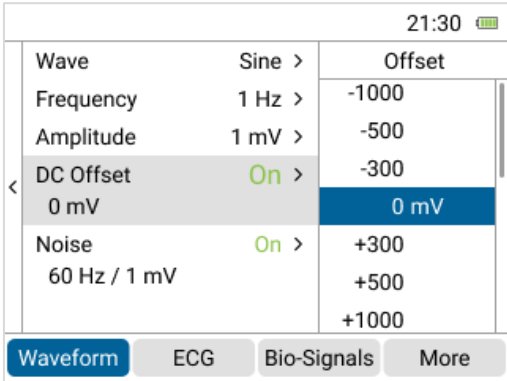


Figure 8: Options of "DC offset" Parameter

2.3.5 “Noise” Parameter

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

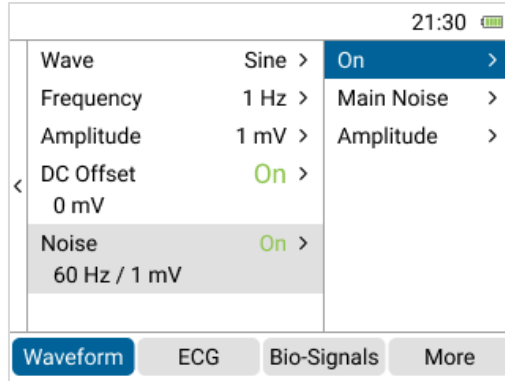


Figure 9: “On/Off” Options of “Noise” Parameter

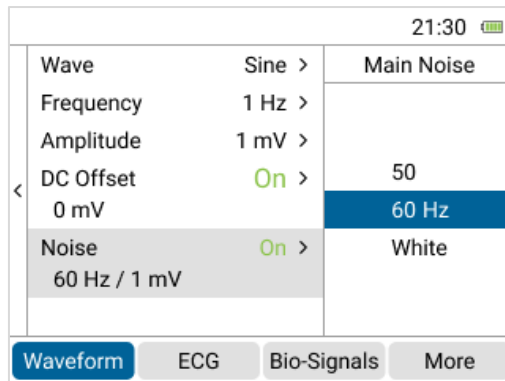


Figure 10: “Main Noise” Options of “Noise” Parameter

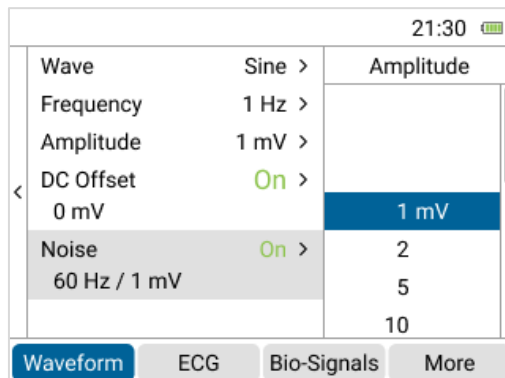


Figure 11: “Amplitude” Options of “Noise” Parameter

2.3.6 "Load .Wav" Function

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

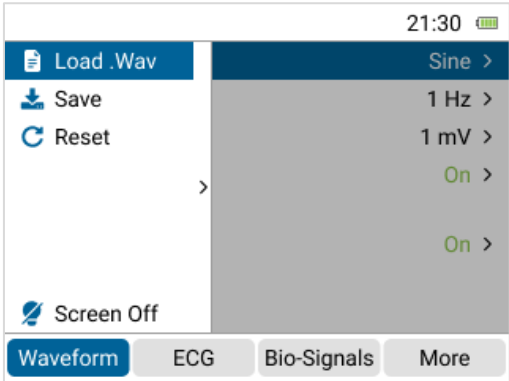


Figure 12: "Load .Wav" Function

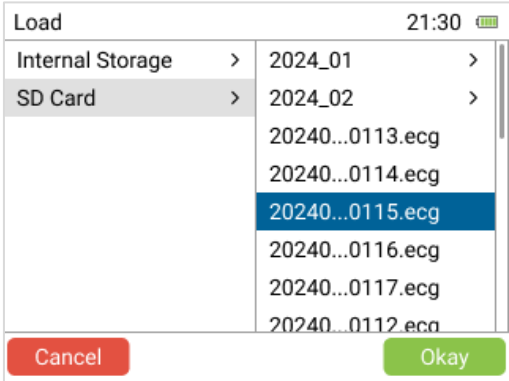


Figure 13: Load Previously Saved Waveforms from the micro SD Card

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.

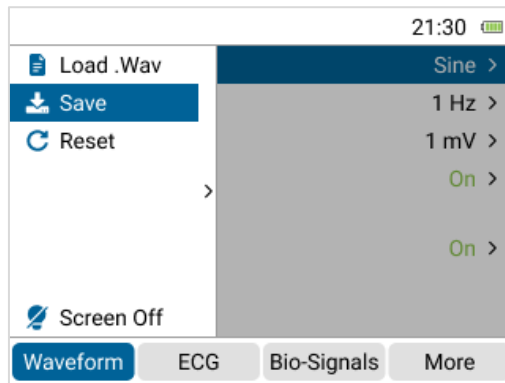


Figure 14: “Save” Function

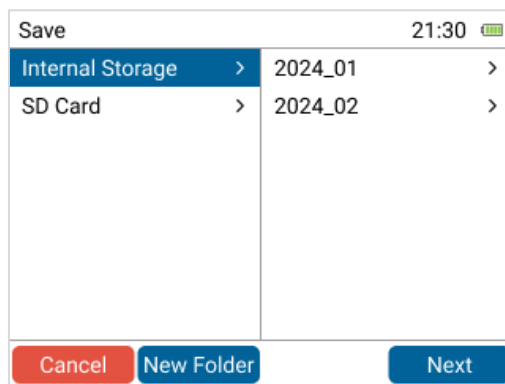


Figure 15: Save Configured Waveforms to the HECG100 Internal Storage

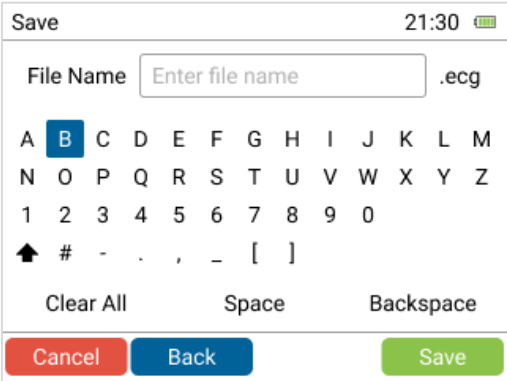


Figure 16: Name the Configured Waveform

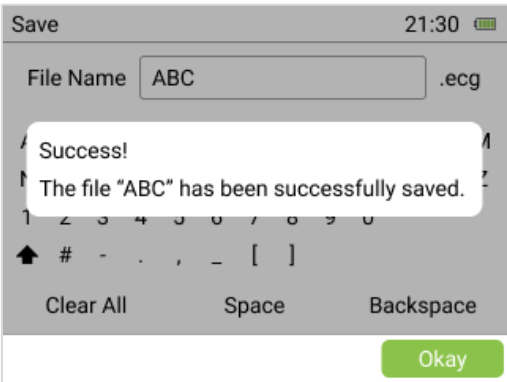


Figure 17: "Successfully Saved" Message of Saving Configured Waveforms

2.3.8 “Reset” Function

Users can reset the settings of a configured waveform.

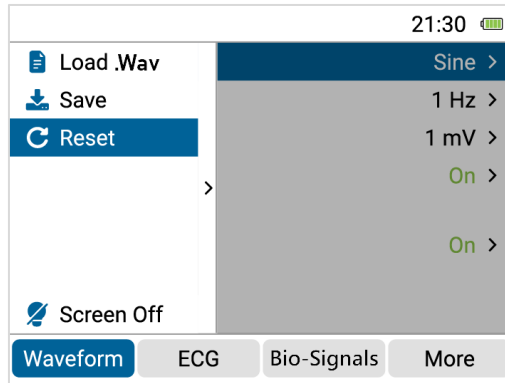


Figure 18: “Reset” Function

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.

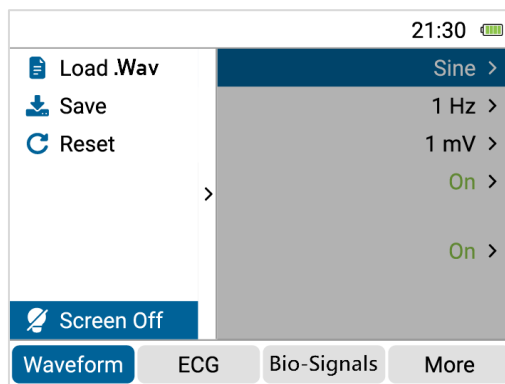


Figure 19: “Screen off” Function

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.

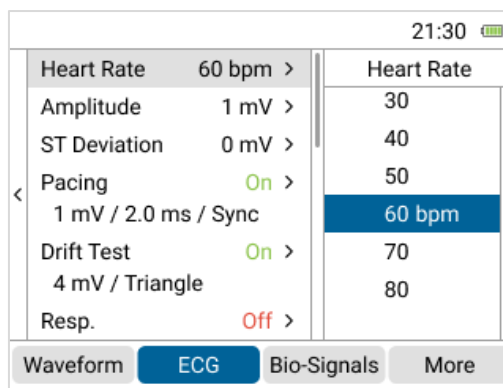


Figure 20: “Heart rate” Parameter

2.4.2 “Amplitude” Parameter

Select the desired amplitude value for the ECG waveform.

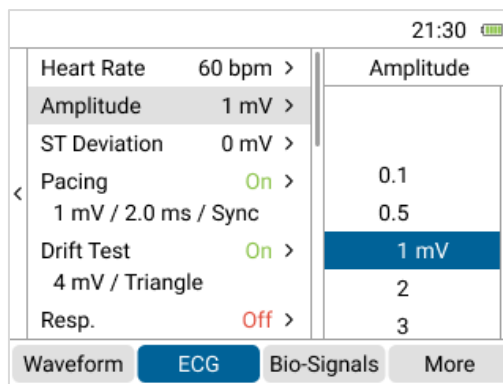


Figure 21: “Amplitude” Parameter

2.4.3 “ST Deviation” Parameter

Select the desired ST deviation value for the ECG waveform.

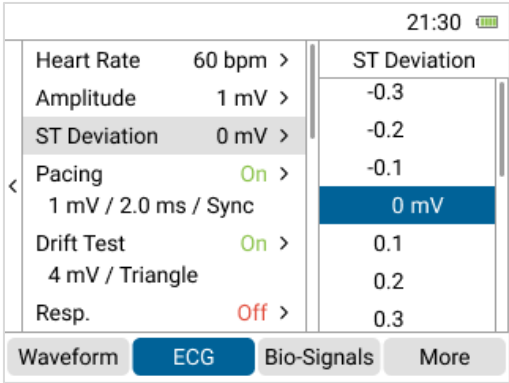


Figure 22: “ST Deviation” Parameter

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.

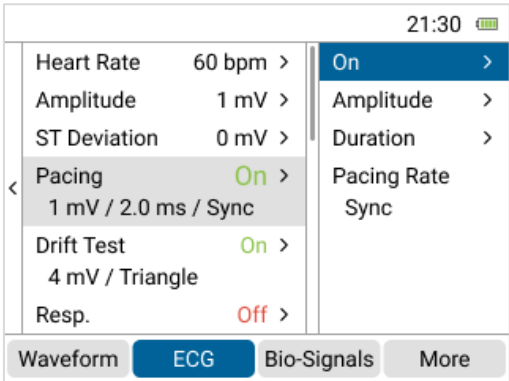


Figure 23: “On/Off” Options of “Pacing” Parameter

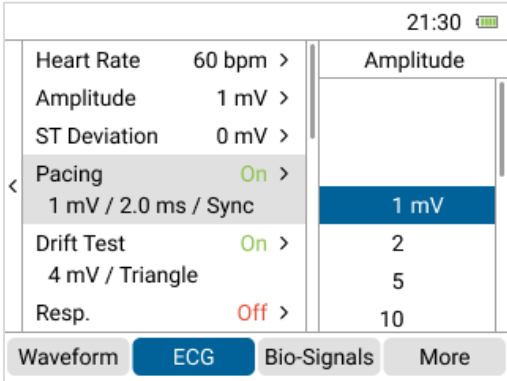


Figure 24: "Amplitude" Options of "Pacing" Parameter

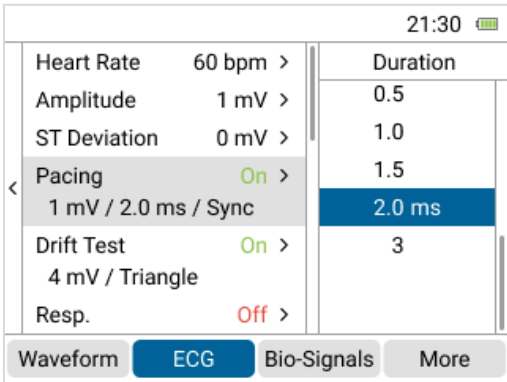


Figure 25: "Duration" Options of "Pacing" Parameter

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.

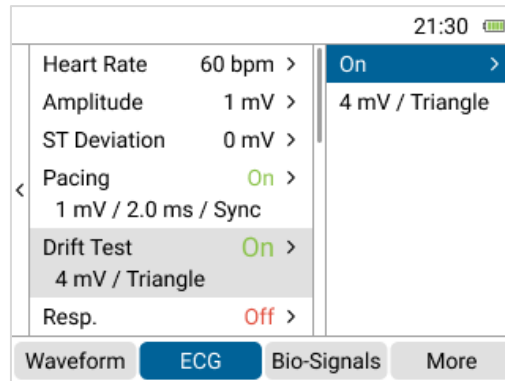


Figure 26: “Drift test” Parameter

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.

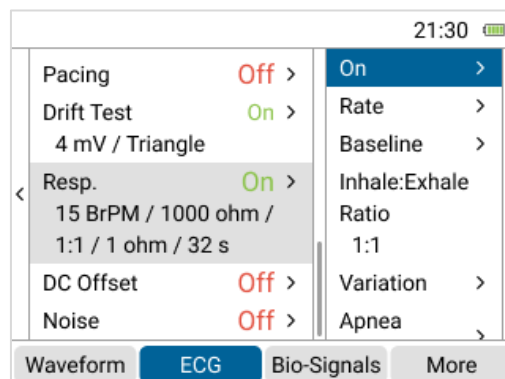


Figure 27: “On/Off” Options of “Respiration” Parameter

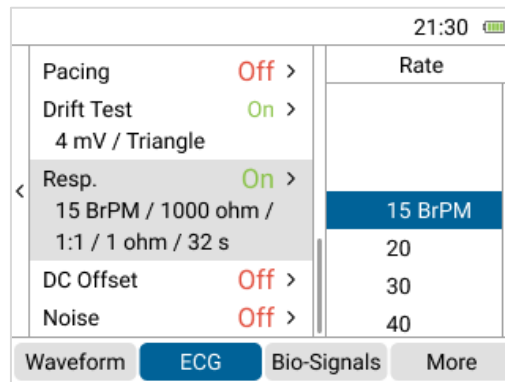


Figure 28: "Rate" Options of "Respiration" Parameter

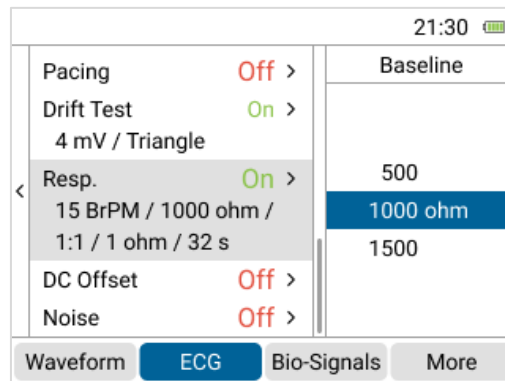


Figure 29: "Baseline" Options of "Respiration" Parameter

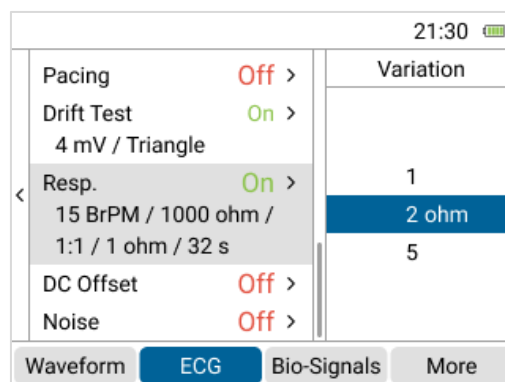


Figure 30: "Variation" Options of "Respiration" Parameter

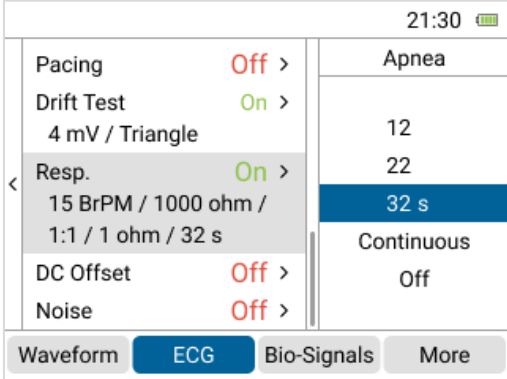


Figure 31: "Apnea" Options of "Respiration" Parameter

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.

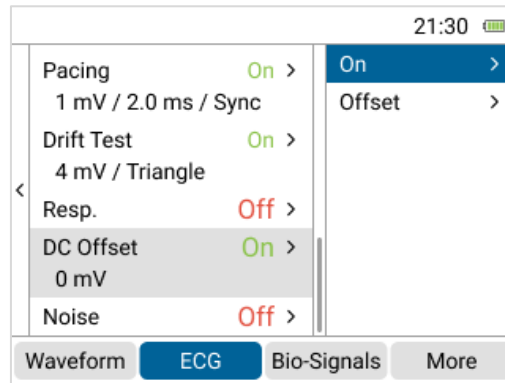


Figure 32: “On/Off” Options of “DC offset” Parameter

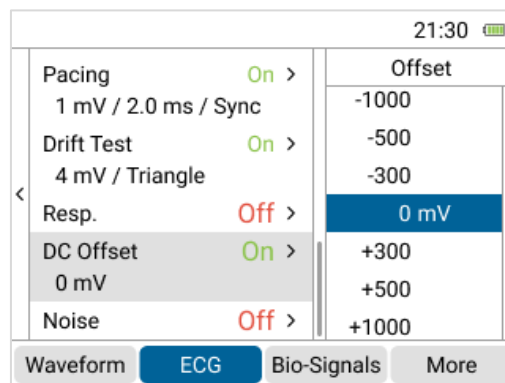


Figure 33: Options of “DC offset” Parameter

2.4.8 “Noise” Parameter

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

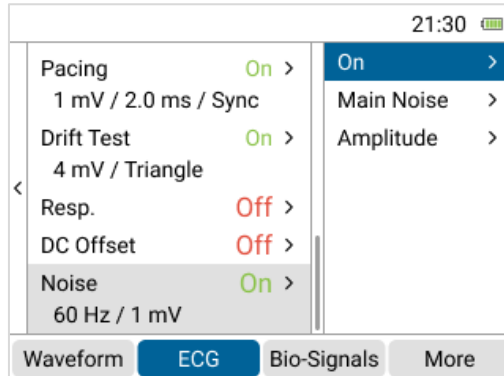


Figure 34: “On/Off” Options of “Noise” Parameter

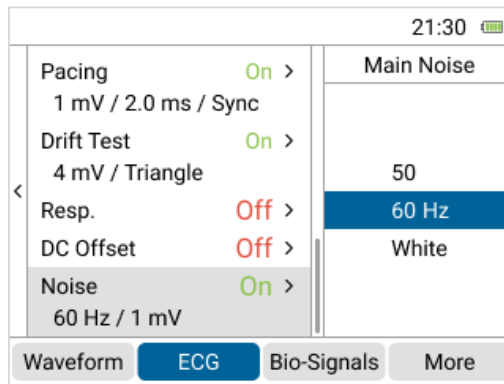


Figure 35: “Main Noise” Options of “Noise” Parameter

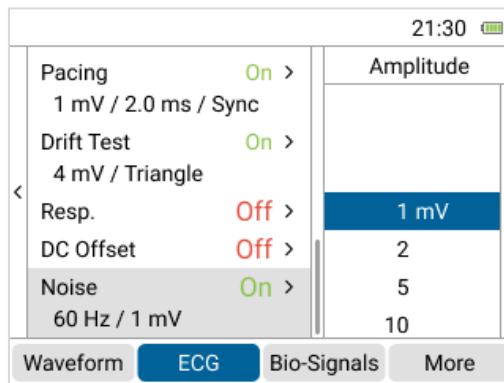


Figure 36: “Amplitude” Options of “Noise” Parameter

2.4.9 “Load .Ecg”, “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 .Wav” Function”, “2.3.7 “Save” Function”, and “2.3.8 “Reset” Function” for more information.

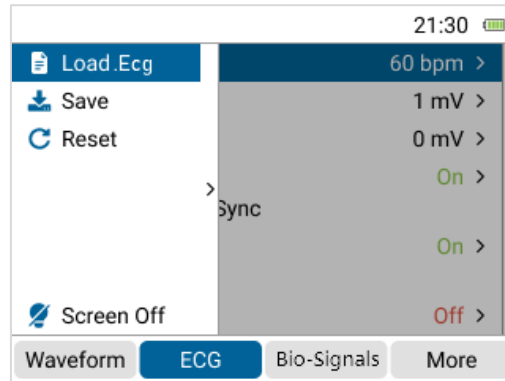


Figure 37: “Load .Ecg”, “Save”, and “Reset” Functions

2.5 “Bio-Signals” 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. For detailed lead output ratios, please refer to the [technical specifications](#).

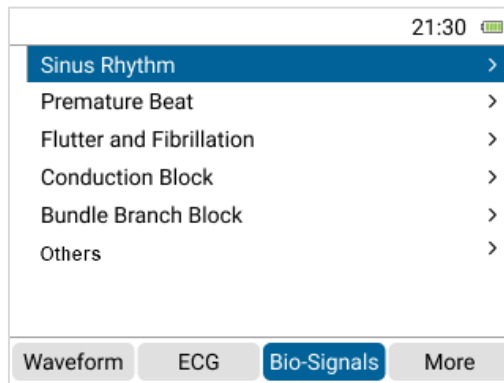


Figure 38: “Bio-Signals” Function

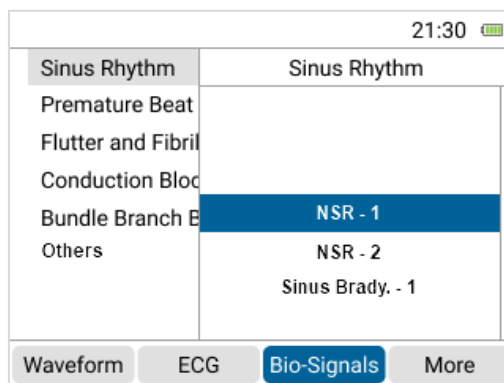


Figure 39: Select a Desired Arrhythmia Waveform for Testing

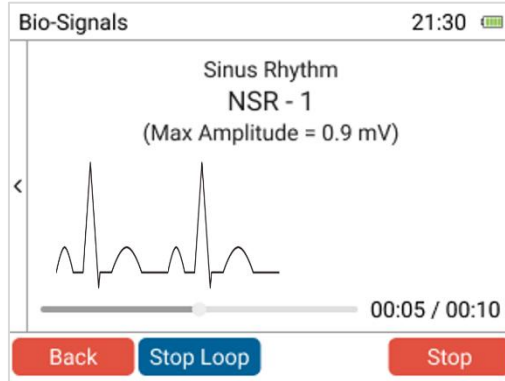


Figure 40: Play the Desired Arrhythmia Waveform for Testing

Table 8: Provided Waveforms of “Bio-Signals” Function

Categories	Waveforms
Sinus Rhythm	NSR-1 (Normal Sinus Rhythm-1)
	NSR-2 (Normal Sinus Rhythm-2)
	Sinus Brady.-1 (Sinus Bradycardia-1)
	Sinus Brady.-2 (Sinus Bradycardia-2)
	Sinus Tachy.-1 (Sinus Tachycardia-1)
	Sinus Tachy.-2 (Sinus Tachycardia-2)
	Sinus Arrhythmia-1
	Sinus Arrhythmia-2
Premature Beat	PVC-1 (Premature Ventricular Contraction-1)
	PVC-2 (Premature Ventricular Contraction-2)
	PVC-3 (Premature Ventricular Contraction-3)
	PVC-4 (Premature Ventricular Contraction-4)
	APC-1 (Atrial Premature Contraction-1)
	APC-2 (Atrial Premature Contraction-2)
	JPC (Junctional Premature Contraction)
Flutter and Fibrillation	AFLT-1 (Atrial Flutter-1)
	AFLT-2 (Atrial Flutter-2)
	AFib-1 (Atrial Fibrillation-1)
	AFib-2 (Atrial Fibrillation-2)
	AFib-3 (Atrial Fibrillation-3)
	VF (Coarse)-1 (Ventricular Fibrillation (Coarse)-1)
	VF (Coarse)-2

Categories	Waveforms
	(Ventricular Fibrillation (Coarse)-2)
	VF (Fine)-1 (Ventricular Fibrillation (fine)-1)
	VF (Fine)-2 (Ventricular Fibrillation (fine)-2)
Conduction Block	First AVB (First-Degree AV Block)
	Second AVB I (Second-Degree AV Block I)
	Second AVB II (Second-Degree AV Block II)
	Third AVB (Third-Degree AV Block)
Bundle Branch Block	RBBB-1 (Right Bundle Branch Block-1)
	RBBB-2 (Right Bundle Branch Block-2)
	LBBB-1 (Left Bundle Branch Block-1)
	LBBB-2 (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.

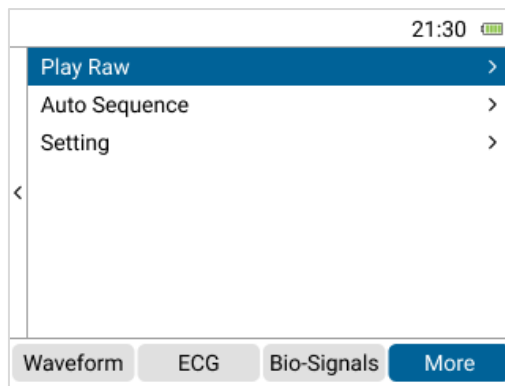


Figure 41: “Play Raw” Function

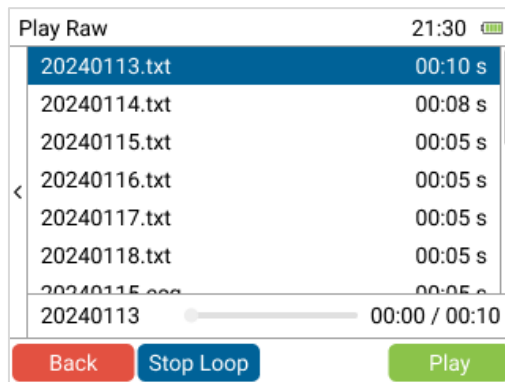


Figure 42: Raw Data Files for Playback

Please follow the steps below to save waveforms to the HECG100 for use:

1. Ensure that the provided micro SD card is inserted into the slot on the HECG100.
2. Use the provided USB Type-C cable to connect the HECG100 to a computer.

3. Launch the HECG100 PC software.
4. Store waveforms to the micro SD card through the software.

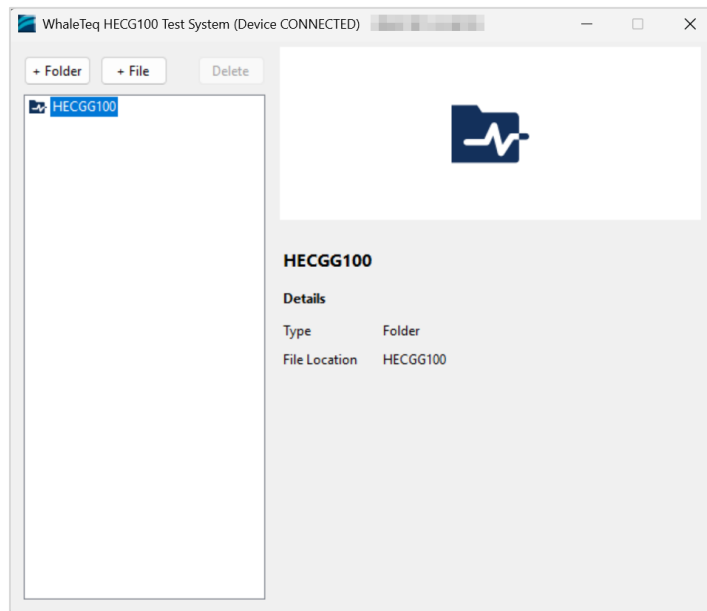


Figure 43: HECG100 PC Software

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.

2.6.1.1 Supported Raw Data File Format

- (3) Supported raw data file format is Text (*.txt) and file content is described as below:
 - **[sampling frequency]**
Sampling rate (Hz). Input the frequency of sample data.
 - **[number of samples per signal]**
 - **[number of signals]**
Fixed string: "1"
 - **[signal description]**

Fixed string: "ECG"

- **[sample data-N]**

The raw data unit is "mV". For ECG, the data range is [-5,5] mV.

2.6.2 “Auto Sequence” Function

Users can flexibly add waveforms set in the “Waveform” and “ECG” functions, as well as arrhythmia waveforms from the “Bio-Signals” function, to build a customized test list.

Note: The option to “Add raw data waveforms to the test list” will be supported in a future firmware update.

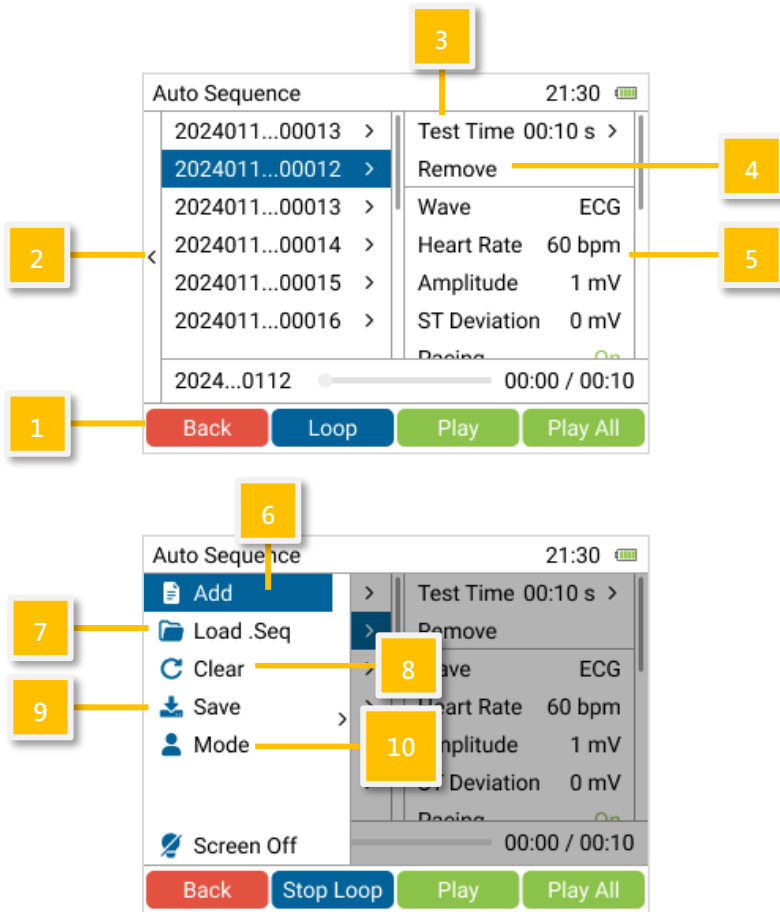


Figure 44: “Auto Sequence” Function

Table 9: “Auto Sequence” Function

Item	Name	Description
1	Functions	<ul style="list-style-type: none"> • Play All: Play all waveforms. • Play: Play the selected waveform.

Item	Name	Description
		<ul style="list-style-type: none"> • Loop: Play all waveforms in a loop. • Back: Back to "More" function.
2	Sidebar	Use the arrow key (◀) to show the sidebar for "Add", "Load .Seq", "Clear", "Save" and "More" functions.
3	Test Time	Set the playback duration for the selected waveform.
4	Remove	Remove the selected waveform.
5	Waveform Information	Show parameter settings of the selected waveform.
6	Add	Add desired waveforms.
7	Load .Seq	Load a previously saved test list.
8	Clear	Clear all waveforms.
9	Save	Save all waveforms as a new test list.
10	Mode	<p>Choose between "Full Access Mode" or "Restricted Access Mode".</p> <p>On first use, the default is "Full Access Mode". For subsequent use, the default will be the mode last selected. "Restricted Access Mode" is designed to ensure that test personnel follow the selected test list. In this mode, users can only play waveforms and cannot perform any editing actions, such as adding or saving waveforms.</p>

Please follow the steps below to perform this function, using saving waveforms to the SD card as an example:

1. In the "Waveform" or "ECG" function, configure the waveform parameters. Press the arrow key (◀) to show the sidebar, select "Save", then choose "SD Card", and assign a name to the waveform. (Refer to 2.3.7 "Save" Function for more information.)
2. Repeat step 1 to save all desired waveform parameters.
3. Press the F4 button to select the "More" function.

- Press the arrow key (◀) to show the sidebar, select “Add”, then “SD Card”, and choose the desired waveform.

Note:

- **Int. Storage ECG:** “.Ecg” files stored in the internal memory of the HECG100. These files are ECG waveforms configured through the “ECG” function.
- **Int. Storage Wave:** “.Wav” files stored in the internal memory of the HECG100. These files are standard waveforms configured through the “Waveform” function.
- **SD Card:** “.Ecg” and “.Wav” files stored on the SD card.
- **Bio-Signals:** The 32 built-in arrhythmia waveforms available in the HECG100.
- **Play Raw:** “.Prd” files stored on the SD card. These files are waveforms stored through the “Play Raw” function.

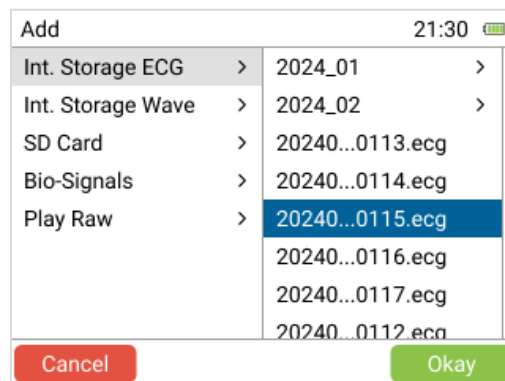


Figure 45: Choose the Desired Waveform to Use in the “Auto Sequence” Function

- Repeat step 4 to add all desired waveforms. Set the playback duration for each waveform, then click “Play All” to start the test.

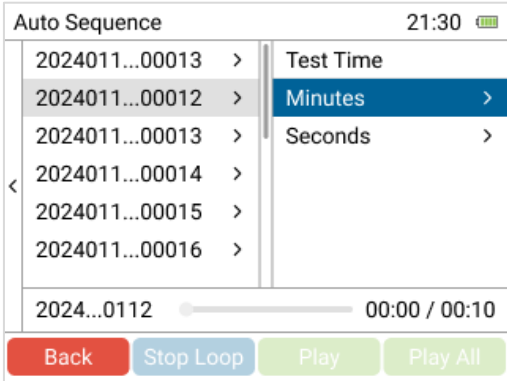


Figure 46: Set the Playback Duration for Each Waveform in the “Auto Sequence” Function

2.6.3 Settings

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

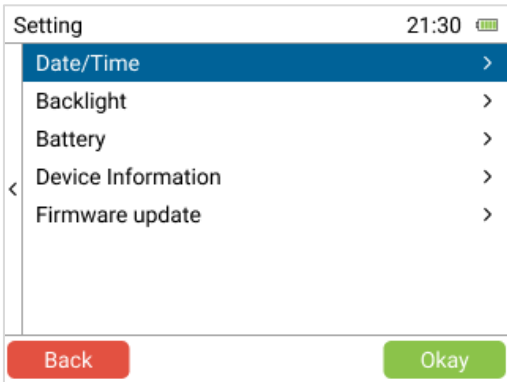


Figure 47: Settings

2.6.3.1 Date/Time Settings

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

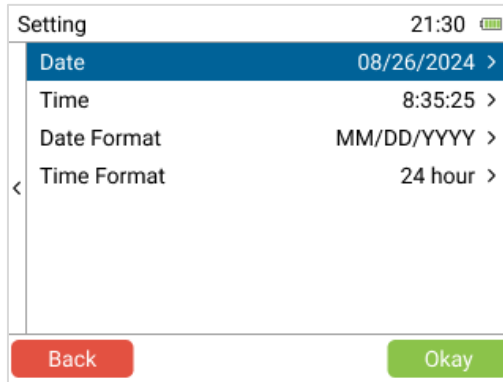


Figure 48: Date/Time Settings

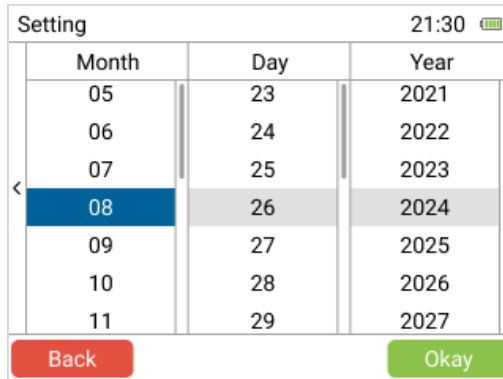




Figure 49: Date Setting

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 50: Time Setting

Setting		21:30 
Date Format		
MM/DD/YYYY		
DD/MM/YYYY		
YYYY/MM/DD		

Back Okay

Figure 51: Date Format Setting

Setting		21:30 
Time Format		
12		
24 hour		

Back Okay

Figure 52: Time Format Setting

2.6.3.2 Backlight Settings

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

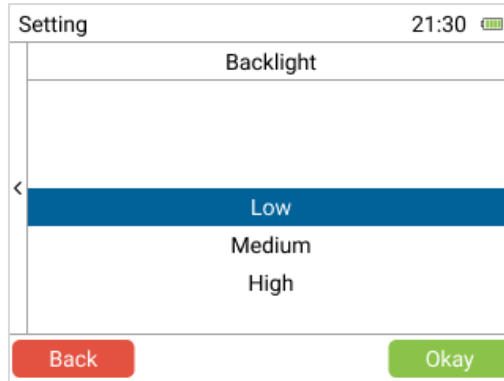


Figure 53: Backlight Settings

2.6.3.3 Battery Settings

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

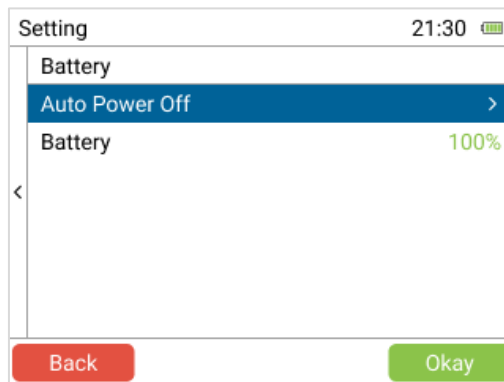


Figure 54: Battery Settings

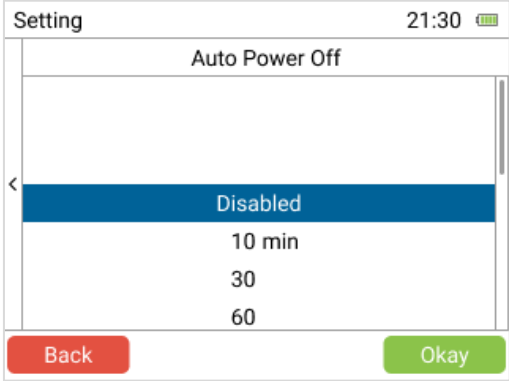


Figure 55: "Auto Power Off" Options

2.6.3.4 Device Information

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

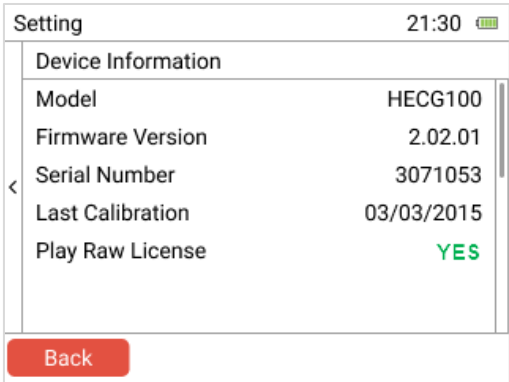


Figure 56: Device Information

2.6.3.5 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.

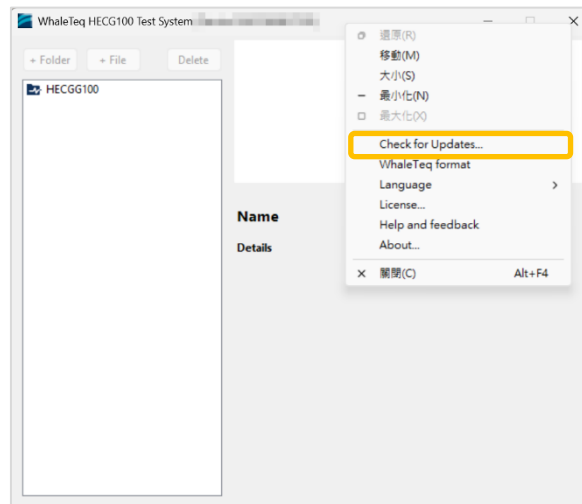


Figure 57: Firmware Update (step 4)



Figure 58: 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 8).

3.1 Self-Calibration

Self-calibration assists users to quickly confirm the signal quality of HECG100 before testing.

If the self-calibration result exceeds the specified tolerance, please contact WhaleTeq for in-house calibration.

1. Set parameters as “Square, 5mV, 0.125Hz” in the “Waveform” function.

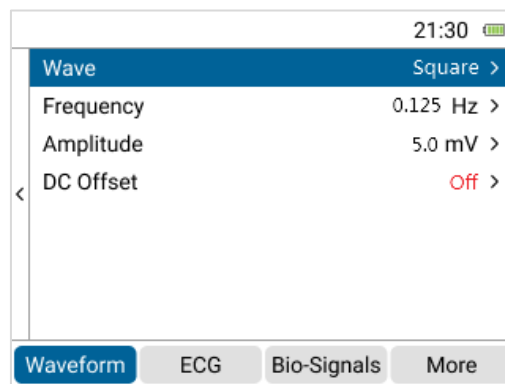


Figure 59: Self-calibration Parameter Settings

2. Connect a multimeter to the RA and LL electrode terminals on the HECG100, and measure the DC value. The value should be in $\pm 2\%$ of 5mV because the output amplitude of HECG100 gives alternating 5s (0.125Hz square wave) phases at -2.5mV and +2.5mV, which the multimeter is zeroed (delta function) at one phase (e.g., -2.5mV), with reading taken from the other phase (e.g., +2.5mV) to obtain the 5mV peak-peak value.

Note: Please use a multimeter which is 6 1/2 (6 1/2 digits) or more.



Figure 60: Self-calibration Setup

- HECG100 DC offset check is shown as the red square in the figure below. HECG100 connects DC in series with the electrode wire (in this case, RA).

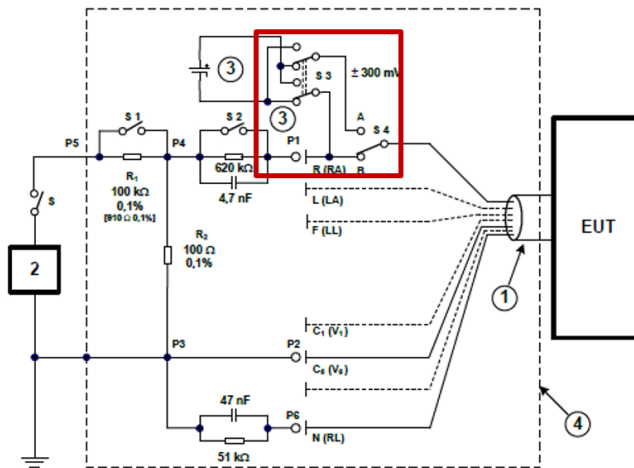


Figure 61: HECG100 $\pm 300\text{mV}$ DC Offset

- Users can verify the DC voltage by setting the parameters as “Square, 0.1mV, 0.125Hz, and DC Offset =300mV” in the “Waveform” function.

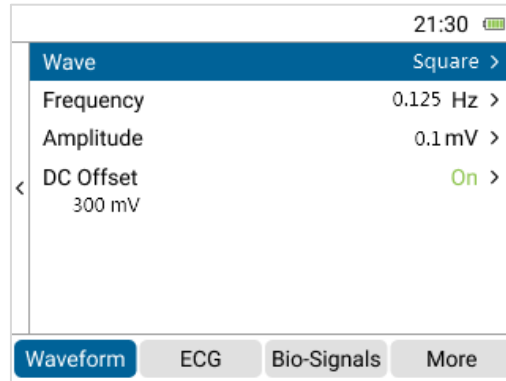


Figure 62: DC Voltage Verification (300mV)


5. Connect the multimeter to the RA and LL electrode terminals on the HECG100 and measure the DC voltage. The value should be in $\pm 1\%$ of 300mV. The setup is shown in the figure below.



Figure 63: Self-calibration Setup for DC Voltage Verification

6. If users want to check the DC voltage other than 300mV, set the DC voltage from -1000mV to +1000mV with 5% accuracy.
Note: This extra DC voltage can support some testing other than 300mV.


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 10: HECG100 Standard Test System

Part No.	Image	Description	Quantity
100-EC00007		<p>Model No.: HECG100 Model Name: Handheld 12-lead ECG Simulator</p> <p>Package contents:</p> <ul style="list-style-type: none"> • HECG100 x 1 • RCA male to BNC cable (60cm, black) x 1 • USB Type-C to Type-C cable (male to male, 44cm, black) x 1 • 32GB micro SDHC card x 1 	1

Optional Accessories

Table 11: Optional Accessories

Part No.	Image	Description	Quantity
5HA-EC1N001		RCA male to BNC cable (60cm) (black)	1
5HA-EC1N002		USB Type-C to Type-C cable (male to male) (44cm) (black)	1
S71-0201011		32GB micro SDHC card	1

Optional Calibration Service and Warranty Extension

Table 12: 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 13: Revision History

Version	Description	Issue Date
2025-03-06	First version	2025-03-31
2025-05-13	Update 2.5 "Bio-Signals" Function	2025-05-15

Version	Description	Issue Date
2025-05-29	Update 2.5 "Bio-Signals" Function	2025-05-29
2025-09-16	<ul style="list-style-type: none"> • Update 1.2 Hardware Overview 1.3 Specifications 2.5 "Bio-Signals" Function 2.6.1 "Play Raw" Function 5 Ordering Information <ul style="list-style-type: none"> • Add 2.6.2 "Auto Sequence" Function 3.1 Self-Calibration 7 Appendix 	2025-10-31

7 Appendix

The time and amplitude figures of the arrhythmia waveforms provided by “Bio-Signals” function are shown below.

7.1 Sinus Rhythm

- NSR-1 (Normal Sinus Rhythm-1)

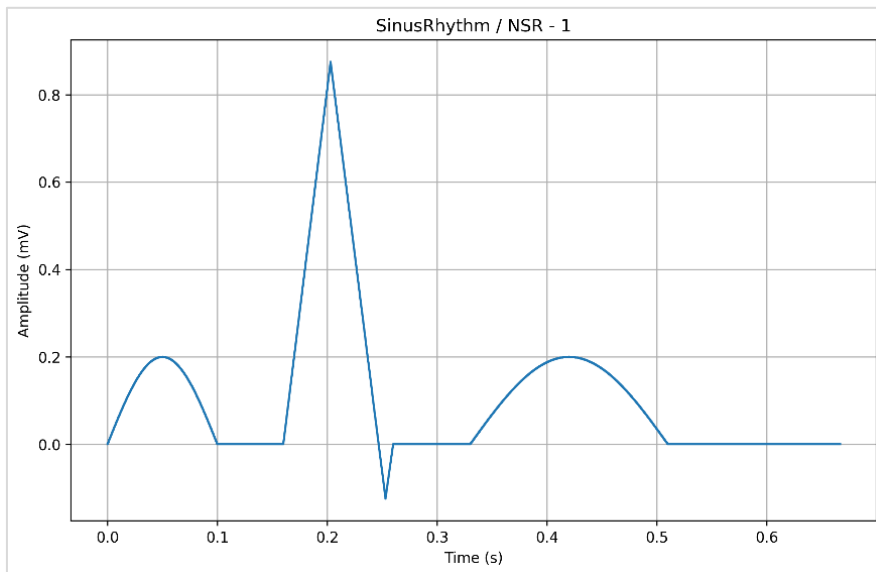


Figure 64: NSR-1 (Normal Sinus Rhythm-1)

- NSR-2 (Normal Sinus Rhythm-2)

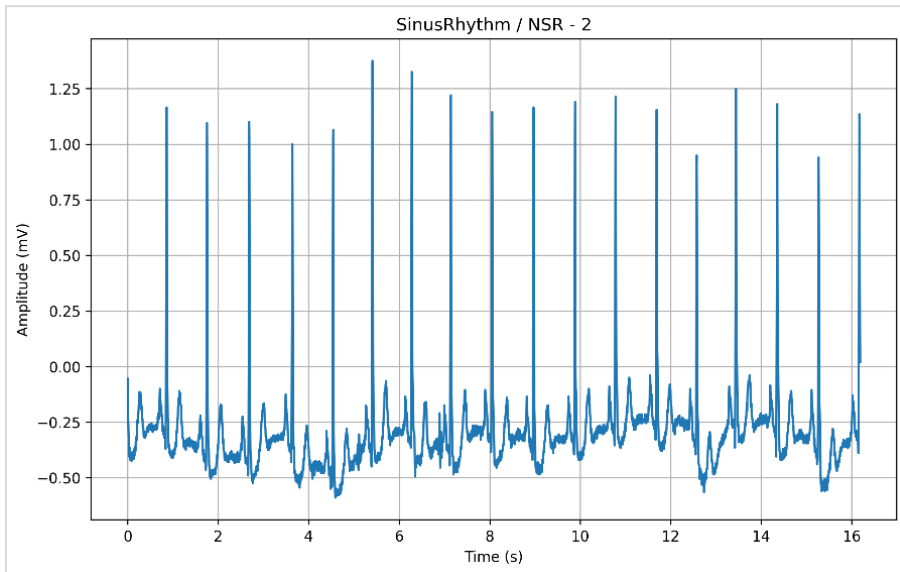


Figure 65: NSR-2 (Normal Sinus Rhythm-2)

- Sinus Brady.-1 (Sinus Bradycardia-1)

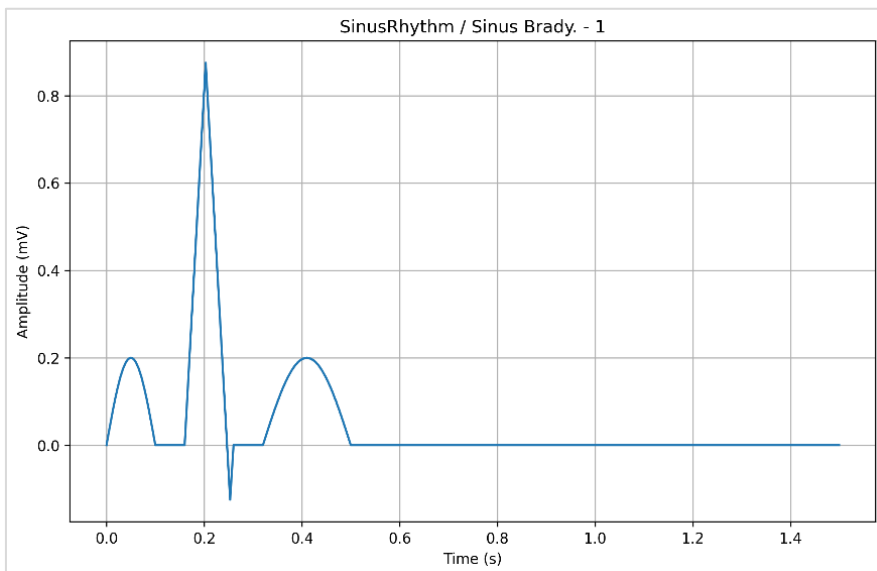


Figure 66: Sinus Brady.-1 (Sinus Bradycardia-1)

- Sinus Brady.-2 (Sinus Bradycardia-2)

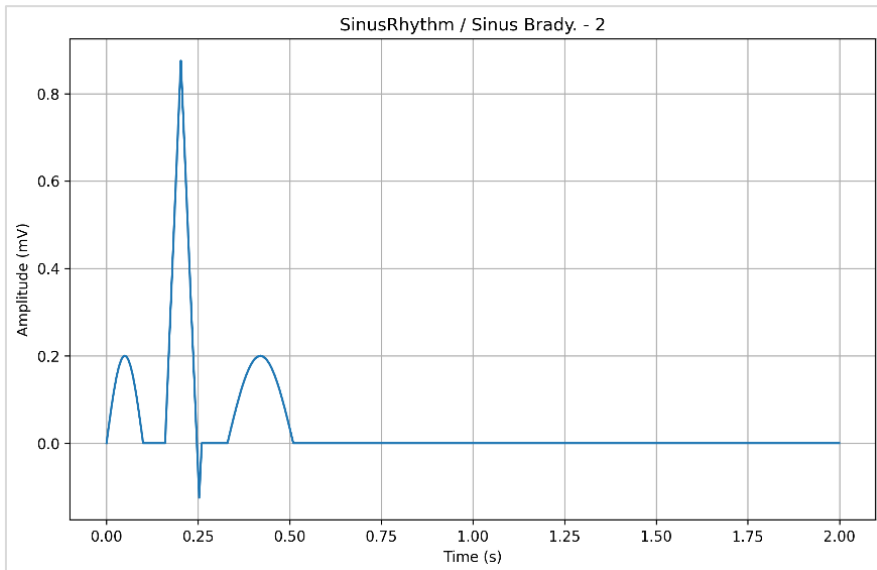


Figure 67: Sinus Brady.-2 (Sinus Bradycardia-2)

- Sinus Tachy.-1 (Sinus Tachycardia-1)

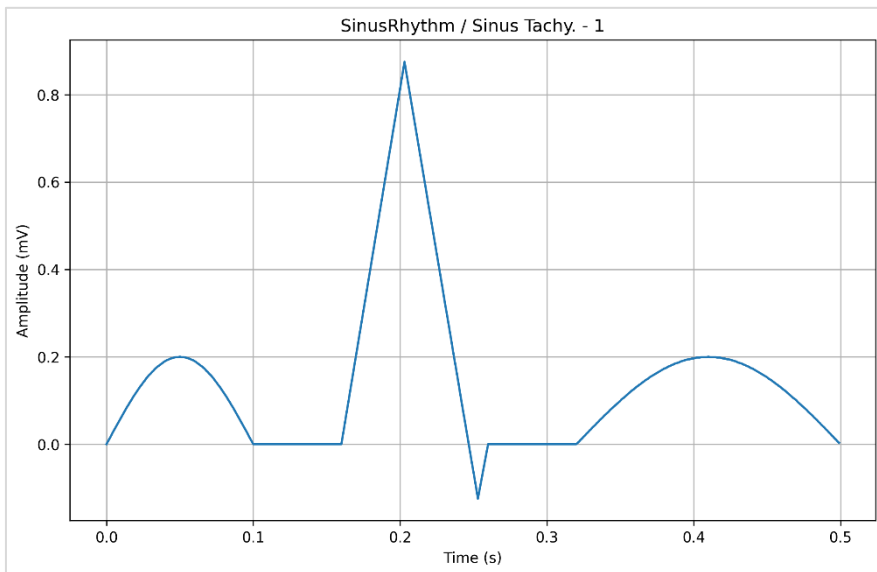


Figure 68: Sinus Tachy.-1 (Sinus Tachycardia-1)

- Sinus Tachy.-2 (Sinus Tachycardia-2)

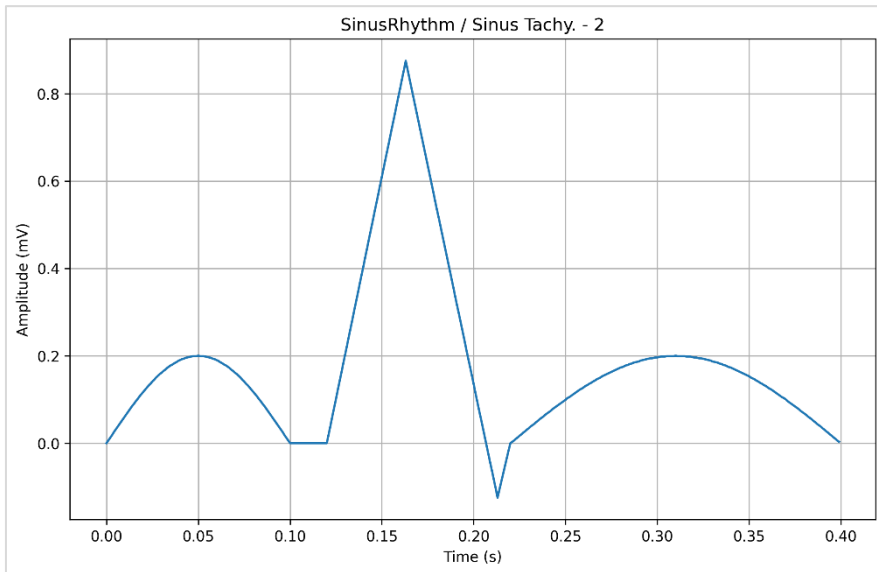


Figure 69: Sinus Tachy.-2 (Sinus Tachycardia-2)

- Sinus Arrhythmia-1

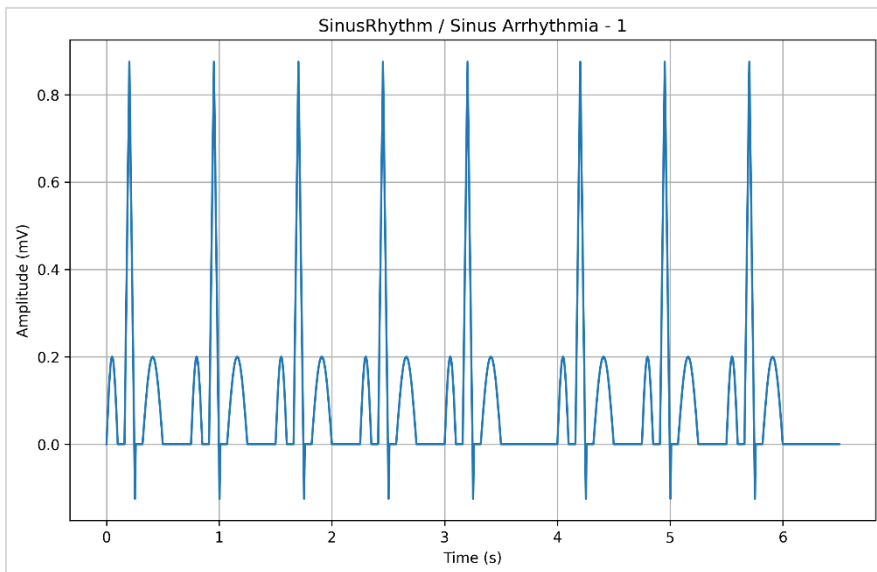


Figure 70: Sinus Arrhythmia-1

- Sinus Arrhythmia-2

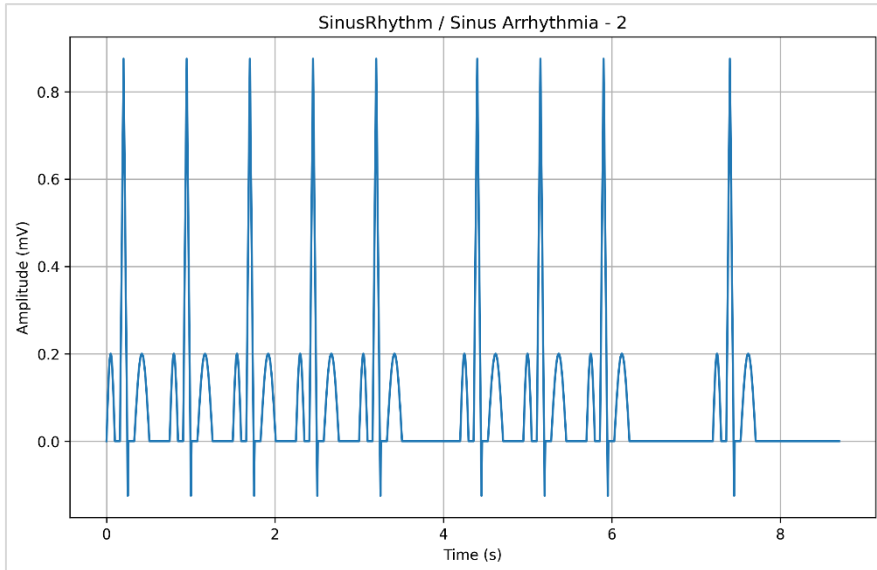


Figure 71: Sinus Arrhythmia-2

7.2 Premature Beat

- PVC-1 (Premature Ventricular Contraction-1)

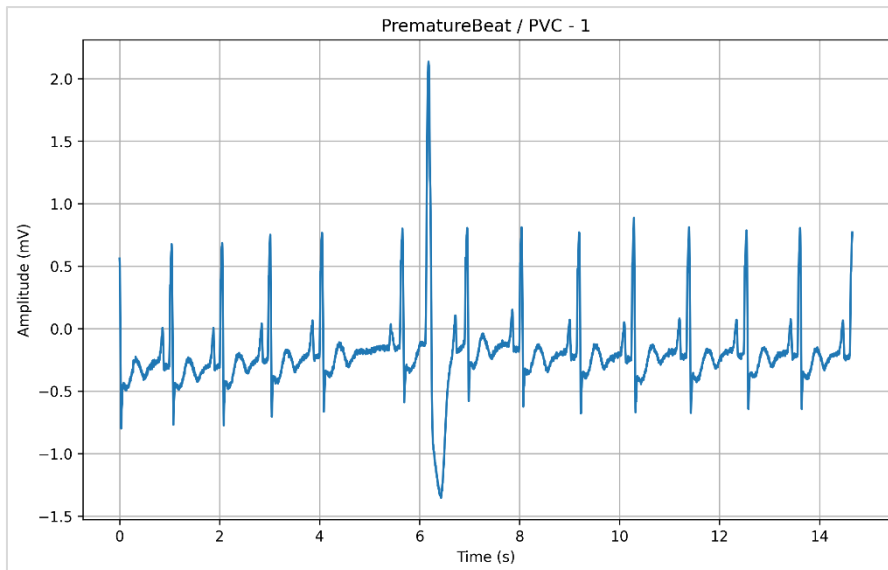


Figure 72: PVC-1 (Premature Ventricular Contraction-1)

- PVC-2 (Premature Ventricular Contraction-2)

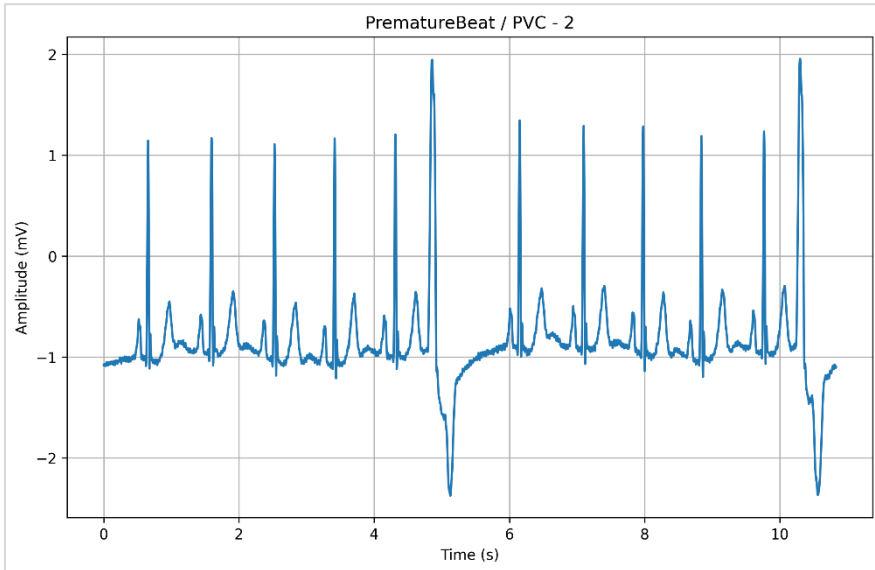


Figure 73: PVC-2 (Premature Ventricular Contraction-2)

- PVC-3 (Premature Ventricular Contraction-3)

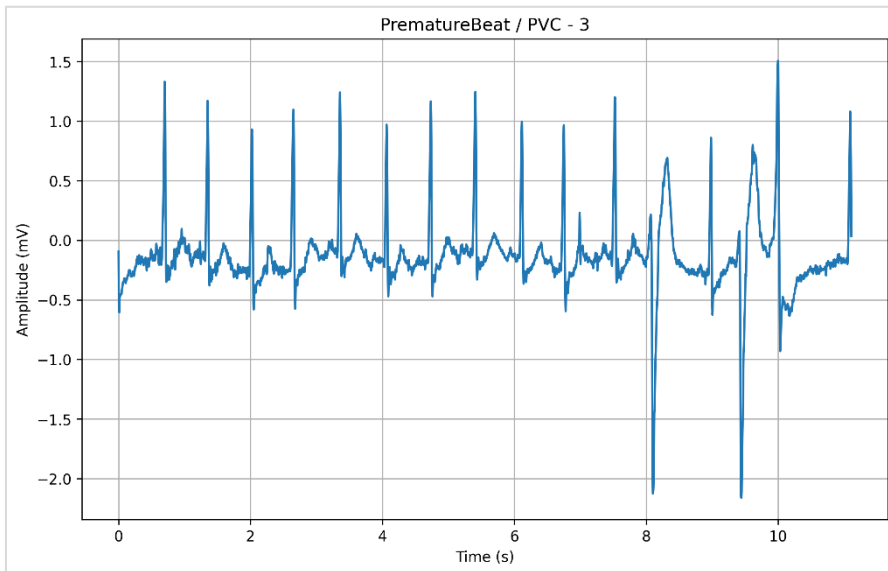


Figure 74: PVC-3 (Premature Ventricular Contraction-3)

- PVC-4 (Premature Ventricular Contraction-4)

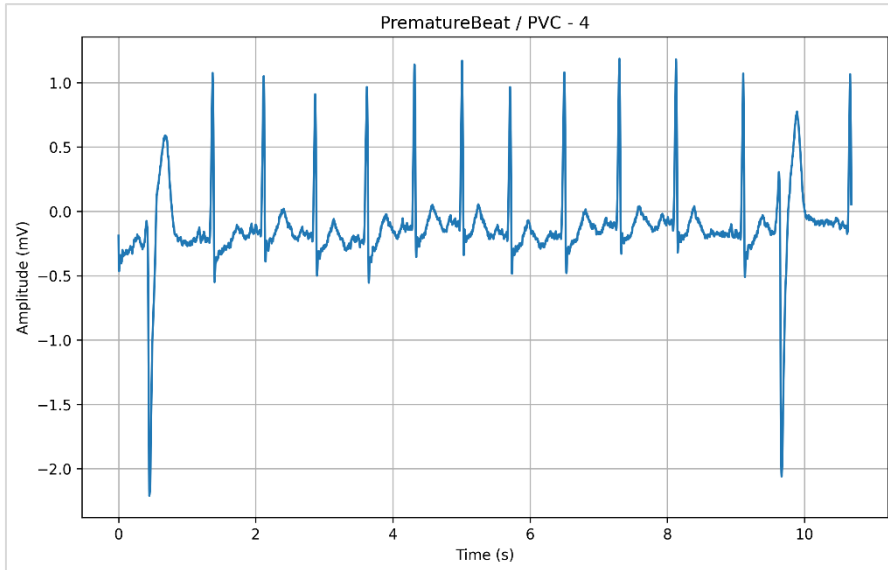


Figure 75: PVC-4 (Premature Ventricular Contraction-4)

- APC-1 (Atrial Premature Contraction-1)

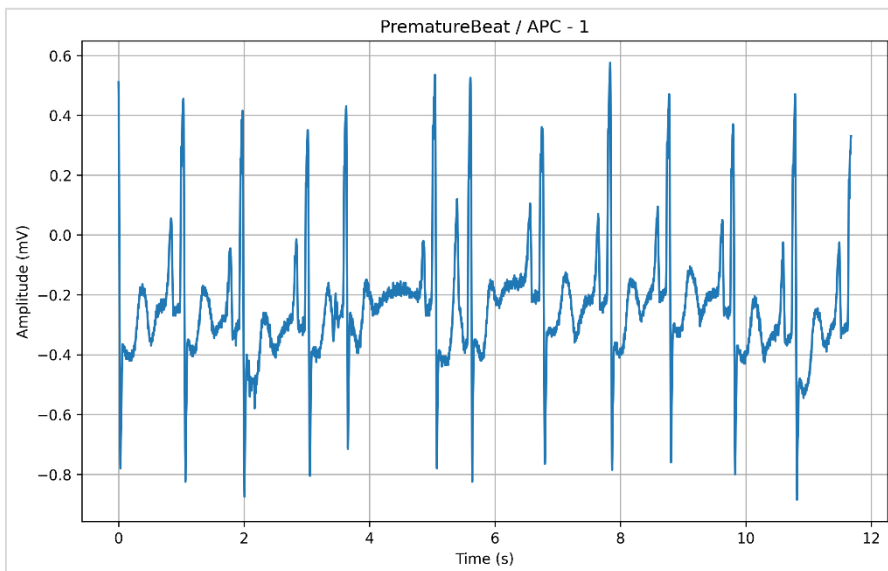


Figure 76: APC-1 (Atrial Premature Contraction-1)

- APC-2 (Atrial Premature Contraction-2)

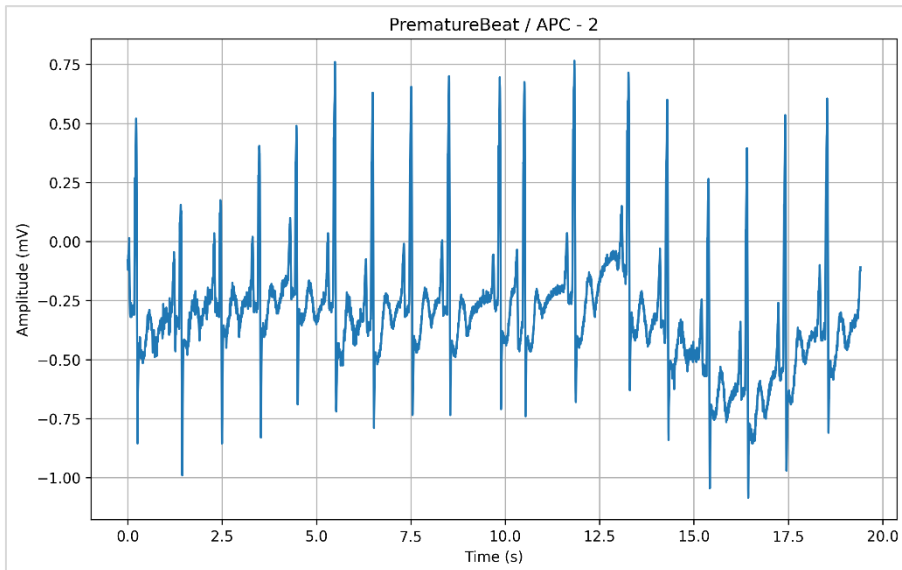


Figure 77: APC-2 (Atrial Premature Contraction-2)

- JPC (Junctional Premature Contraction)

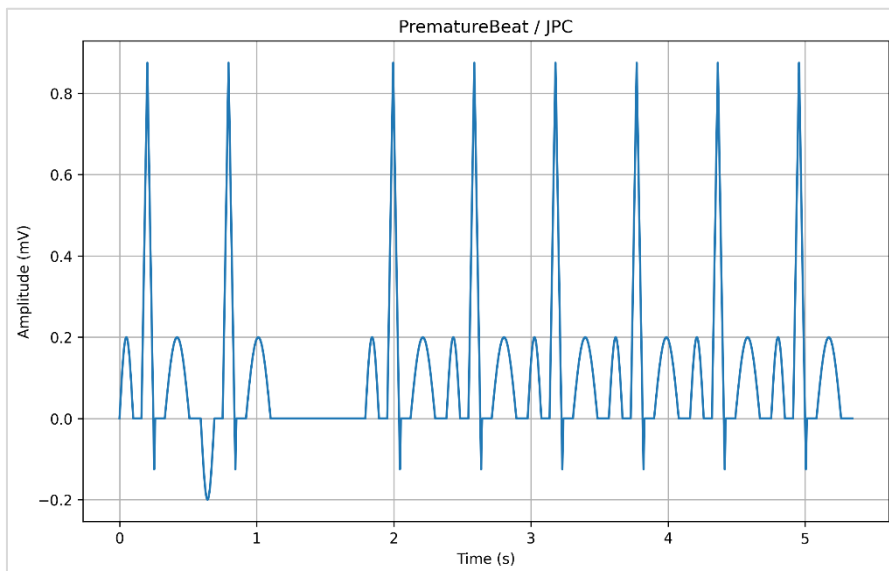


Figure 78: JPC (Junctional Premature Contraction)

7.3 Flutter and Fibrillation

- AFLT-1 (Atrial Flutter-1)

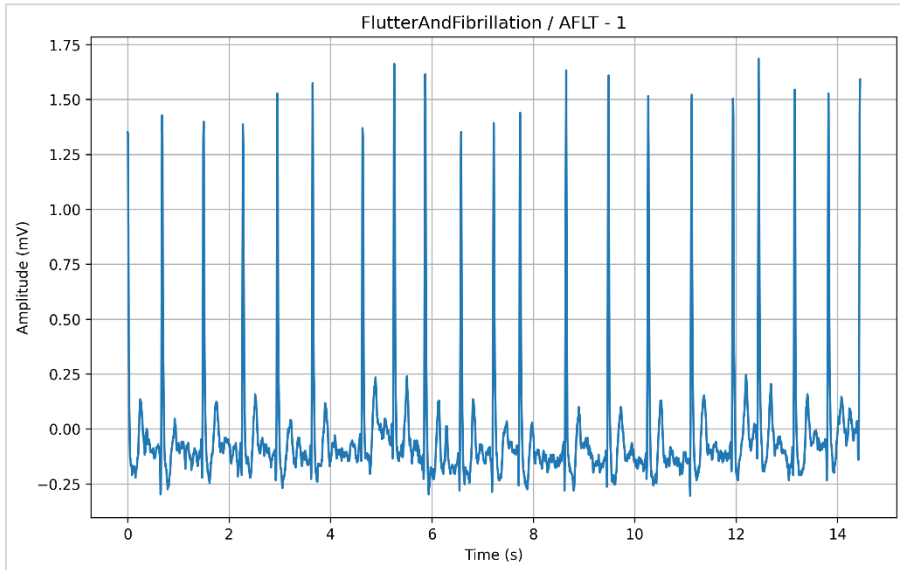


Figure 79: AFLT-1 (Atrial Flutter-1)

- AFLT-2 (Atrial Flutter-2)

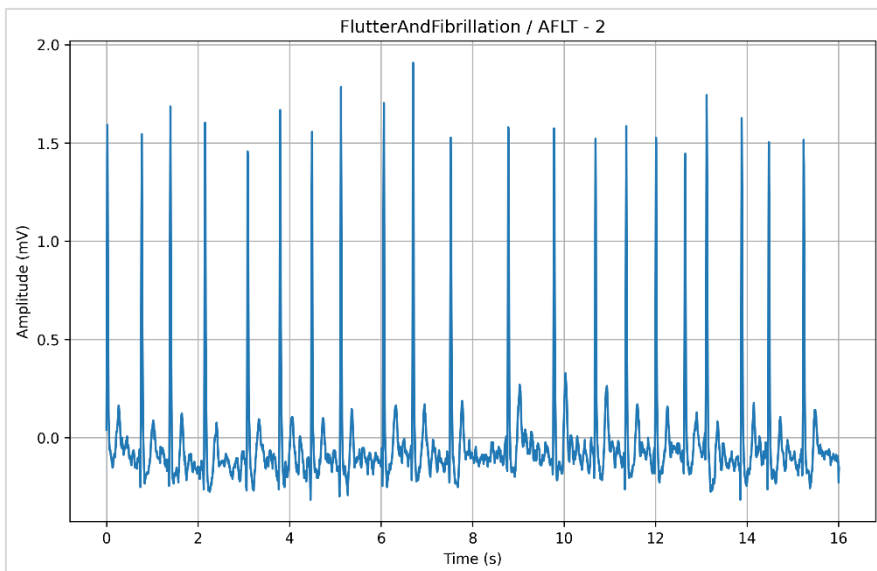


Figure 80: AFLT-2 (Atrial Flutter-2)

- AFib-1 (Atrial Fibrillation-1)

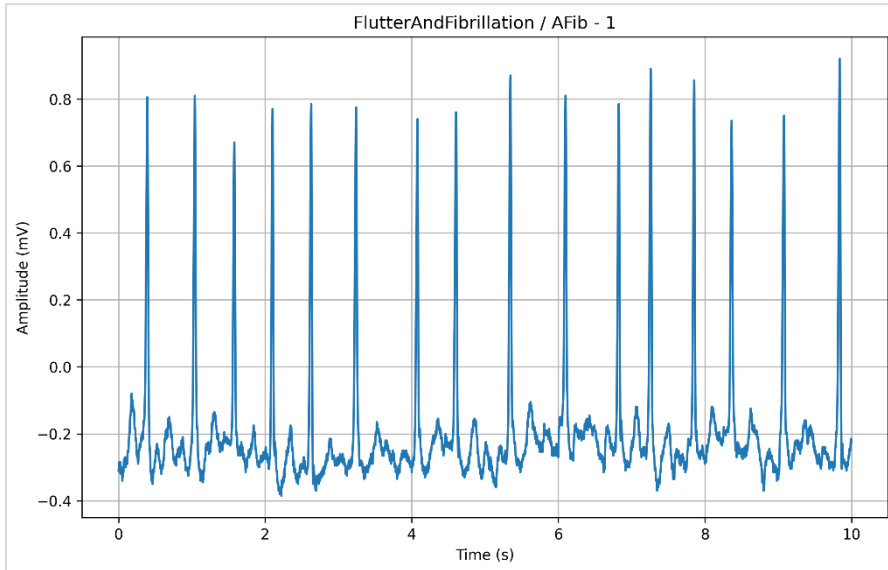


Figure 81: AFib-1 (Atrial Fibrillation-1)

- AFib-2 (Atrial Fibrillation-2)

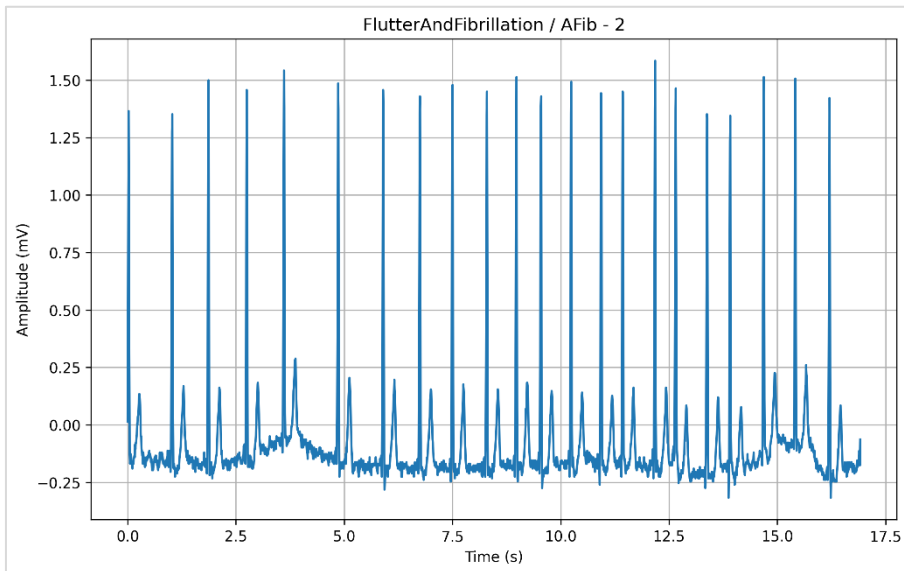


Figure 82: AFib-2 (Atrial Fibrillation-2)

- AFib-3 (Atrial Fibrillation-3)

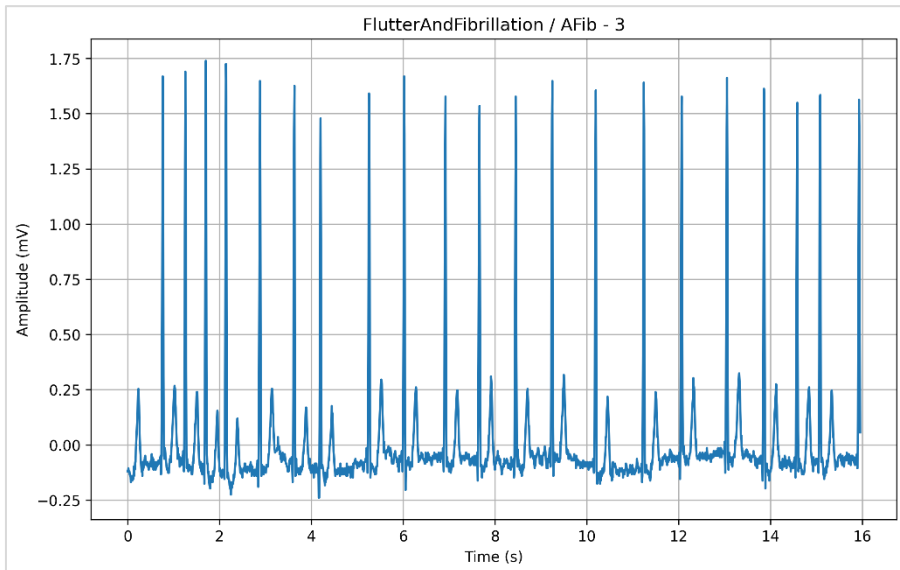


Figure 83: AFib-3 (Atrial Fibrillation-3)

- VF (Coarse)-1 (Ventricular Fibrillation (Coarse)-1)

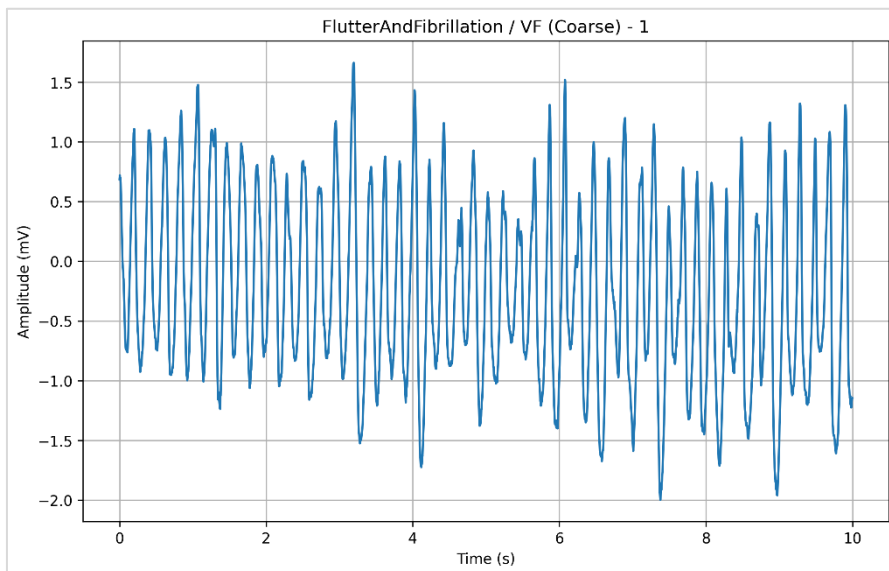


Figure 84: VF (Coarse)-1 (Ventricular Fibrillation (Coarse)-1)

- VF (Coarse)-2 (Ventricular Fibrillation (Coarse)-2)

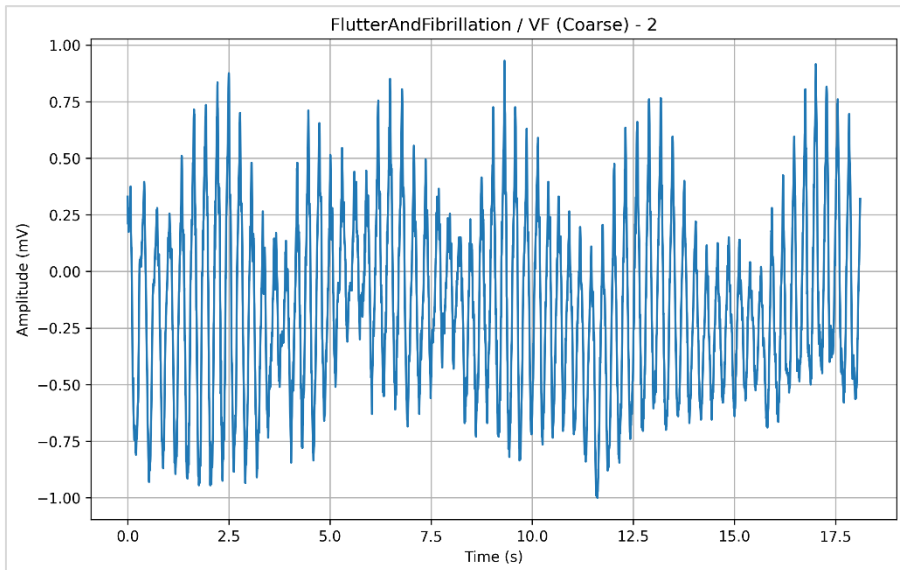


Figure 85: VF (Coarse)-2 (Ventricular Fibrillation (Coarse)-2)

- VF (Fine)-1 (Ventricular Fibrillation (fine)-1)

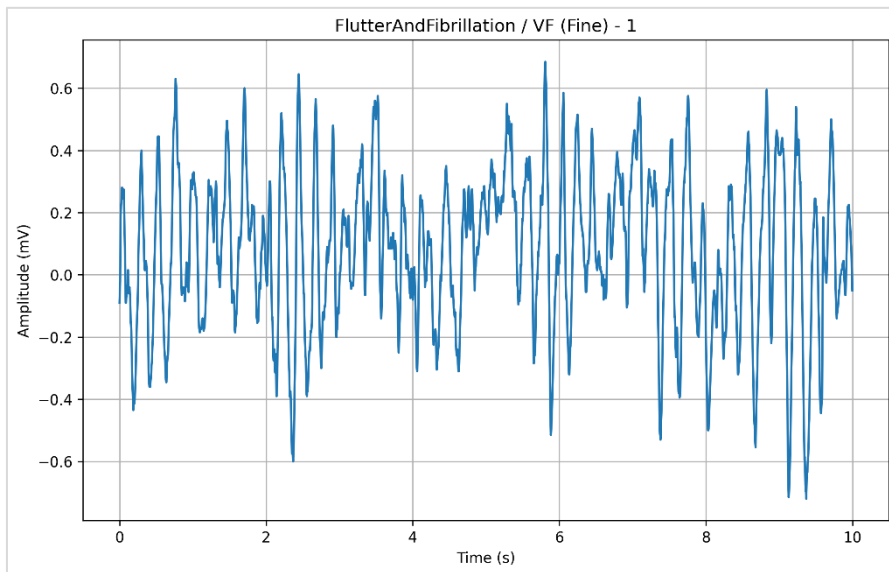


Figure 86: VF (Fine)-1 (Ventricular Fibrillation (fine)-1)

- VF (Fine)-2 (Ventricular Fibrillation (fine)-2)

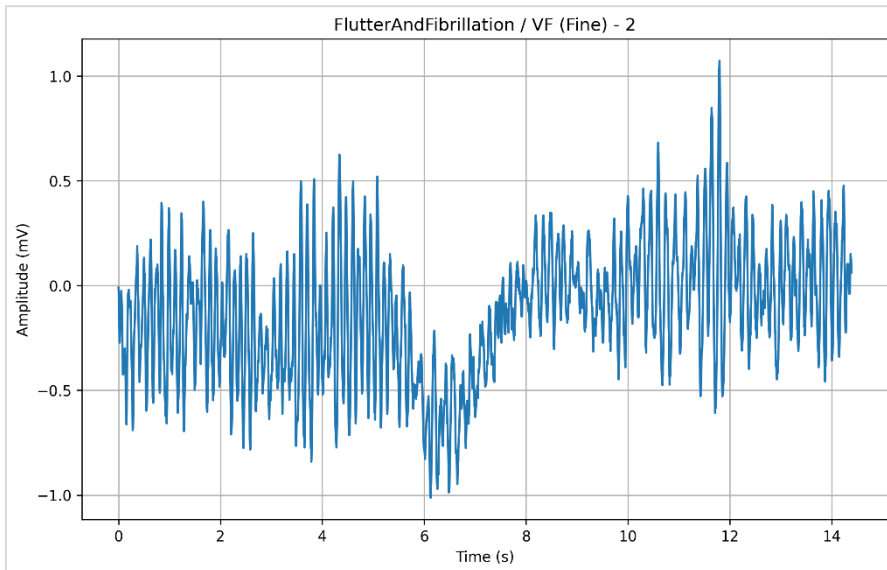


Figure 87: VF (Fine)-2 (Ventricular Fibrillation (fine)-2)

7.4 Conduction Block

- First AVB (First-Degree AV Block)

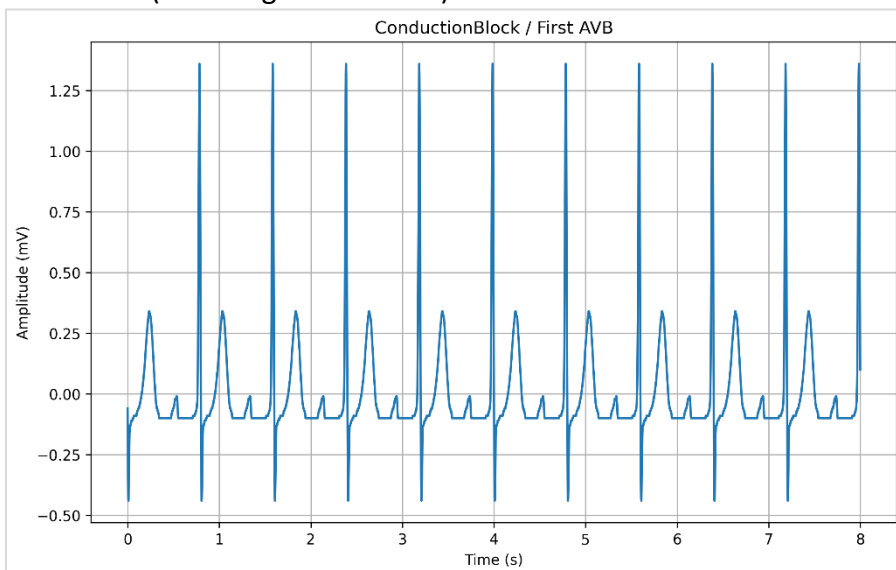


Figure 88: First AVB (First-Degree AV Block)

- Second AVB I (Second-Degree AV Block I)

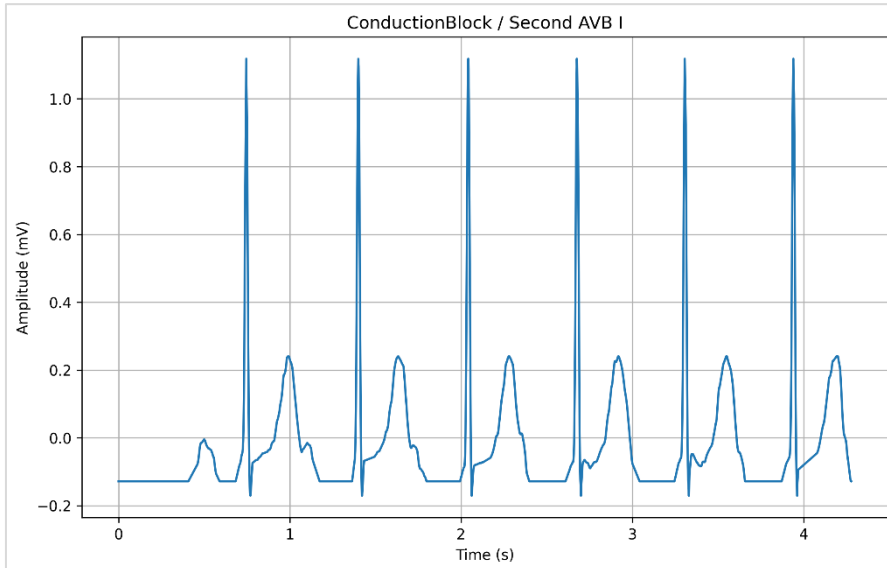


Figure 89: Second AVB I (Second-Degree AV Block I)

- Second AVB II (Second-Degree AV Block II)

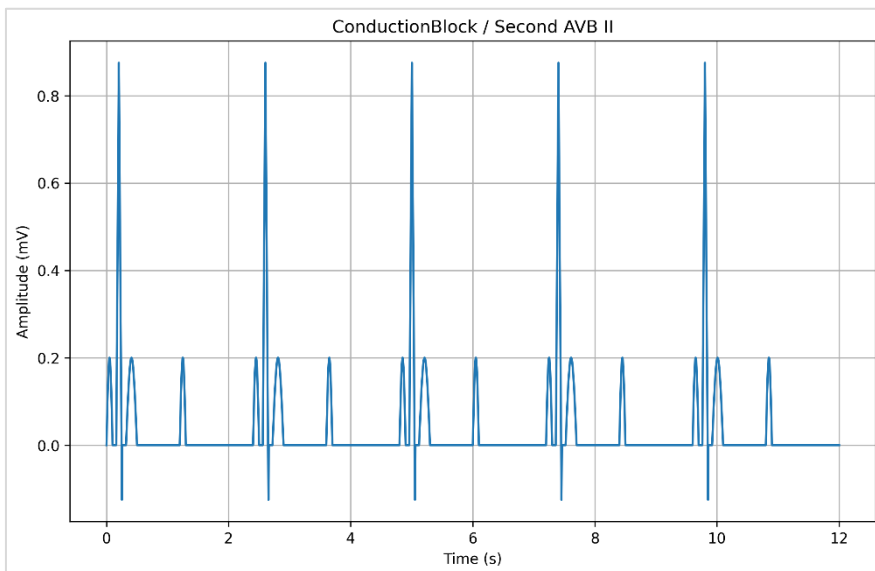


Figure 90: Second AVB II (Second-Degree AV Block II)

- Third AVB (Third-Degree AV Block)

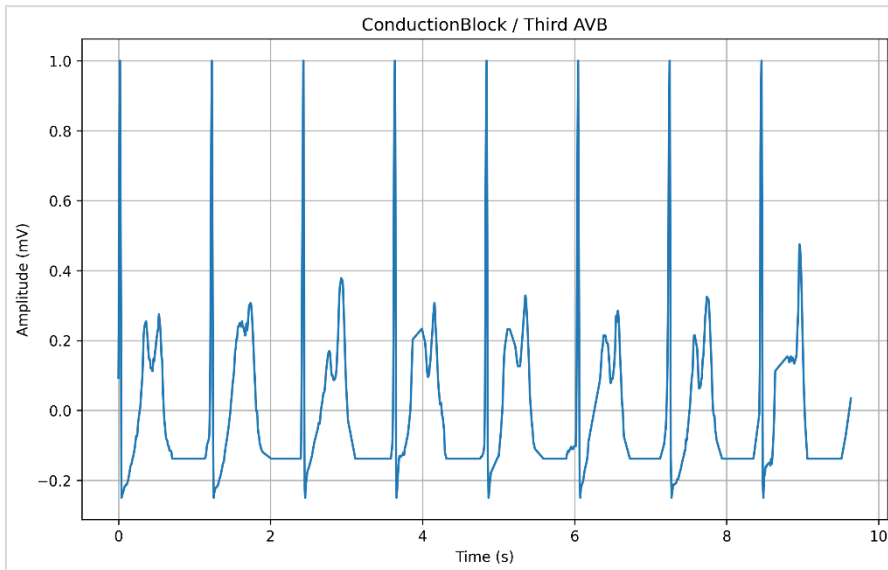


Figure 91: Third AVB (Third-Degree AV Block)

7.5 Bundle Branch Block

- RBBB-1 (Right Bundle Branch Block-1)

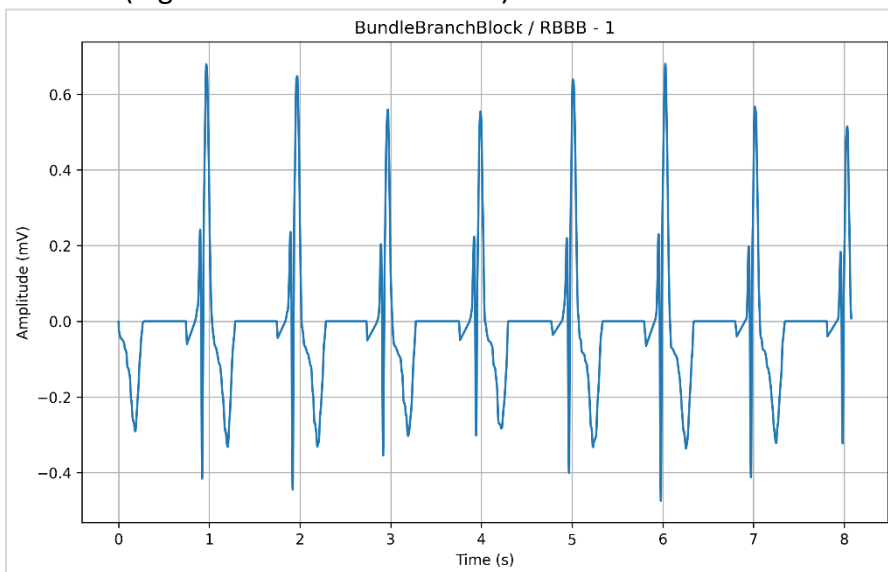


Figure 92: RBBB-1 (Right Bundle Branch Block-1)

- RBBB-2 (Right Bundle Branch Block-2)

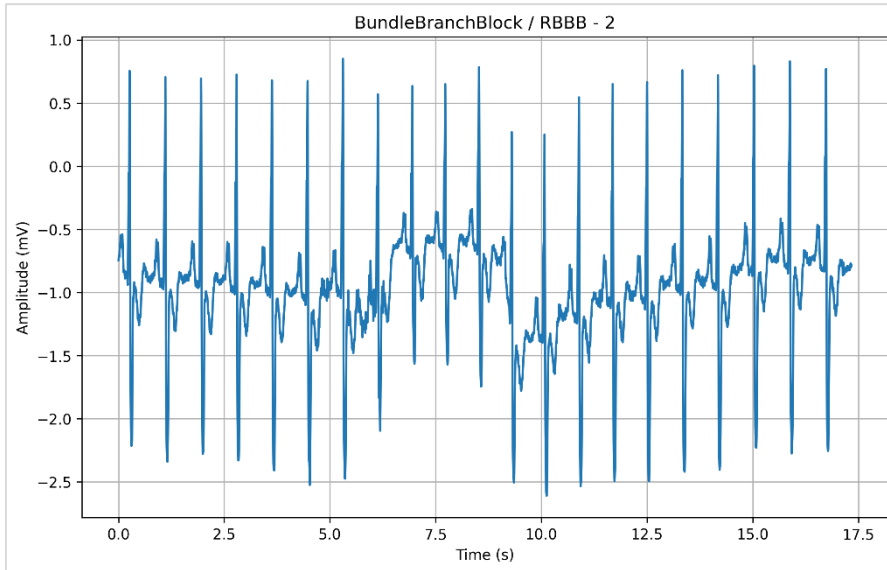


Figure 93: RBBB-2 (Right Bundle Branch Block-2)

- LBBB-1 (Left Bundle Branch Block-1)

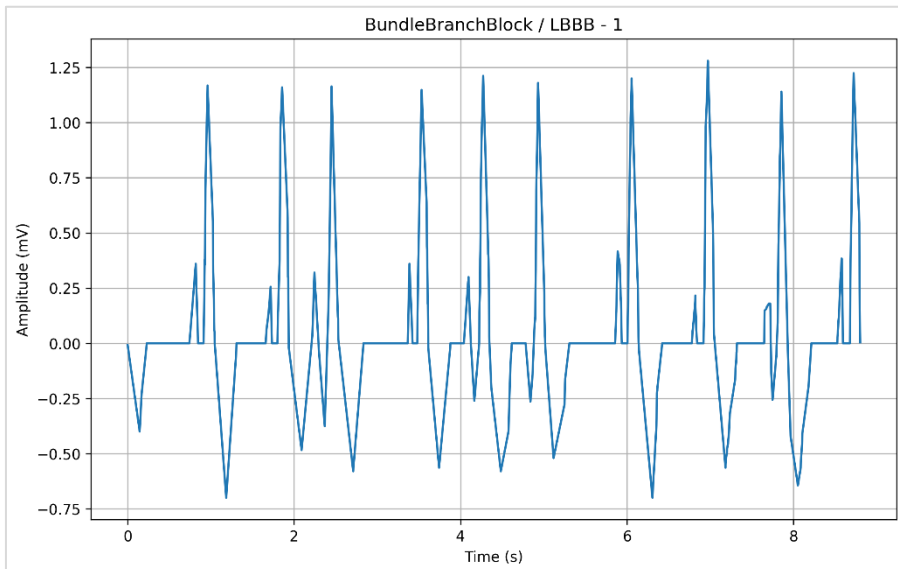


Figure 94: LBBB-1 (Left Bundle Branch Block-1)

- LBBB-2 (Left Bundle Branch Block-2)

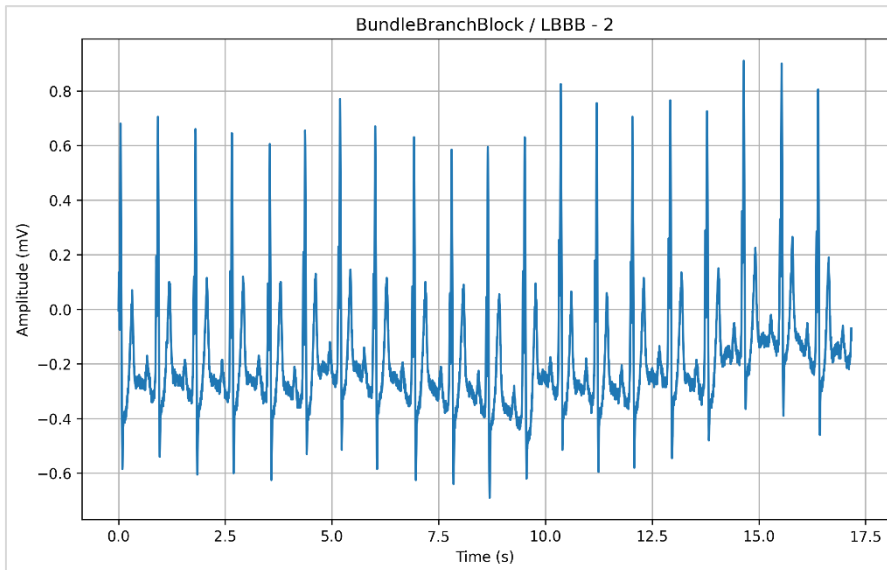


Figure 95: LBBB-2 (Left Bundle Branch Block-2)

7.6 Others

- CAL20110

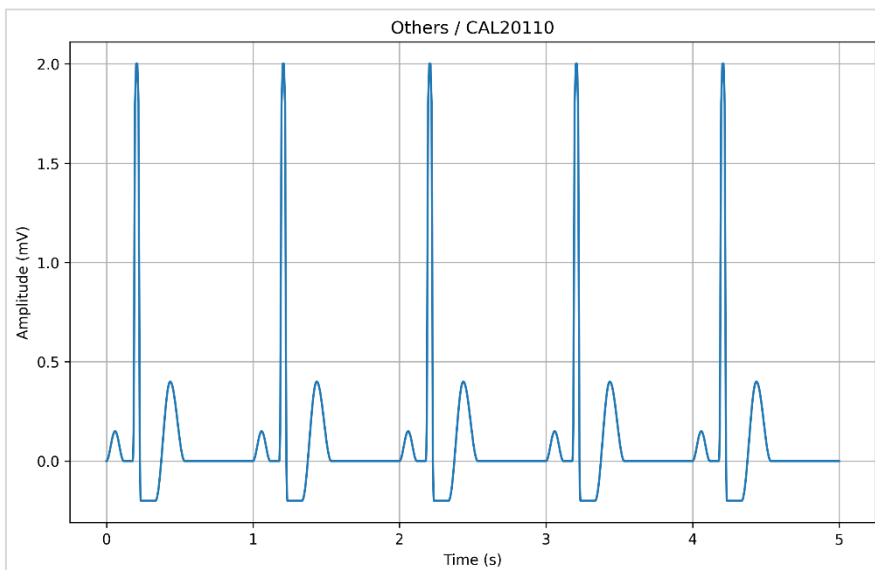


Figure 96: CAL20110

- **EMG-1**

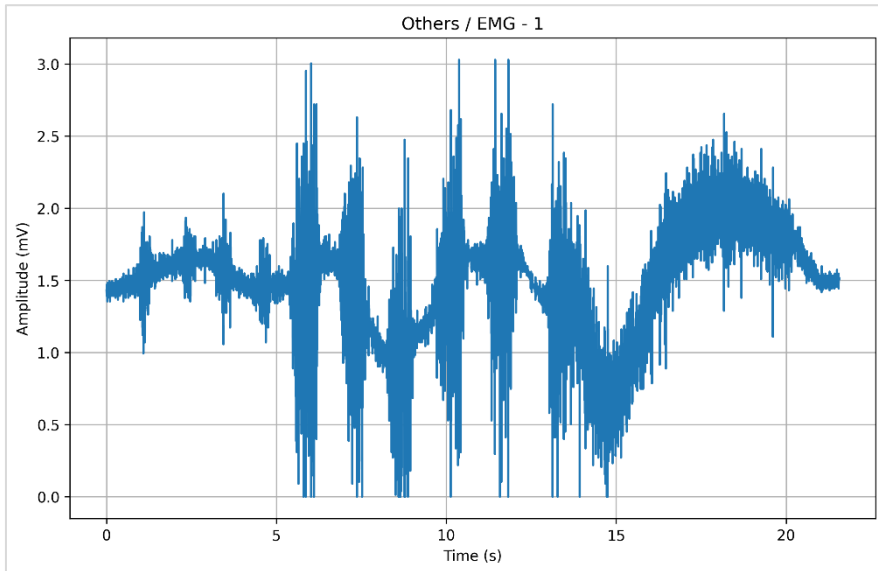


Figure 97: EMG-1

- **EMG-2**

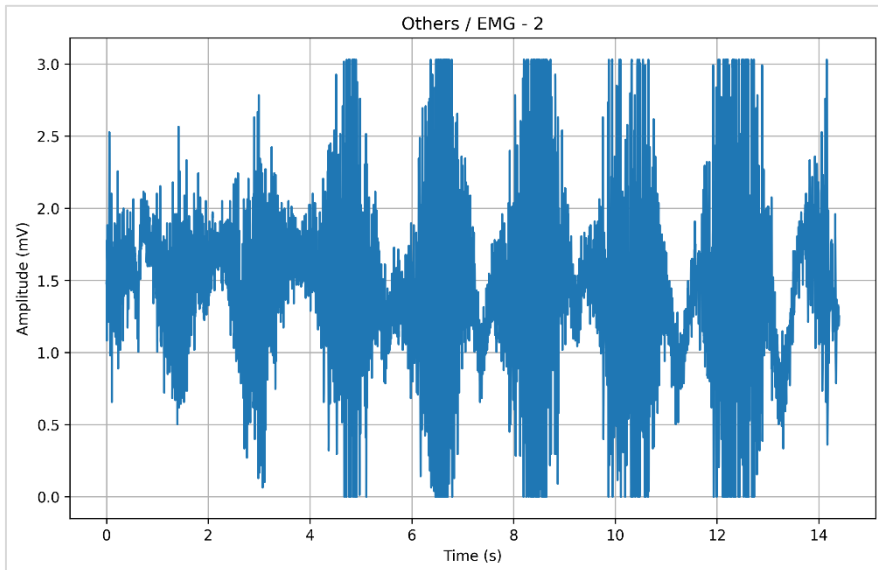


Figure 98: EMG-2

- EMG-3

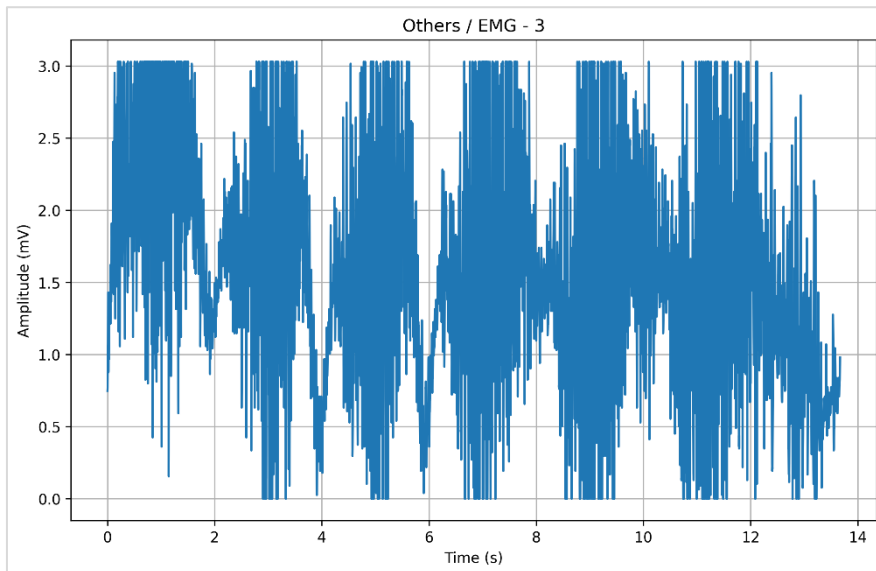


Figure 99: EMG-3

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