



SECG 5.0 AIO Multi Vital Sign Simulator

Simulates ECG, PPG, and PWTT signals for the patient monitor, ECG, and wearable device manufacturers to test performance in standalone or PC operations

SECG 5.0 AIO

- Built-in test circuits per defined in ECG standards
- Adjustable parameters and selectable options enable to verify DUT with flexibility
- Provides NST noise simulation – Electrode Motion Artifact / Muscle Noise / Baseline Wander
- Various signal simulation – Impedance Type Respiration, Wave Modulation Type (Baseline / Amplitude / Frequency) Respiration and lead-off simulation
- Auto Sequence function assists in conducting semi-automated tests
- Loads and plays recorded or programmed waveforms
- Software Development Kit (SDK) allows to develop customized or automated test software with less efforts
- Optional Standard Assistant software pack simplifies the medical standard with test sequences, options, parameters and pass criteria

With Respiration Module

- Expands the respiratory measurement range and optimizes resolution — provides the impedance baseline of up to 4500Ω and adjustable variations with a minimum step size of 0.05Ω
- Raw data playback — loads and plays clinically recorded or user-defined waveforms to rapidly verify respiratory signal processing systems and algorithms

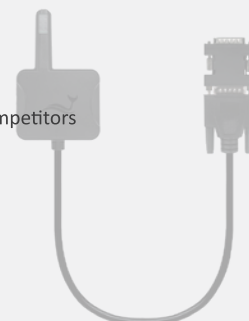
Note: The respiration module only supports impedance respiratory signal simulation in ECG mode on the SECG 5.0 AIO.



With Transmittance SpO₂ Module (PPG-2TF-660 2.0)

- Simulates ECG and PPG signals to conduct SpO₂ and PWTT (Pulse Wave Transit Time) testing
- Adjustable SpO₂ parameters, such as AC, DC, and PI (fine adjustment down to 0.01%, meeting FDA recommendations) values of R / IR, to confirm the accuracy of DUTs
- Builds or loads the R curve of the SpO₂ function to quickly verify products' performance and assist in comparing against competitors
- Built-in 14 types of ambient light signals and respiratory variation simulation – add-on signals for more authentic testing
- Synchronizes ECG and PPG signals while enabling users to adjust the time difference to test the accuracy of non-invasive blood pressure measurement algorithms
- Exclusive Auto Test SpO₂ Mode* – automatically calculates the DUT's DC value of R/IR to rapidly build the R curve, bringing convenience for testing the consistency of quality on oximeters
- Built-in 6 transmission rates – simulates 5 finger types varying in color brightness and thickness, and neonatal foot test mode for measuring newborns to optimize algorithms

*Note: This mode is mainly for developers to quickly test for reference, not for after-sales calibration and testing on oximeters. If users require development tests on SpO₂ parameters and specifications, please use the SpO₂ Mode.



With Reflectance SpO₂ Module (PPG-2R-880 / PPG-2R-940)

- Simulates ECG and PPG signals to conduct SpO₂ and PWTT (Pulse Wave Transit Time) testing
- Adjustable SpO₂ parameters, such as AC, DC, and PI values of R/IR, to confirm the accuracy of DUTs
- Builds or loads the R curve of the SpO₂ function to quickly verify products' performance and assist in comparing against competitors
- Built-in respiratory variation simulation – add-on signals for more authentic testing
- Synchronizes ECG and PPG signals while enabling users to adjust the time difference to test the accuracy of non-invasive blood pressure measurement algorithms



With Reflectance Green Light Heart Rate Module (PPG-1R-525)

- Outputs green light analog signals to simulate PPG signals
- Built-in respiratory variation simulation – add-on signals for more authentic testing
- Synchronizes ECG and PPG signals while enabling users to adjust the time difference to test the accuracy of non-invasive blood pressure measurement algorithms
- Equipped with RCA to BNC ports to connect to an oscilloscope – outputs amplified and stable signals for viewing the voltage of AC analog signals of green light, optical signals received by the PPG-1R-525, and the switch status of green LED of DUT



Medical Standard Coverage

IEC 60601-2-25 IEC 60601-2-27 IEC 60601-2-47 ANSI/AAMI EC11 ANSI/AAMI EC13
GB 9706.225 GB 9706.227 YY 9706.247 YY 1079 YY 1139 YY 0782 YY 0885 JJG 760 JJG 1042

• Specifications
ECG Test Mode

Parameters	Specifications
Main Output Voltage Accuracy	±1% for amplitudes of 0.5mVpp or higher
Main Output Voltage Resolution (DAC resolution)	0.63μV
Frequency / Pulse Repetition Rate Accuracy	±0.5%
Pulse Duration / Timing 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% Range: ±2mV – ±700mV
Pacing Pulse Characteristics	Rise / fall time 5μs; Overshoot <1%; Settling time <1%
Pacing Pulse Overshoot (intentional)	Method A according to IEC 60601-2-27
Resistor Tolerance	±1%
Capacitor Tolerance	±5%
Precision 250 : 1 Divider	±0.1%
Sample Rate	10kHz ± 0.05%
DC Offset (fixed, noise free, sourced from the internal supercapacitor)	300mV ± 1%
DC Offset (variable, up to 1000mV, may include up to 50μVpp noise)	±1000mV ±1% or ±3mV
Environment	5 – 40°C 50 – 80%RH Altitude < 2000M Overvoltage CAT II

ECG Special Functions

Parameters		Setting Range	Default Values	Minimum Step Size
Play Raw Data	Sample Rate	Maximum: 20kHz	-	-
NST Noise	Noise Type	EM - Electrode Motion Artifact BW - Baseline Wander MA - Muscle Noise	EM - -	- - -
	Gain	0.1 – 10	1	0.1
	Heart Rate	30, 60, 120, 180, 200, 250	-	-
Auto (Auto Heart Rate)	QRS Amplitude	0.5, 1, 2, 5	-	-
	QRS Duration	40, 70, 80, 100, 120	-	-
	Amplitude (mV)	±2, ±100, ±300, ±500, ±700	-	-
Auto (Auto Pacing)	Duration (ms)	0.1, 0.5, 1, 2	-	-
	Synchronization	Synchronized / Asynchronized at 80BPM	-	-
	Pulse Number	Single / Double -150ms / Double -250ms	-	-
	Overshoot (ms)	0, 4, 10, 20, 50, 100	-	-
	QRS / T	on / off	-	-
	Start	0.67 – 500Hz	0.67Hz	0.01
Frequency Scan (Sine)	Stop	0.05 – 500Hz	150Hz	0.01
	Duration	10 – 180s	30s	0.01
Frequency Scan (ECG)	BPM	-	3 – 30BPM	-
	Duration	-	30s	-
Lead Off	Lead Off Detection	Lead on / 10MΩ / 20MΩ / Lead off (open)	Lead on	-

Respiration Parameter

Parameters	Respiration Module Specifications	SECG 5.0 AIO Built-in Respiration Specifications
Rate	1 – 200BrPM (Minimum step size: 1BrPM)	1 – 200BrPM (Minimum step size: 1BrPM)
Ratio (inspiration:expiration)	1:1, 1:2, 1:3, 1:4, 1:5	1:1, 1:2, 1:3, 1:4, 1:5
Impedance Variations (Δ Ω)	0.0 – 5Ω (Minimum step size: 0.05Ω) 5.0 – 10.0Ω (Minimum step size: 0.1Ω)	1.0 – 5.0Ω (Minimum step size: 0.1Ω)
Variation Accuracy	± (2% of setting + 0.1Ω)	±1% (according to the component's specifications)
Impedance Baseline	100Ω, 200Ω, 500Ω, 1000Ω, 1500Ω, 2000Ω, 2500Ω, 3000Ω, 3500Ω, 4000Ω, 4500Ω	500Ω, 1000Ω, 1500Ω, 2000Ω, 2500Ω
Baseline Accuracy	±2%	±5% (including 25kΩ internal resistance of the internal ECG signal line)
Respiration Lead	RA, LA, LL	RA, LA, LL, V1 – V6
Apnea Selection	1 – 60sec./min.	1 – 60sec./min.
Noise Add-on	Selection	50, 60, 100, 120, 150, 180, 200, 240Hz White noise
	Amplitude	0.01 – 5mV (Minimum step size: 0.01mV)
Play Raw Data	Sample Rate	Maximum: 10kHz (able to play customized digital ECG waveforms together with impedance respiratory signals)
	Baseline	0 – 16% (Minimum step size: 1%)
	Amplitude	0 – 16% (Minimum step size: 1%)
Wave Modulation	Amplitude	0 – 16% (Minimum step size: 1%)
	Frequency	0 – 16% (Minimum step size: 1%)

SpO₂ Test Mode (with Reflectance PPG Module)

Parameters		Specifications
Heart Rate	Setting Range	10 – 300BPM
	Minimum Step Size	1BPM
	Accuracy	±1BPM
LED DC Level Reference Output	Setting Range ⁽¹⁾	100 – 3000mV
	Minimum Step Size	1mV
LED AC Level Reference Output	Setting Range ⁽¹⁾	0.75 – 30mV
	Minimum Step Size	0.01mV
PI (AC level / DC level) ⁽²⁾	Setting Range	0.025% – 30% (AC / DC, varies with AC or DC level)
LED Scan Rate	Rate	10kHz (Raw data mode)
	Accuracy	±5µs
PD Sample Rate	Rate	250kHz (Single channel)
	Accuracy	±5µs
PD Response Time	Rising	1µs Typical ⁽³⁾
	Falling	1µs Typical ⁽³⁾
SpO ₂ % ⁽⁴⁾	Setting Range	1% – 100%
	Minimum Step Size	1%
	Accuracy	±1% + specified accuracy of the DUT (using Masimo Radical-7 Pulse CO-Oximeter or "Covidien" Nellcor Portable SpO ₂ Patient Monitoring System)

Note: (1) The SECG 5.0 AIO test system adjusts AC/DC output according to the linearity of LED electro-optical conversion.
(2) The PI value may vary according to the different calculation methods of each manufacturer.
(3) PD response time varies with the light intensity of the DUT.
(4) The SpO₂ parameter specifications apply to SpO₂ Test Mode.

PWTT Test Mode (with Reflectance PPG Module)

Parameters		Specifications
Time Difference (PTTp, PTTf) Setting Range		0 – 5999ms (for the heart rate setting as 10BPM. As the heart rate value increases, the setting range of time difference will decrease accordingly.)
Time Difference (PTTp, PTTf) Minimum Step Size		1ms
Time Difference (PTTp, PTTf) Accuracy		±1ms
ECG Parameters in PWTT Test Mode		
Heart Rate	Setting Range	10 – 300BPM
	Minimum Step Size	1BPM
ECG Amplitude	Setting Range	0 – 20mV
	Minimum Step Size	0.1mV
T Wave Amplitude	Setting Range	0 – 5mV
	Minimum Step Size	0.01mV
QRS Interval	Setting Range	0 – 200ms
	Minimum Step Size	1ms
SpO ₂ Parameters in PWTT Test Mode		
Heart Rate	Setting Range	10 – 300BPM
	Minimum Step Size	1BPM
PI	Setting Range	0.025% – 30%
	Minimum Step Size	0.001%
LED DC Level Reference Output	Setting Range	100 – 3000mV
	Minimum Step Size	1mV
LED AC Level Reference Output	Setting Range	0.75 – 30mV
	Minimum Step Size	0.01mV

*For transmittance PPG module specifications, please refer to PPG-2TF-660 2.0 product page.

• Ordering Information SECG 5.0 AIO Test System

Part No.	Description	Quantity
100-EC00002	Model No.: SECG 5.0 AIO Model Name: Multi Vital Sign Simulator The standalone ECG simulator with 12 leads (RA, LA, LL, N, V1 - V6) output for ECG performance tests.	1

Optional Respiration Module, SpO₂ Module, Heart Rate Module, and Accessories

Part No.	Description	Quantity
100-EC00006	Model No.: Respiration module Model Name: Respiration Module	1
100-AE00002	Model No.: PPG-1R-525 Model Name: Reflectance Green Light Heart Rate Module The reflectance PPG module of 525nm green LED. Supports the PWTT test mode.	1
100-AE00004	Model No.: PPG-2R-880 Model Name: Reflectance SpO ₂ Module The reflectance PPG module of 880nm IR LED and 660nm red LED. Supports PWTT / SpO ₂ test modes.	1
100-AE00005	Model No.: PPG-2R-940 Model Name: Reflectance SpO ₂ Module The reflectance PPG module of 940nm IR LED and 660nm red LED. Supports PWTT / SpO ₂ test modes.	1
100-AE00025	Model No.: PPG-2TF-660 2.0 Model Name: Transmittance SpO ₂ Module (60cm) The transmittance PPG module. Supports PWTT / Auto Test SpO ₂ / SpO ₂ test modes.	1
K22-0310301	BNC cable (banana male to banana male) (31cm) (black)	1
K27-1500301	USB Type-C to Type-C cable (male to male) (150cm) (black)	1
K28-0300301	DB15 cable (male to female) (30cm)	1
K29-0300601	MCX (RF) male to BNC cable (30cm)	1
K29-1000801	Grounding cable (alligator clip to ring terminal) (100cm)	1
N54-0120013	Compound Terminal	1

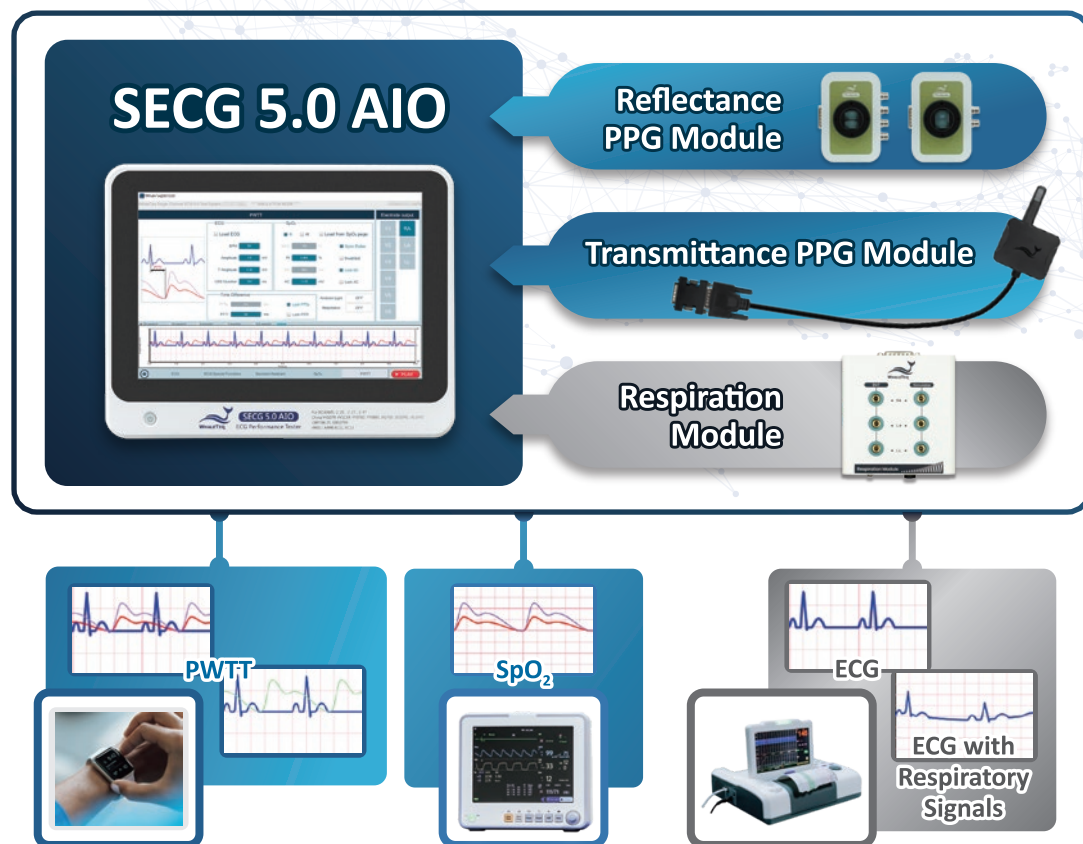
Optional Software Add-on Pack

Part No.	Description
HA0-SE0G001	Auto setup for IEC60601-2-25:2011 performance tests. (Basic Edition: Standalone or computer-connected operation)
HA0-SE0G002	Auto setup for IEC60601-2-27:2011 performance tests. (Basic Edition: Standalone or computer-connected operation)
HA0-SE0G003	Auto setup for IEC60601-2-47:2012 performance tests. (Basic Edition: Standalone or computer-connected operation)
HA0-SE0G004	Auto setup for YY0782-2010 performance tests. (Basic Edition: Standalone operation only)
HA0-SE0G005	Auto setup for YY0885-2013 performance tests. (Basic Edition: Standalone operation only)
HA0-SE0G006	Auto setup for YY1079-2008 performance tests. (Basic Edition: Standalone operation only)
HA0-SE0G007	Auto setup for YY1139-2013 performance tests. (Basic Edition: Standalone operation only)
HA0-SE0G014	Auto setup for China GB 9706.225-2021 performance tests. (Premium Edition: Adjustable test parameters; computer required)
HA0-SE0G015	Auto setup for China GB 9706.227-2021 performance tests. (Premium Edition: Adjustable test parameters; computer required)
HA0-SE0G016	Auto setup for China YY 9706.247-2021 performance tests. (Premium Edition: Adjustable test parameters; computer required)

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.

• Testing Scenario



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more information

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