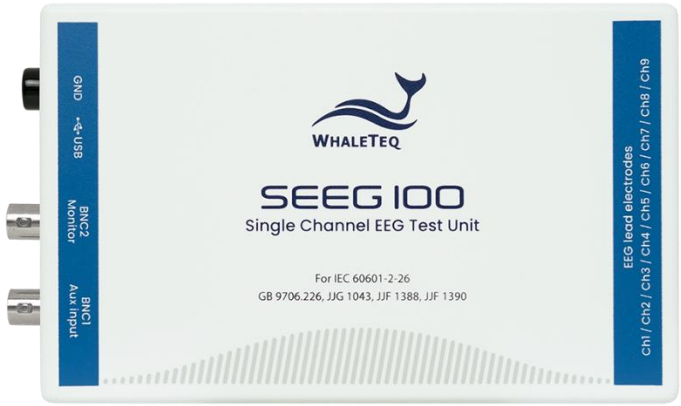
WHALETEQ

Single Channel EEG Test System (SEEG 100)

User Manual



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1 Introduction

1.1 Basic Concept

WhaleTeq Single Channel EEG Test System provides a single waveform to one or more lead electrodes of EEGs, for testing to IEC and GB particular standards. The following diagram shows the single channel concept:

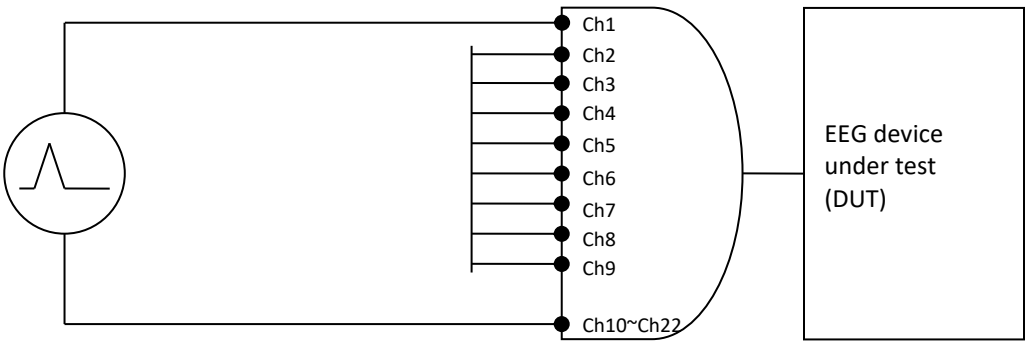


Figure 1: Single-channel Concept

Via a SEEG 100, the system produces arbitrary waveforms (streamed from the PC with digital to analogue conversion) at up to ±1V, which is then applied to a precision 1000:1 divider to produce the voltages at up to ±1mV level (2mVpp). The SEEG 100 contains resistor/capacitor networks, dc offset, and relay switching to provide the full range of single channel performance tests in IEC, GB and JJG(F) standards.

The basic range of tests in the standards include, for example:

- Sensitivity (accuracy of the µV/mm indication)
- Frequency response (sine wave, and impulse tests)
- Input impedance
- Noise

For a full list of tests, refer to the standard together with Section 1.2.

The limitations of the system are as below:

- Exclude CMRR tests (this requires a special noise free test unit, available from WhaleTeq)

- There are 22 terminals (Ch1~Ch22) in EEG breakout box. However, there are only 9 terminals (Ch1~Ch9) could output waveforms, and the rest 13 terminals (Ch10~Ch22) are connected to ground. Please refer to section 2.2 for details.

1.2 Standards/Application

The following table shows the standards for which this system has been designed for, and includes any limitations:

Table 1: Supported Medical Standards

Standard	Clause(s)	Limitations/Notes
IEC 60601-2-26:2012	201.12.1.101	201.12.1.101 all performance tests except CMRR tests
JJG 1043-2008	4.1 ~ 4.17	4.1 to 4.17 all performance tests except CMRR tests
JJF 1390-2013	5.1 ~ 5.17	5.1 to 5.17 all performance tests except CMRR tests
JJG 954-2000	3.1 ~ 3.9	3.1 to 3.9 all performance tests except CMRR tests
JJF 1388-2013	5.1.1 ~ 5.1.13	5.1.1 to 5.1.13 all performance tests except CMRR tests
GB 9706.226-2021	201.12.1.101	201.12.1.101 all performance tests except CMRR tests

General limitation:

(1) This equipment is designed for use with isolated EEG circuits, as are generally provided for medical EEG. If applied to a non-isolated circuit, the noise may be excessive.

(2) In EEG breakout box, there are 22 terminals. But there are only 9 terminals could output waveforms, the rest 13 terminals are connected to ground.

1.3 Block Diagram/SEEG 100 Module Overview

The following is a simplified block diagram of the system inside the SEEG 100 module:

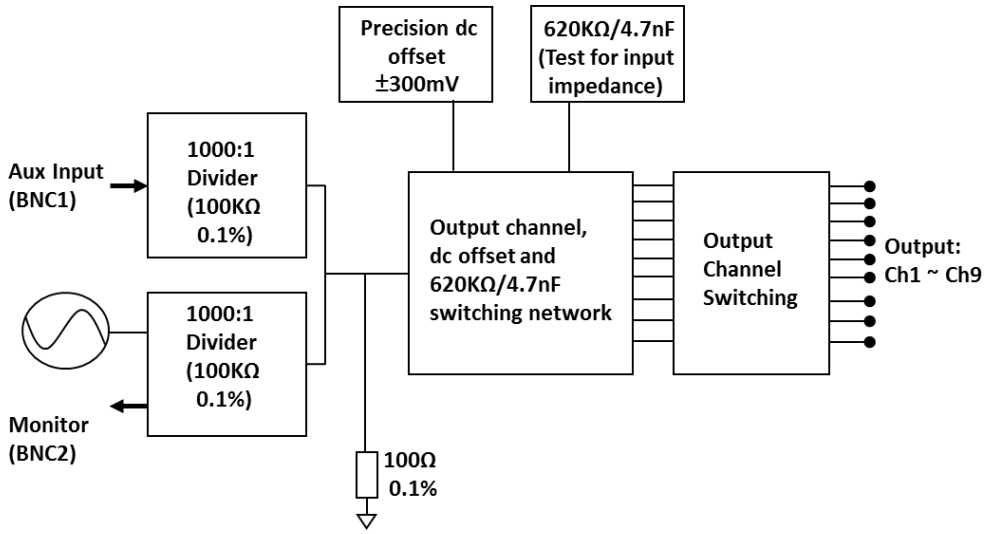


Figure 2: Simplified Block Diagram

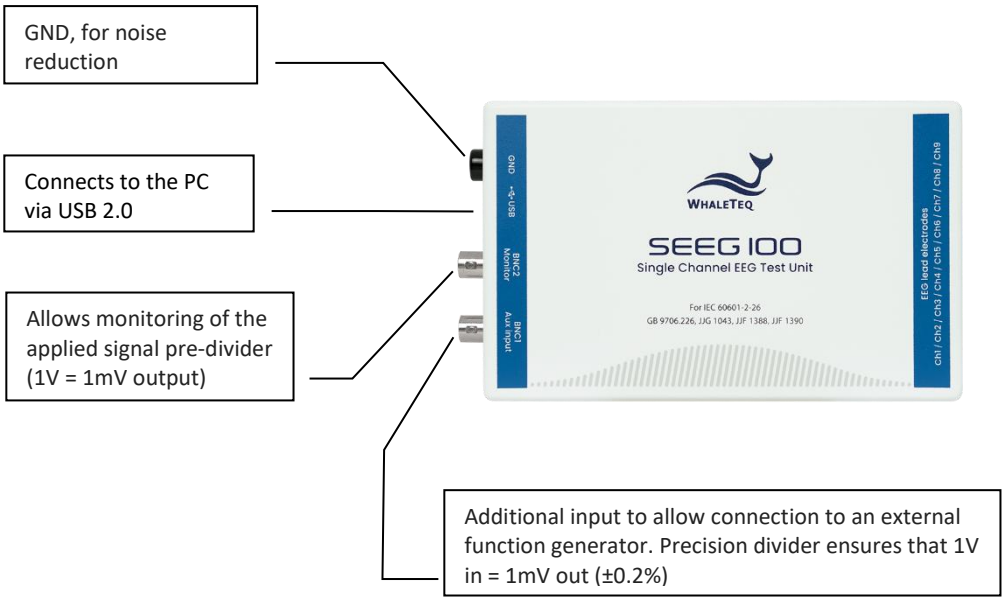


Figure 3: SEEG 100 Hardware Overview

1.4 Main Specifications

In general, the system has been designed to the IEC 60601-2-26 and GB 9706.226 standards. The SEEG 100 specifications are listed below.

- Technical Specifications

Table 2: Technical Specifications

Parameters	Specifications
Main output voltage accuracy	±1% for amplitudes of 50µVpp or higher
Main output voltage resolution (DAC resolution)	0.5µV
Frequency / pulse repetition rate accuracy	±0.1%
Pulse duration / timing accuracy	±0.2ms
Resistor tolerance	±0.5%
Capacitor tolerance	±5%
Precision 1000:1 divider (100kΩ:100Ω)	±0.05%
Sample rate	5kHz±0.05% (50ppm)
DC offset (fixed, noise free, from internal supercapacitor)	300mV±0.1%
DC offset (variable, may include up to 50µVpp noise)	Setting ±1% or ±3mV
Power supply	Typical load<0.25A, up to 0.45A is possible if all relays are turned on
Environment	5—40°C 50—80% RH altitude < 2000M
Safety Signal processing	Built-in USB IC protection mechanism to avoid the impact from high voltage and current; as well as special filters to reduce noise from the microprocessor

Parameters	Specifications
	(8MHz) and DC/DC converters (200kHz).

- Signal Type

Table 3: Signal Specifications

Parameters		Setting Range	Default Values	Minimum Step Size
Sine	Frequency (Hz)	0.05—500Hz	10Hz	0.01
	Amplitude	(-2000)—2000μV	100μV	1
Triangle	Frequency (Hz)	0.05—500Hz	10Hz	0.01
	Amplitude	(-2000)—2000μV	100μV	1
Square	Frequency (Hz)	0.05—500Hz	10Hz	0.01
	Amplitude	(-2000)—2000μV	100μV	1
Rectangle pulse	Frequency (Hz)	0.05—5Hz	5Hz	0.01
	Amplitude	(-2000)—2000μV	100μV	1
	Pulse width	2—300ms	100ms	1
Triangle pulse	Frequency (Hz)	0.05—5Hz	5Hz	0.01
	Amplitude	(-2000)—2000μV	100μV	1
	Pulse width	2—300ms	100ms	1
Hysteresis	Frequency (Hz)	0.05—500Hz	5Hz	0.01
	Amplitude	(-2000)—2000μV	100μV	1
	Pulse width	2—300ms	100ms	1

- Signal Add-on

Table 4: Signal Add-on Specifications

Parameters		Setting Range	Default Values	Minimum Step Size
DC offset		(-1000)—1000mV	0mV	1
620kΩ / 4.7nF (Turn on for short circuit)		on / off	Off	-
Noise	Main noise	50Hz, 60Hz, 80Hz, 100Hz (The 80Hz and 100Hz settings are for capacitance correction only, not for testing EEG.)	50Hz	-
Frequency scan (Sine)	Start frequency	0.67—500Hz	0.67Hz	0.01
	Stop frequency	0.67—500Hz	150Hz	0.01
	Duration	10—180s	30s	0.01
Output lead electrode		Ch1—Ch9 (Ch10—Ch22 are shorted together.)	Ch1	-

1.5 Cautions

- Before using products, use a grounded wrist strap or touch a grounded safely object or a metal object, such as the power supply case, to avoid damaging them due to static electricity.
- WhaleTeq does not recommend to connect test equipment with DUT to conduct Electrostatic Discharge (ESD) test. This may cause unexpected damages to test equipment. Please contact WhaleTeq for alternatives before ESD test.

- For operating “Firmware Update” feature, there are risks of losing data if improper options are performed during the Firmware Update period.
- The professional testing instrument, not a medical device, is for testing only, and will not involve human or clinical use.

2 PC Software Mode

2.1 Installation and Environment

2.1.1 System Requirements

The Single Channel EEG system uses a normal PC to interface and control the USB module.

PC requirements:

- Windows PC (Windows 7 or later, suggest to use the genuine version)
- Microsoft .NET 4.5.2 or higher
- Administrator access (essential for installing software, driver, and Microsoft .Net Framework)
- 1.5 GHz CPU or higher
- 1GB RAM or higher[1]
- USB port

2.1.2 SEEG 100 Software Installation

Please follow the below steps to download and execute SEEG 100 Software.

- Download SEEG 100 software from WhaleTeq website.
- Browse to the download location.
- Unzip the file to your destination folder.
- Click the installation file in the destination folder to initiate the installation process.
- When the installation is completed, SEEG 100 software would be executed automatically. User can also execute SEEG 100 software via

[1] Relative to normal PC processing, there is no special use of PC speed. However, there has been noted a slow increase in system RAM usage over long periods of time up to 30-40MB (related to MS Windows "garbage collection"). PCs with only 512MB or less installed and are running several other programs (in particular, Internet Explorer), may exceed the available RAM, requiring access to the hard drive and dramatically impacting speed. In this case, streaming interruptions and other problems may occur.

selecting “All Programs” → “WhaleTeq” → “WhaleTeq SEEG” in Windows startup program manager.

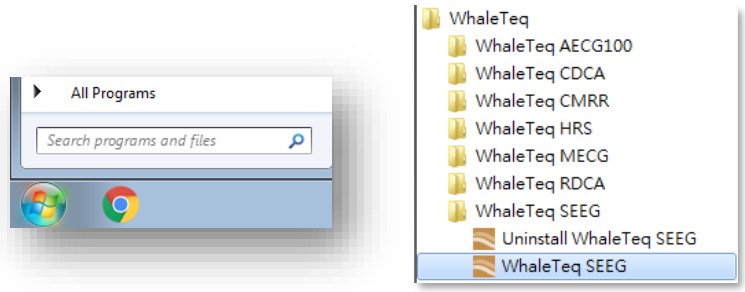


Figure 4: Execute SEEG 100 Software

If SEEG 100 software can’t be executed properly or this is the first time using WhaleTeq product, please refer to section 2.1.3 and 2.1.4 to confirm that USB driver and Microsoft .Net Framework 4.5.2 are all installed.

2.1.3 First Time Using WhaleTeq Product—USB Driver Installation

If Windows device manager can’t recognize WhaleTeq product, please follow the below instructions to Install Microchip® USB driver.

Microsoft Windows 10

As Windows 10 has built-in Microchip® USB Driver, there’re no needs to install any drivers. It just takes a while for Windows Device manager to recognize and install the driver.

Microsoft Windows 8 and Windows 8.1

- Windows 8 and Windows 8.1 can’t recognize SEEG 100 unit, please download “mchpcdc.inf” from WhaleTeq website. This driver is provided by Microchip® for using with PIC microprocessors having built-in USB function.
- As mchpcdc.inf provided by Microchip® does not contain digital signature, please disable driver signature enforcement in Windows 8 and Windows 8.1. Please click here to watch the tutorial video.

- When the USB module is connected for the first time, select manual installation, and point to the folder containing the above file. Then continue to follow the instructions to finish the installation. There may be a warning that the driver is not recognized by Windows®, and this can be ignored. Please click here to watch the tutorial video.

Microsoft Windows 7

- Windows 7 can't recognize SEEG 100 unit, please download "mchpcdc.inf" from WhaleTeq website. This driver is provided by Microchip® for using with PIC microprocessors having built-in USB function.
- When the USB module is connected for the first time, select manual installation, and point to the folder containing the above file. Then continue to follow the instructions to finish the installation. There may be a warning that the driver is not recognized by Windows®, and this can be ignored. Please click here to watch the tutorial video.

2.1.4 First Time Using WhaleTeq Product—Microsoft .Net Framework 4.5.2 Installation

WhaleTeq software is developed by Microsoft .Net Framework 4.5.2. If SEEG 100 software fails to launch properly, please check whether Microsoft .Net Framework 4.5.2 or higher versions was installed in the operation system.
If your PC does not install Microsoft .Net Framework 4.5.2 or higher versions, please download from Microsoft website. Please click here to watch the tutorial video (from 2:03).

Note: If .NET Framework 4.5.2 cannot be installed, please try installing version 4.0 first, and then proceed to install version 4.5.2.

2.2 Connecting to the EEG

For connecting the EEG device to the SEEG 100 and use the provided 22 channels “EEG breakout box”. There are only 9 terminals (Ch1~Ch9) could output waveforms, and the rest 13 terminals (Ch10~Ch22) are connected to ground. Please refer to below chart for internal circuit diagram.

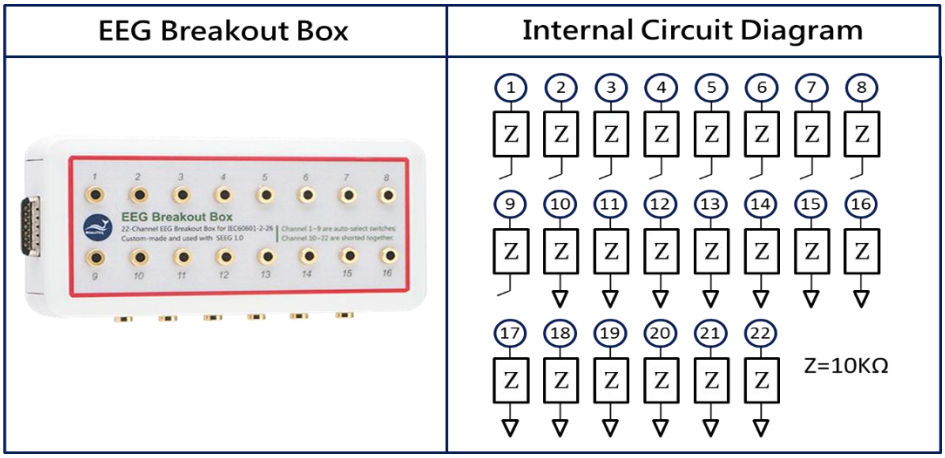


Figure 5: Internal Circuit Diagram

Alternately the EEG device under test can be directly connected to the SEEG 100 module using a male D15 connector. The pin outs are:

1–Ch1	4–GND	7–Ch7	10–Ch4
2–Ch2	5–Ch9	8–Ch6	11–NC
3–Ch3	6–Ch8	9–Ch5	12–GND

Note: Ch10 ~ Ch22 connect to pin 4 each through a 10kΩ resistor. Also, pin12 is the system ground.

2.3 Environmental Noise Reduction

A noise free environment is necessary for testing EEG equipment. This can be achieved relatively easily by (a) using a metal bench or metal sheet underneath the EEG device under test and the SEEG 100, and (b) connecting SEEG 100 GND terminal to the sheet and also the frame ground (or EP terminal) of the EEG device under test:

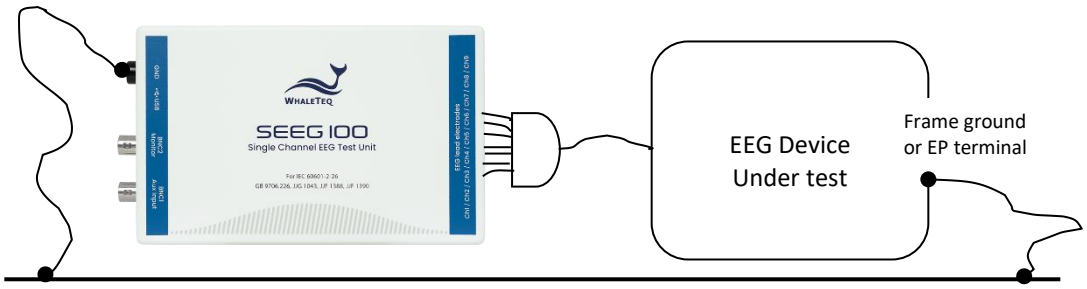


Figure 6: Low-noise Test Environment Setup

With this set up, turn the EEG device under test to maximum sensitivity, turn off the ac filters (if possible) and confirm that the level of noise is acceptable for tests. For most tests, this set up is satisfactory without any special efforts. However, for the input impedance test with the 620kΩ is in series the imbalance in impedance can cause high noise. For this test, the ac filter may be turned on. If the noise is still excessive, move to an electrically quiet environment or increase the size of the metal sheet underneath and around the set up.

2.4 Firmware Update

Firmware Update only can be supported with specific hardware and firmware. If your SEEG 100 doesn't support the feature, you could contact Whaleteq for upgrade at service@whaleteq.com.

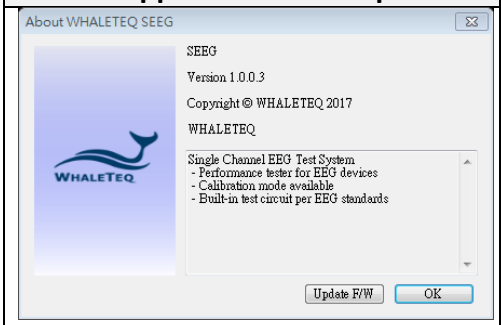
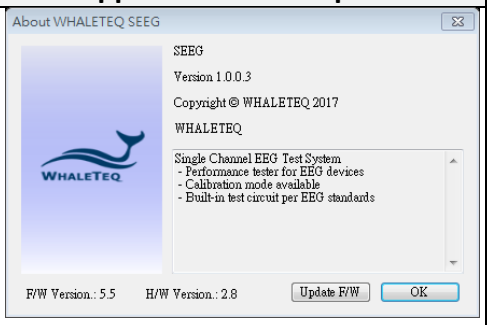
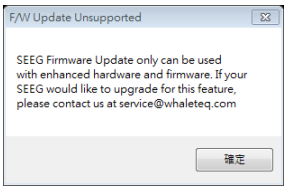
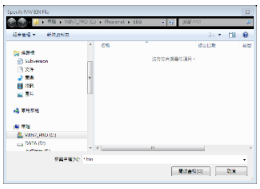
Question:

How to check your SEEG 100 have supported Firmware Update?

Answer:

Connect the SEEG 100 to PC. Go to "About" dialog, then check whether the **"F/W Version"** and **"H/W Version"** buttons are hidden. (Please watch **Step 1** in below section for where to find "About" dialog.)

Table 5: Software Screenshots of Not Supporting and Supporting Firmware Update

Not Support Firmware Update	Support Firmware Update
	
	

Caution: There are risks of losing data if improper options are performed during the Firmware Update period.

2.4.1 How to Update Firmware

If your SEEG 100 supports “Firmware Update” feature. Below is the step-by-step instruction for how to update firmware:

Step 1.

Connect the SEEG 100 to PC, then open the SEEG 100 application with version **1.0.0.3 or higher**. Move the cursor to the title bar, right click your mouse. Then there will show up a menu, select “**About**”.

Figure 7: Update the Firmware (Step 1)

Step 2.

"**About**" dialog is popped up. Press the "**Update F/W**" button.

Figure 8: Update the Firmware (Step 2)

Step 3.

Go to the SEEG 100 web page and download Firmware file.

Step 4.

Back to SEEG 100 application, select the downloaded firmware file.

Step 5.

The application will show an information dialog. After pressing "OK", the operation cannot be cancelled.

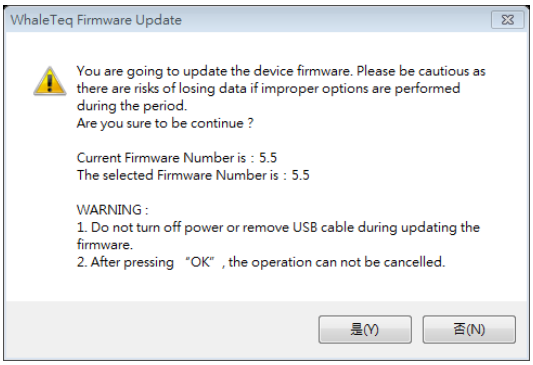


Figure 9: Update the Firmware (Step 5)

Step 6.

Wait for firmware update complete.

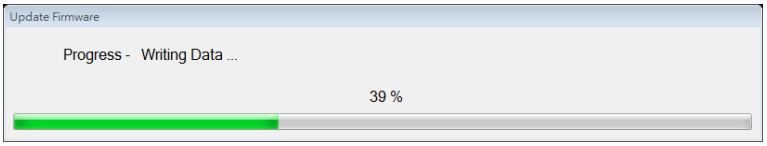


Figure 10: Update the Firmware (Step 6)

Step 7.

Please restart the SEEG 100 system to complete firmware update process.

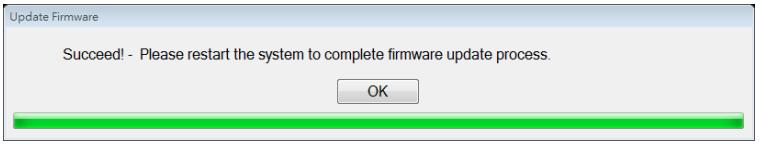


Figure 11: Update the Firmware (Step 7)

2.5 Main Screen

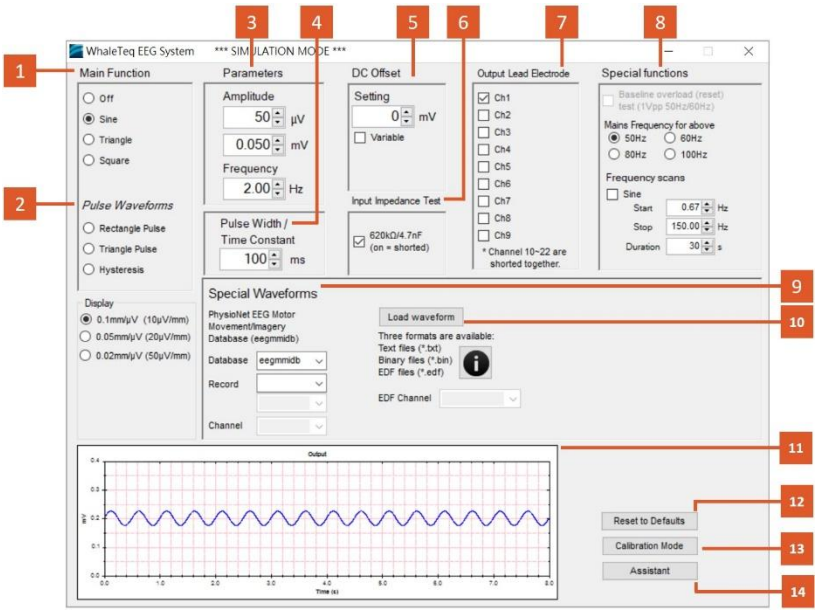


Figure 12: Main Screen

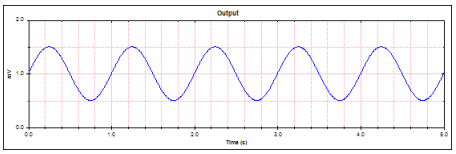
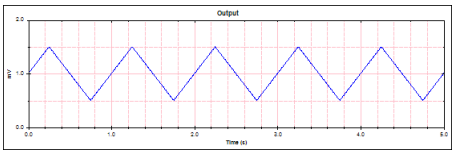
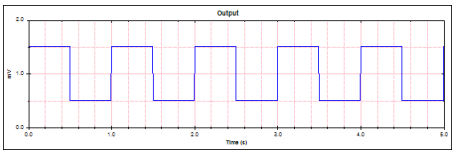
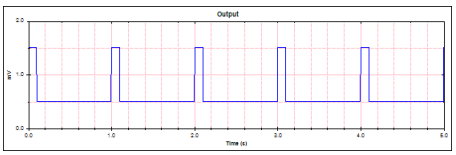
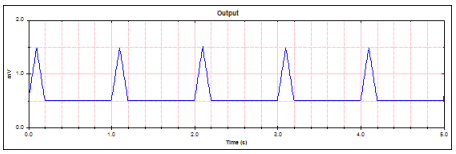
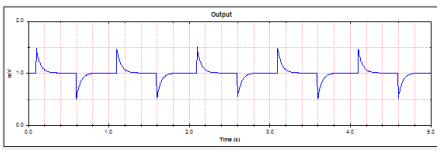
01- Select the main function (waveform) type, such as sine, triangle and square wave.
02- Select the pulse function (waveform) type, such as rectangle pulse, triangle pulse and Hysteresis.
03- Parameter setting
04- Select the pulse width for rectangle and triangle pulse only, time constant for hysteresis only.
05- DC offset setting.
06- Select if 620kΩ/4.7nF is in circuit (for input impedance test).
07- Select the lead electrode which the output is switched to (Ch1~Ch9).
08- Special functions
09- Select PhysioNet EDF format waveform and download directly from Internet
10- Load text and binary format waveforms from local.
11- Provide a semi-real time graphical display of the current signal
12- Reset to default
13- Calibration mode
14- IEC 60601-2-26 and GB 9706.226 option

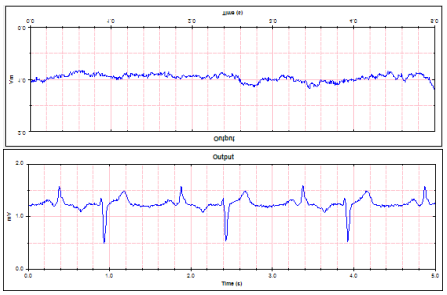
2.6 Description of Functional groups

2.6.1 Main Function (Main Waveform)

This group allows the operator to select the main waveform to be used in the test, from the following:

Table 6: Waveform Settings

Waveform Type	Description	Sample Waveform
Sine	Basic sine wave, according to the amplitude (mVpp) and frequency (Hz).	
Triangle	Basic triangle wave, according to the amplitude (in mVpp) and frequency (Hz).	
Square	Basic square wave, according to the amplitude (in mVpp) and frequency (Hz).	
Rectangle pulse	A rectangular pulse, according to the amplitude setting, pulse width and pulse repetition rate (frequency, Hz).	
Triangle pulse	A triangle pulse, according to the amplitude setting, base (pulse) width and pulse repetition rate (frequency, Hz).	
Hysteresis	Exponential waveform, used for hysteresis test (set amplitude to ±0.5mV, time constant 50ms, adjustable).	

Waveform Type	Description	Sample Waveform
EDF File Manager, Load Waveforms	A range of stored waveforms including: (1) load waveform and (2) load PhysioNet database through internet, then play. For these waveforms, the amplitude and frequency settings have no effect.	

2.6.2 Main Parameters

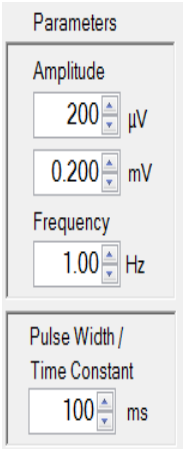


Figure 13: Amplitude, Frequency, and Pulse Width Settings

Amplitude:
Can be set in either mV or µV, changing one will automatically change the other to match. The waveform amplitude from -2 mV to +2 mV at a 0.001mV (1 µV) resolution. For all waveforms the amplitude represents the peak to peak value. For example, for a 1mV sine wave the actual waveform varies between +0.5mV and -0.5mV. This correlates with testing requirements in standards.

Frequency:
Set in either Hz. Continuous waveform (Sine, Triangle and Square), can up to 500 Hz, for pulse waveforms (rectangle, triangle), the frequency can also be referred to as the pulse repetition rate. For some pulse settings the frequency is limited to prevent overlapping pulses (limit to 5 Hz).

Pulse Width:
Apply to rectangle, triangle and exponential pulse waveforms only. For the rectangle, pulse width is defined as the time between crossing the 50% point in rising and falling edges of the pulse[2]. For triangle pulses, the setting matches the base of the triangle pulse. For exponential pulse, the set pulse width is time constant. Pulse width can be set to down to 2ms[3].

[2] To minimise ringing due to EEG notch filters, rectangle pulses have a rise time of 1ms. This means that a 20ms rectangle pulse will actually have a 21ms base and a 19ms at the top of the pulse. This definition ensures that the pulse integral matches the setting, e.g. a 3mV 100ms pulse will have an integral of 300µVs.

[3] Note the sampling rate is limited to 0.2ms. Therefore, a 2ms pulse will have limited time resolution.

2.6.3 DC Offset Settings

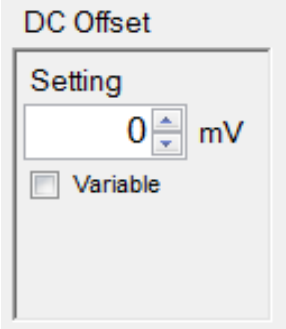


Figure 14: DC Offset Settings

This function allows the operator to switch in a dc offset. In the default condition (not variable), only +300mV, 0 or -300mV can be set. In this mode, the dc offset is sourced from an internal “super capacitor” which at least 3 minutes of accurate and stable 300mVdc offset to be placed in series with the main waveform, without impacting the quality of that main waveform. The capacitor is charged while not in use (i.e. when the setting is zero).

In the variable mode, the dc offset is provided by a second channel. It is limited to 1000mV.

2.6.4 Input Impedance Test

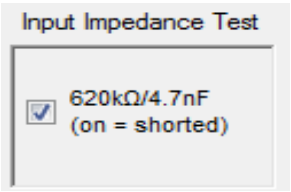


Figure 15: Input Impedance Test

This check box allows the user to switch in an impedance of 620kΩ//4.7nF in series with the main function, for testing the input impedance of the EEG device under test. When the check box is ticked, the impedance is shorted. The ±300mVdc offset can be used in conjunction with this test.

2.6.5 Output Lead Electrode

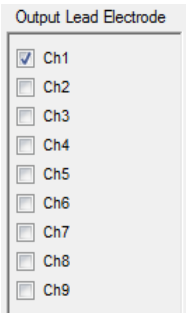


Figure 16: Output Lead Electrode Settings

This section allows the user to select which lead electrode the output is connected to (i.e. terminal P1 in the IEC 60601-2-26 and GB 9706.226, Figure 201.104). Unselected electrodes are connected to the system ground (terminal P2 in Figure 201.104).

More than one lead electrode may be selected.

2.6.6 Lead Electrode Impedance

As required in IEC 60601-2-26 and GB 9706.226, each lead electrode has in series 10kΩ to simulate the skin impedance, all the 10 KΩ resistors built in the 22 channels breakout box.

2.6.7 Output Graphic Display

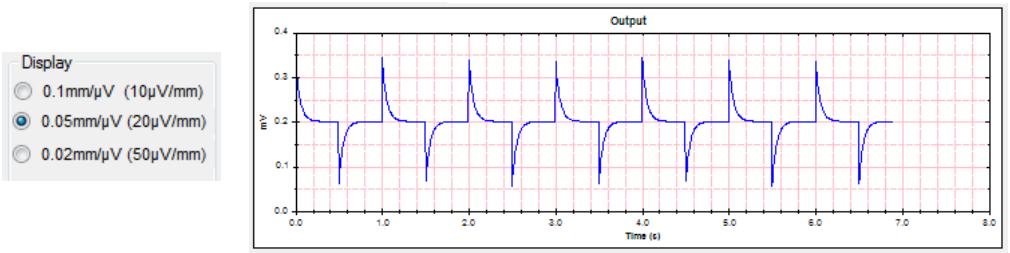


Figure 17: Output Graphic Display

The output display provides an image similar to that provided by EEGs. The sensitivity of the display range may be set at 0.1mm/µV, 0.05mm/µV or 0.02mm/µV to cover the full range of waveforms offered by the system. The time rate is fixed. The output display uses the same data as used in the DAC output and serves as a cross check of the selected waveform.

2.6.8 Special Functions

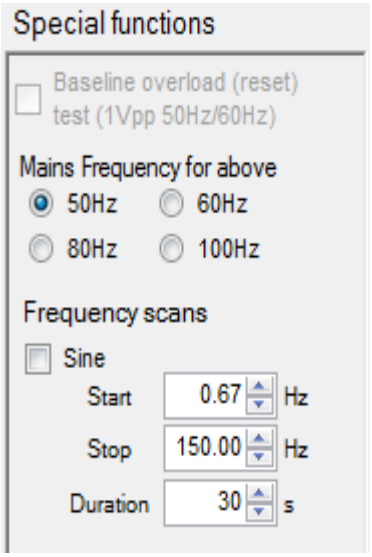


Figure 18: Special Functions

Baseline reset test (sine wave only):
When checked the parameters are ignored and a large signal of 1Vpp (0.354Vrms) is applied. It is intended to test the EEG's response to overload, in particular automated resetting of baseline (due to high pass filtering). When unchecked, the system reverts to the previous settings (e.g. 1mVpp 10Hz signal). Mains frequency of the test can be selected from 50Hz or 60Hz.

Frequency scans:
Sine: may be used to test systems with extended frequency response. This system uses a fixed sampling rate of 5kHzwhich has been found to reduce problems of beating from other digital sources. If beating still occurs, a

separate analogue input at BNC1 is provided to allow testing with analogue type function generators.

2.6.9 Special Waveforms and Load Waveform

There are two features on the bottom right frame: “Special Waveforms” and “Load waveform”. For these two features, the amplitude and frequency settings have no effect.

Special Waveforms:

The SEEG 100 can play PhysioNet waveforms with 1 electrode at each time. This feature will download waveforms from PhysioNet directly. Please check your internet status before use this feature.

The SEEG 100 built-in databases are as below:

- *EEG Motor Movement/Imagery Database (eegmmidb):*
  Each volunteer performed different motor/imagery tasks while 64-channel EEG were recorded. Here for more details.
- *CHB-MIT Scalp EEG Database (chbmit):*
  This database, collected at the Children’s Hospital Boston, consists of EEG recordings from pediatric subjects with intractable seizures. Each seizure is annotated. Here for more details.

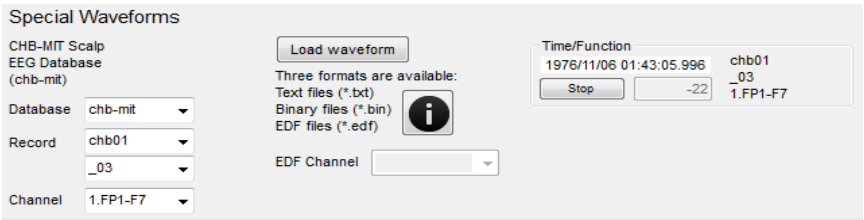


Figure 19: Special Waveforms

Load waveform:

The “Load waveform” function supports three formats – Text, Binary and EDF files.

Text (*.txt)

- Ascii file, Windows line breaks (LF, CF)
- first line is sample rate (Hz)

- second line number of samples
- following lines are samples in microvolts (one sample per line)

Binary files (*.bin)

- Bytes 1-2 are sample rate (Hz)
- Bytes 3-6 are number of samples
- Following bytes are samples, 2 bytes per sample
- all data is big-endian (high byte first), 2's compliment

EDF files (*.edf)
This is a commonly used but complicated format. Here for the format details.

2.7 IEC 60601-2-26 and GB 9706.226 Helper

It is a companion software add-on to enhance the function of SEEG 100. It supports the latest EEG standards IEC 60601-2-26:2012 and GB 9706.226-2021 with detailed preset parameter settings and actual test sequence for testing needs.
Note: The GB 9706.226 standard assistant needs a separate purchase for its license. Please send the "Hardware ID" of SEEG 100 to WhaleTeq to purchase this function and receive an Activation Key.

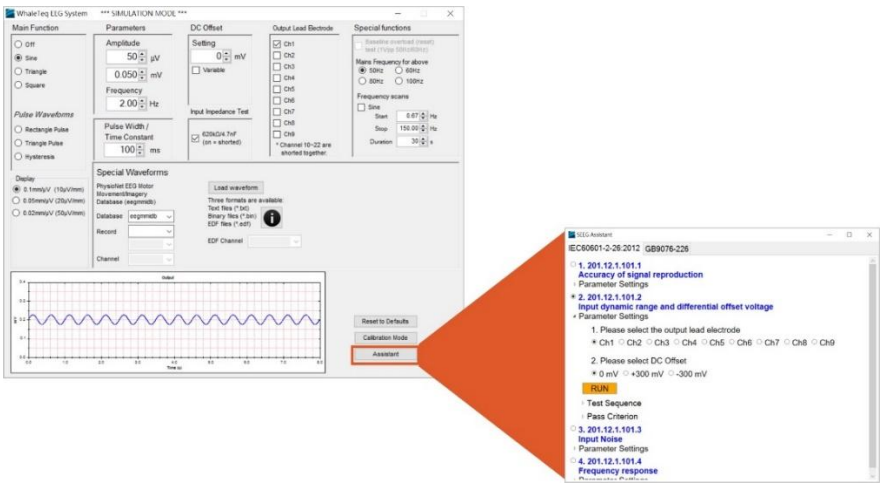


Figure 20: Standard Assistant

2.8 Calibration and Software Validation

SEEG 100 has undergone a detailed system validation including software. A report for this can be provided on request.

Prior to shipping, each unit is tested for component values and output voltages, using a calibrated precision multi-meter. As WhaleTeq cannot provide ISO 17025 accredited calibration, laboratories which are required to follow ISO 17025 should perform calibration either periodically or on a before use basis, following normal procedures and practice. The extent of calibration may be limited depending on the needs of the laboratory.

As the calibration procedure is complicated, a software assisted calibration mode is provided. The software sets up the SEEG 100 as required for the particular tests, and instructs the user on what measurement to make (e.g. measure resistance between ch1 and ch2).

#1	*Test location:	---	---	WhaleTeq, Taipei, Taiwan		
#2	*Date (yyyy/mm/dd):	---	---	2015/10/27		
#3	*Reference equipment:	---	---			
#4	*Room temperature, ˚C:	---	---	25		
#5	*Room humidity, %RH:	---	---	50		
#6	*Tests by:	---	---	Joseph Liu		
#7	*SECG Serial No.	---	---	WEE1501111		
#8	Input imp. rest., kΩ:	620.0	1%	621	0.2%	Pass
#9	Input imp. cap., nF:	4.70	5%	4.6	-2.1%	Pass
#10	* Change to mVdc	---	---	None required		---
#11	Output voltage, mVpp:	0.200	1%	0.201	0.5%	Pass
#12	Output voltage, mVpp:	0.400	1%	0.401	0.2%	Pass
#13	Output voltage, mVpp:	0.500	1%	0.501	0.2%	Pass
#14	Output voltage, mVpp:	0.800	1%	0.801	0.1%	Pass
#15	Output voltage, mVpp:	1.000	1%	1.001	0.1%	Pass
#16	Output voltage, mVpp:	1.200	1%	1.201	0.1%	Pass
#17	Output voltage, mVpp:	1.500	1%	1.501	0.1%	Pass
#18	Output voltage, mVpp:	2.000	1%	2.000	0.0%	Pass
#19	Fixed DC offset, mV:	300.0	1%	300.0	0.0%	Pass
#20	Variable DC offset, mV:	+200	5%	200	0.0%	Pass
#21	Variable DC offset, mV:	+600	5%	600	0.0%	Pass
#22	Variable DC offset, mV:	+1000	5%	1000	0.0%	Pass
#23	Variable DC offset, mV:	-200	5%	-200	0.0%	Pass
#24	Variable DC offset, mV:	-600	5%	-605	0.8%	Pass
#25	Variable DC offset, mV:	-1000	5%	-1000	0.0%	Pass
#26	*Pre-divider out, Vdc	2.000	---	1.999	---	---
#27	Divider ratio:	1000	0.2%	1000.5	0.0%	Pass
#28	Frequency, Hz:	10.00	1%	10.00	0.0%	Pass
#29	Frequency, Hz:	40.00	1%	40.02	0.1%	Pass
#30	Overall Result:	20	---	20	---	Pass

Figure 21: SEEG 100 Calibration Items

The user then enters the results into the form provided, and the software checks if the results are within allowable limits. When complete, the results of calibration are automatically copied to the notepad and stored in a text file at:

C:\WhaleTeq\SEEG_Cal_yyyymmdd.txt

Where “yyyymmdd” is the date based on the PC’s system. If a fixed width font such as “Courier New” is used, the data appears aligned.

To calibrate 10kΩ simulated skin impedance in series with lead electrodes, please choose manual mode and measure EEG breakout box channels one by one from ch1 to ch22.

The following manual procedure is retained here for reference and explanation.

2.8.1 Calibration Procedure

Table 7: Calibration Procedure

Parameter	Nominal value, tolerance	Method
Lead electrode resistance	10kΩ±1%	The 10kΩ can be measured between ch1 and pin 1 (25 pins, D type connector of EEG breakout box), ch2-pin 2, ch3-pin 3, ch4-pin 5, ch5-pin 6, ch6-pin 7, ch7, pin 8, ch8-pin 9, ch9-pin 10, ch10~ch22 all to pin 4.
Input impedance resistor	620kΩ±1%	This can be measured as follows: • Set Main function to “Off” • Set output to ch1 • Uncheck “620kΩ/4.7nF” Measure the resistance between ch1 and ch2
Input impedance capacitance	4.7nF±5%	Measure as for the 620kΩ above, using a capacitance meter at 1kHz. Note: there is about 100pF stray capacitance in the circuit which is included in the measurement. However, even with this the measured result is within the limit.

Parameter	Nominal value, tolerance	Method
Precision divider ratio (100kΩ:100Ω)	1000:1±0.1%	Resistance values are specified as 100kΩ and 100Ω ± 0.1%, but these cannot be verified once in circuit. An alternate method is used to verify the accurate ratio: • Set up a 2mVpp, 0.1Hz square wave to output ch1 • Using the Fluke 8845A or equivalent precision meter, measure and record the peak to peak voltage at BNC2 by zeroing during the negative cycle, and measuring at the positive cycle (nominally 2Vpp). • Repeat this measurement at the output between ch1 and ch2 (nominally 2mV) Calculate the ratio and confirm it is 1000:1 ±0.2%
Output voltage	Setting±1%	Method: • Set up a 0.2mVpp, 0.1Hz square wave, output to ch1 • Measure the peak to peak output between ch1 and ch2, using the Fluke 8845A or equivalent, record this as output mVpp • Repeat for 0.4, 0.5, 0.8, 1, 1.5 and 2mVpp • Confirm all values are within 1% or 5µV of the set value Note: The Fluke 8845A has suitable accuracy at 10mVpp but has borderline accuracy at 1mVpp and lower. An alternate method is to measure the output at BNC2 and then use the divider ratio above.

Parameter	Nominal value, tolerance	Method
DC offset (fixed ±300mV)	300mV±1%	Method: • Set the equipment to “Off” • Select +300mV • Measure the voltage between Ch1 and Ch2 Note: the DC offset is sourced from an internal super capacitor which will discharge after ~10min. Tests in the standard are typically <<2 minutes.
DC variable	Setting±5mV or 1%	Use the following procedure: • Set the equipment to “Off” • Select the “Variable” checkbox • Set to +200mV dc offset • Confirm the value is 200±5mV • Repeat for +600, +1000, -200, -600 and -1000mV
Output frequency	Setting±1%	Method: • Set up 1mVpp 10/40Hz sine wave • Measure the frequency at BNC2 using any appropriate meter Note: this verifies the system clock is accurate. Verification of other frequencies or timing is not as this is covered by software validation, although users are free to measure other frequencies and timing. The use of 40Hz is recommended to avoid beating with mains frequency.

3 Software Development Kit (SDK)

WhaleTeq provides SEEG 100 software development kit. All operating parameters and options have corresponding commands in the software development kit. The software development kit contains DLL (Dynamic-link library), which will provide highly efficient program binding and version upgrade, supports C/C++ header and C# interface, and can also be integrated with third-party tools and script languages.

4 Troubleshooting

Table 8: Troubleshooting

Problem	Resolution
SEEG 100 module (test unit) not recognized (USB driver is installed correctly)	Recognition of USB devices needs to be done in order: 1. Close SEEG 100 software if open. 2. Disconnect the USB module for ~2s. 3. Reconnect the USB module. 4. Wait for the recognition sound. 5. Start SEEG 100 software.
SEEG 100 module stops responding	Move the main function mode to “Off” and then return to the function being used. If this does not work, close WhaleTeq software, disconnect the SEEG 100 module, reconnect the SEEG 100 module and re-start the SEEG 100 module.

5 Ordering Information

5.1 Standard Package

Table 9: SEEG 100 Standard Package

Part No.	Description	Quantity
100-EE00101	**Model No.**: SEEG 100 Single Channel EEG Test System with one EEG Breakout Box and Assistant Software for IEC 60601-2-26:2012 performance tests. Package contents: • SEEG 100 x 1 • EEG breakout box x 1 • Wire tie x 22 • USB cable x 1 • Grounding wire x 1	1

5.2 Optional Software, Accessories, and Services

- **Optional Software Add-on Pack**

Table 10: Optional Software Add-on Pack

Part No.	Description
HA0-SE0U002	The GB 9706.226-2021 standard assistant is designed for EEG product performance testing by simplifying the medical standard test steps into test parameters.

- **Optional Accessories**

Table 11: Optional Accessories

Part No.	Description	Quantity
100-OT00001	USB isolator for reducing the power noise from PC. Recommended to use with SECG 4.0, MECG 2.0, HRS200, HRS100+, SEEG 100 and SEEG 100E.	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	Modified Contents	Issued Date
2020-12-31	Add Chap 3 Software Development Kit (SDK) Chap 5 Ordering Information Chap 6 Version information	2021-03-31
2021-06-30	Add Chap 1.5 Cautions	2021-06-30
2023-06-12	Update 1.2 Standards/Application 1.4 Main specifications 2.5 Main Screen 2.7 IEC 60601-2-26 and GB 9706.226 Helper 5 Ordering Information	2023-06-12
2023-07-31	Update the SEEG 100 image in the following sections: Front cover 1.3 Block diagram/SEEG 100 Module overview 2.3 Environmental noise reduction	2023-08-04
2024-05-20	Update 1.4 Main specifications 5 Ordering Information	2024-05-21
2024-11-28	Update 1.4 Main Specifications 2.1.1 System Requirements 2.1.2 SEEG 100 Software Installation 2.1.4 First Time Using WhaleTeq Product	2024-12-12

7 Contact WhaleTeq

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