Trigno® Link Communication Module User's Guide

MAN-048-2-0

Important Information **4**
Intended Use 4
Technical Service and Support 5
Symbols 6
Warnings 8
Important Notes 9
Trigno® Link Overview **12**
PC Specifications 12
Trigno Link with Bluetooth Low Energy (BLE) Devices 13
Trigno Link with ANT+ Devices 14
Trigno Link LED Feedback States 15
LED State Descriptions 16
Compatible Devices **17**
Getting Started with Trigno Link Module **19**
Connecting the Link Module 19
Connecting the Trigno Wireless Biofeedback System 19
Initiating Trigno Discover Software 20
Working with Link Control Utility 21
Reference Specifications **28**

Important Information

Intended Use

The Trigno Link is a USB-powered communication module that supports the Bluetooth (BLE v4.2) and ANT+ wireless protocols as well as the Trigno wireless protocol for connecting BLE-enabled or ANT+ enabled devices to the Trigno Wireless Biofeedback System. The Trigno Link module is intended for research, educational/teaching, and general wellness/fitness purposes.

The Trigno Link module, sensors connected to it, and data resulting from these sensors are not intended to be used for medical purposes.

Refer to manufacturer user guide of specific sensors for additional information.

Technical Service and Support

For information and assistance please visit our website:

www.delsys.com

Or contact us:

E-mail: support@delsys.com

Telephone: (508) 545 8200

Symbols

Warning – immediate action must be taken to avoid undesirable consequences.

Important Note.

Consult accompanying User's Guide for detailed instructions.

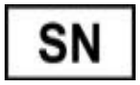
Keep the device dry.

Handle with care.

Sensitive electronic device. Avoid static discharges. Do not operate or store near strong electrostatic, electromagnetic, magnetic or radioactive fields. Interference from external sources may decrease the signal-to-noise ratio or result in corrupted data.

Manufacturer:
Delsys Inc.
23 Strathmore Rd.
Natick, MA, 01760, USA

Made in the USA



Serial Number (appears on device or package label)

Catalog Number (appears on device or package label)

Batch Identifier (appears on device or package label)

Dispose of the device according to local rules for electronic waste.

Contains FCC ID: SQGBL654PA
Contains IC/ISED: 3147A-BL654PA
Contains KC: R-C-LAI-BL654PA

Complies with requirements put forth by the Radio Equipment Directive 2014/53/EU, the EMC Directive 2014/30/EU and the RoHS Direcive 2011/65/EU.

Warnings

DO NOT USE near Participants with implanted electronic devices of any kind, including cardiac pacemakers or similar assistive devices, electronic infusion pumps, and implanted stimulators. Trigno® systems have not been tested with these devices, and the wireless communication may interfere with implanted device function.

DO NOT USE on Participants with electronic wearable devices essential for well-being, therapy, or other medical needs that cannot be safely removed during operation of the Trigno® Wireless Biofeedback System. Trigno® systems have not been tested with these devices, and the wireless communication may interfere with these other essential devices.

DO NOT USE in critical care applications or critical care environments as the device is not intended to be used in these conditions.

DO NOT DAMAGE, CRUSH, BURN, FREEZE, OR OTHERWISE MISHANDLE THE DEVICE

NO MODIFICATIONS of this equipment are allowed.

Emissions from the Trigno® System may result in reciprocal interference with other devices in the environment. Research study coordinators must review and manage potential hazards with other equipment intended to be used in the environment.

Important Notes

- IMMEDIATELY DISCONTINUE DEVICE USE if a change in the performance of the device is noted. Contact Delsys technical support for assistance.
- Device is not intended to be serviced by users or service personnel.
- Delsys Inc. guarantees the safety, reliability, and performance of the equipment only if assembly, modifications, and repairs are carried out by Delsys Factory Technicians; the electrical installation complies with the appropriate local building code requirements; and the equipment is used in accordance with these instructions for use.
- Use only with the Trigno® Wireless Biofeedback System
- Disposal of the Trigno® Wireless Biofeedback System and its components is to be made in accordance with local electronic waste regulations or by returning the equipment to Delsys Inc. for processing.
- Report any serious incidents with the device to Delsys at 508 545 8200 or support@delsys.com.
- These devices comply with Part 15 of the FCC Rules and the Canadian Innovation, Science and Economic Development license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) these devices may not cause harmful interference and (2) these devices must accept any interference received, including interference that may cause undesired operation.

Ces appareils sont conforme à des règlements Innovation, Sciences et Développement économique Canada exempts de licence standard RSS (s). Le fonctionnement est soumis aux deux conditions suivantes: (1) ces appareils ne doivent pas causer d'interférences nuisibles, et (2) ces appareils doivent accepter toute interférence reçue, y compris les interférences pouvant entraîner un fonctionnement indésirable.

This Class B digital apparatus complies with Canadian ICES-003.

Ces appareils numériqués de la classe B sont conformés à la norme NMB-003 du Canada.

This product complies with FCC OET Bulletin 65 radiation exposure limits set forth for an uncontrolled environment.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that required for successful communication.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with instructions, may cause harmful interference to radio communications. There is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful

interference to radio or television reception (which can be determined by turning the equipment off and on), the user is encouraged to try and correct the interference via one or more of the following measures: (1) reorient or relocate the receiving antenna; (2) increase the separation between the equipment and the receiver; or (3) connect the equipment into an outlet on a separate circuit.

Pursuant to FCC 15.21 of the FCC rules, changes not expressly approved by Delsys Inc. could void the user's authority to operate the equipment.

These products comply with FCC & Industry Canada's RSS-102 radiation exposure limits set forth for an uncontrolled environment.

Ces produits sont conforme à la norme FCC et aux limites d'exposition au rayonnement RSS-102 d'Industrie Canada définies pour un environnement non contrôlé.

Trigno® Link Overview

The Trigno® Link communication module is designed to interface with ANT+ and BLE-compliant devices and stream data from these devices into the Trigno Discover Software. The module operates in concert with the Trigno Wireless Biofeedback System, synchronizing data from connected BLE/ANT+ sensors with data from the Trigno Avanti sensors. A minimum of one Trigno Avanti sensor must be in operation in order for this synchronization and data transfer to occur. The Trigno Link module will communicate with either the ANT+ protocol or the Bluetooth Light Energy (BLE) protocol but cannot communicate with both simultaneously. Multiple ANT+ sensors or multiple BLE sensors can be supported at one time. Note that some sensors support both communication modes. To facilitate workflow, the system will remember the previous configuration used.

PC Specifications

The following specifications are recommended for optimal performance.

Category	Recommended
Operating System	Windows 11 or later
Trigno Discover Software	Version 2.0 or later
USB Port	2x USB 3.0

Trigno Link with Bluetooth Low Energy (BLE) Devices

The BLE communication protocol (also known as Bluetooth Smart) is ubiquitous in commercial devices and operates in the same 2.4 GHz frequency space as the Trigno system and many other protocols (such as Wi-Fi for networking and Zigbee for IoT devices). Trigno Link facilitates a two-way connection of 3rd party BLE devices to the Trigno System. Up to 6 simultaneous BLE connections can be supported at one time. The Trigno Link automatically manages frequency allocations to prevent overlapping interferences between Trigno and BLE devices.

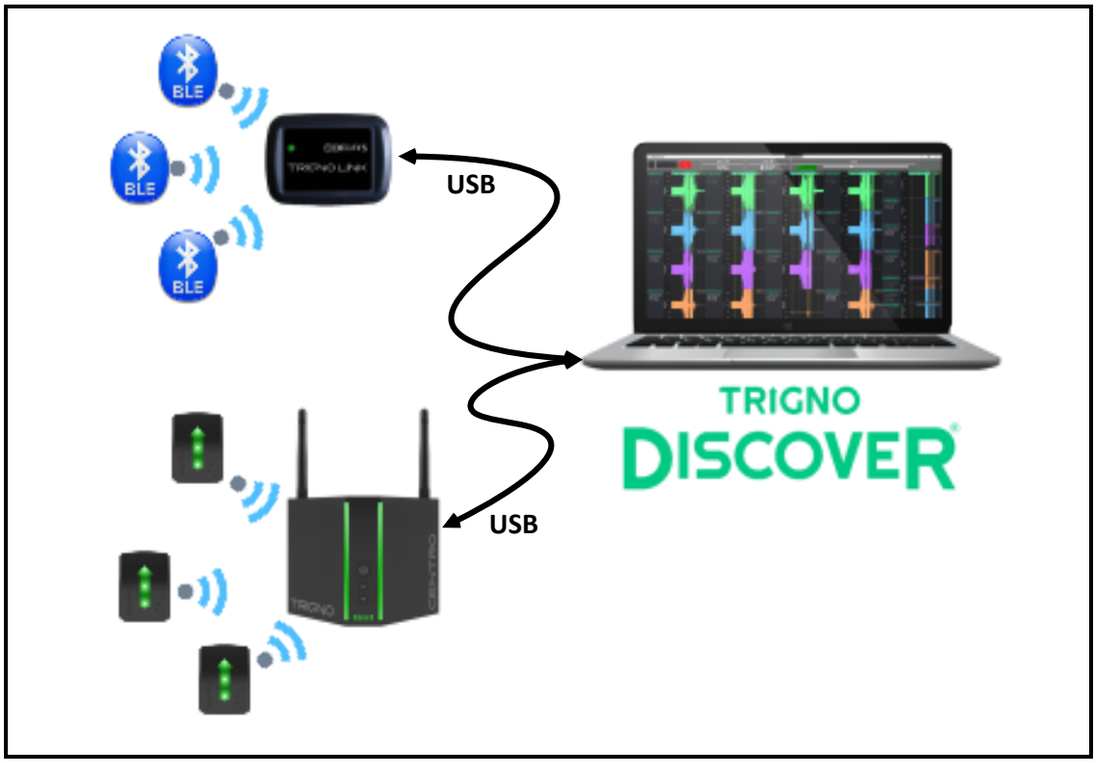


Figure 1: Trigno Wireless Biofeedback System and Sensors, Trigno Discover software, Trigno Link, and 3rd party BLE devices.

Trigno Link with ANT+ Devices

Similar to the BLE communication protocol, the ANT+ protocol is designed to support communication on many wireless devices to a central node. This communication standard is defined and managed by Garmin Inc. and is often found in devices used in the fitness industry. Once turned on, ANT+ devices will immediately transmit data for any approved host in the vicinity. The Trigno Link can support up to 6 simultaneous ANT+ connections at one time. The Trigno Link automatically manages frequency allocations to prevent overlapping interferences between Trigno and ANT+ devices. Note that Trigno Link cannot operate BLE and ANT+ devices concurrently.

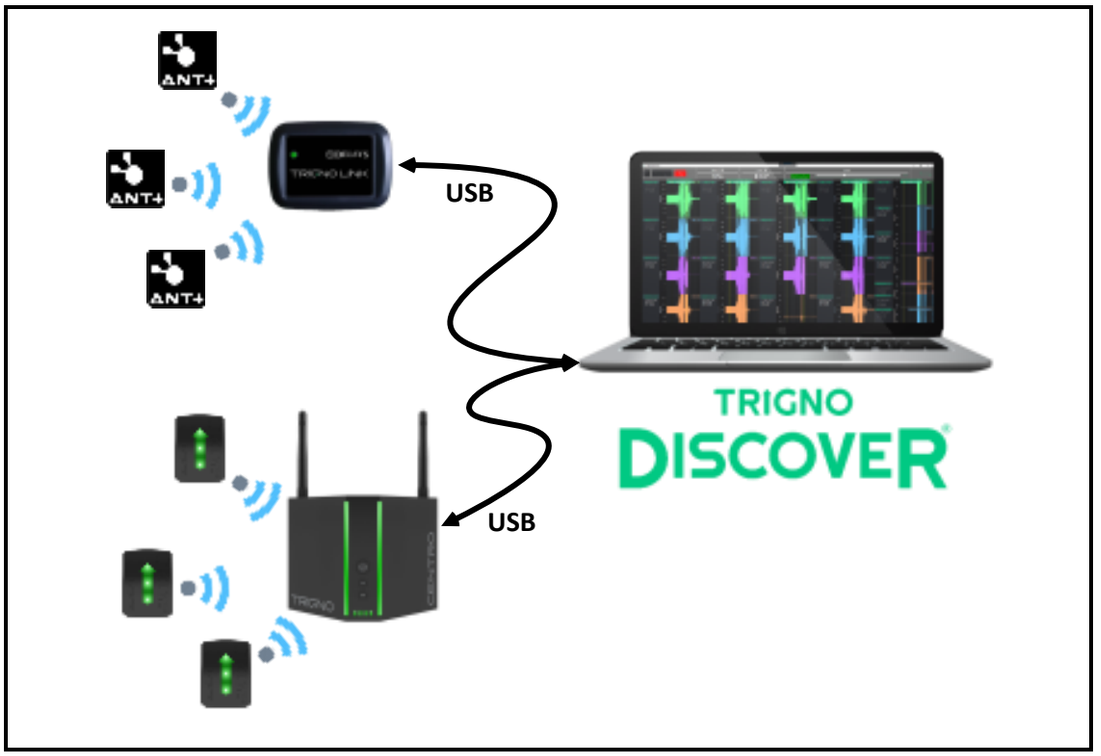


Figure 2: Trigno Wireless Biofeedback System and Sensors, Trigno Discover software, Trigno Link, and 3rd party ANT+ devices.

Trigno Link LED Feedback States

The Trigno Link module indicates its status through various LED indicator colors and flashing patterns as outlined in the table below.

Trigno Link State		Color	Pattern
1	Power Off	**off**	n/a
2	Power On	**amber**	solid
3	USB Connection	**green**	solid
4	Searching ANT+ Sensors	**amber**	slow flash
5	Data gathering ANT+, synchronous	**green**	slow flash
6	Data gathering ANT+, asynchronous	**green** / **amber**	slow flash
7	Searching BLE Sensors	**magenta**	slow flash
8	Data gathering BLE, synchronous	**blue**	slow flash
9	Data gathering BLE, asynchronous	**blue** / **magenta**	slow flash
10	Stage I Firmware Update	**red**	breathing
11	Stage II Firmware Update	**cyan**	double flash
12	Firmware Fault	**red**	rapid flash

LED State Descriptions

1) **Power Off**: No LED activity is present when the module is off or disconnected from USB power.
2) **Power On:** Indicates a connection to USB port, otherwise dormant.
3) **USB Connection**: Device is initialized and ready for activity.
4) **Searching ANT+ Sensors**: Device is scanning to connect with any compatible ANT+ sensors that are broadcasting.
5) **Data Gathering ANT+ Synchronous:** Data are streaming from connected ANT+ sensors and time synchronized with Trigno Sensor.
6) **Data Gathering ANT+ Asynchronous:** Data are streaming from connected ANT+ sensors with no synchronization with Trigno sensors.
7) **Searching BLE Sensors**: Device is scanning to connect with any compatible BLE Sensors that are broadcasting.
8) **Data Gathering BLE Synchronous:** Data are streaming from connected BLE sensors and time synchronized with Trigno Sensors.
9) **Data Gathering BLE Asynchronous:** Data are streaming from connected BLE sensors with no synchronization with Trigno Sensors.
10) **Stage I Firmware Update:** Update firmware on stage I microcontroller.
11) **Stage II Firmware Update:** Update firmware on stage II microcontroller (Trigno com system).
12) **Firmware Fault**: Incompatible command, automatic device reset.

Compatible Devices

The Bluetooth and ANT+ standards define protocols for communicating between one or more host devices and with one or more sensor peripherals. While the protocols are standardized, the exact details of how to engage with and parse data from a sensor are unique to the sensor itself. The following is a verified list of devices and associated firmware versions that are compatible with the Trigno Link module. Please contact Delsys for up-to-date information on compatible devices.

Jamar Smart Hand Dynamometer

Manufacturer: Performance Health (www.performancehealth.com)

Model:	Communication:	Firmware:
081669928	BLE	n/a

Polar H10 Hear Rate Monitor

Manufacturer: Polar Electro Oy (www.polar.com)

Model:	Communication:	Firmware:
H10	BLE/ANT+	3.1.1

MoxyMonitor Muscle Oxygen Sensor

Manufacturer: Fortiori Design LLC (www.moxymonitor.com)

Model:	Communication:	Firmware:
Moxy5	BLE/ANT+	FW V 1.5.4

VO2 Master Analyzer

Manufacturer: VO2 Master (www.vo2master.com)

Model:	Communication:	Firmware:
HW version 12	BLE	FW V1.5.3

KICKR BIKE Cycle Ergometer

Manufacturer: Wahoo (www.wahoofitness.com)

Model:	Communication:	Firmware:
WFBIKE1	ANT+	V1.27.0

Getting Started with Trigno Link Module

Connecting the Link Module

The Trigno Link Module includes a standard USB-C cable, providing power to the module and enabling data transfer when connected to the host PC.

Figure 3: Connecting the Trigno Link module to the host PC.

Connecting the Trigno Wireless Biofeedback System

The Trigno Link module requires use of the Trigno Wireless Biofeedback System to provide synchronized data between the connected devices. Refer to the Trigno Wireless Biofeedback System User Guide for details on setting up the system.

Usage of the Trigno Wireless Biofeedback System with the Trigno Link Module is restricted to educational, general wellness, fitness, and research purposes only and should not be used for any medical purposes.

Initiating Trigno Discover Software

With the Trigno Wireless Biofeedback System and the Trigno Link module connected to the PC, launch the Trigno Discover Software. It is recommended to initiate the software after the two USB connections for the Link module and the Trigno System have been established with the PC. Refer to the Trigno Discover User Guide and the Trigno Wireless Biofeedback System User Guide for details on getting started with these elements. The Trigno Link module requires at least one Trigno Sensor to be connected to the system and software so that proper synchronization across all the sensors can be maintained.

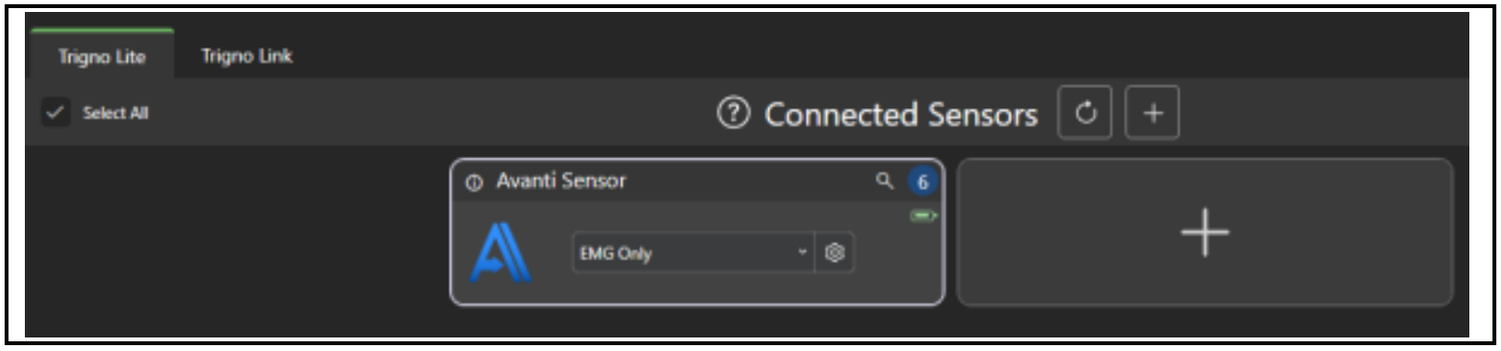


Figure 4: Connecting a Trigno sensor to the system by using the sensor control utility in Trigno Discover software.

Working with Link Control Utility

The Trigno Link Control Utility in the Trigno Discover Software manages the sensors connected to the Link module. The Link module can operate either in Bluetooth mode or in ANT+ mode, but not in both modes at the same time. Not all sensors can operate in both BLE and ANT+ modes; refer to manufacturer information for details.

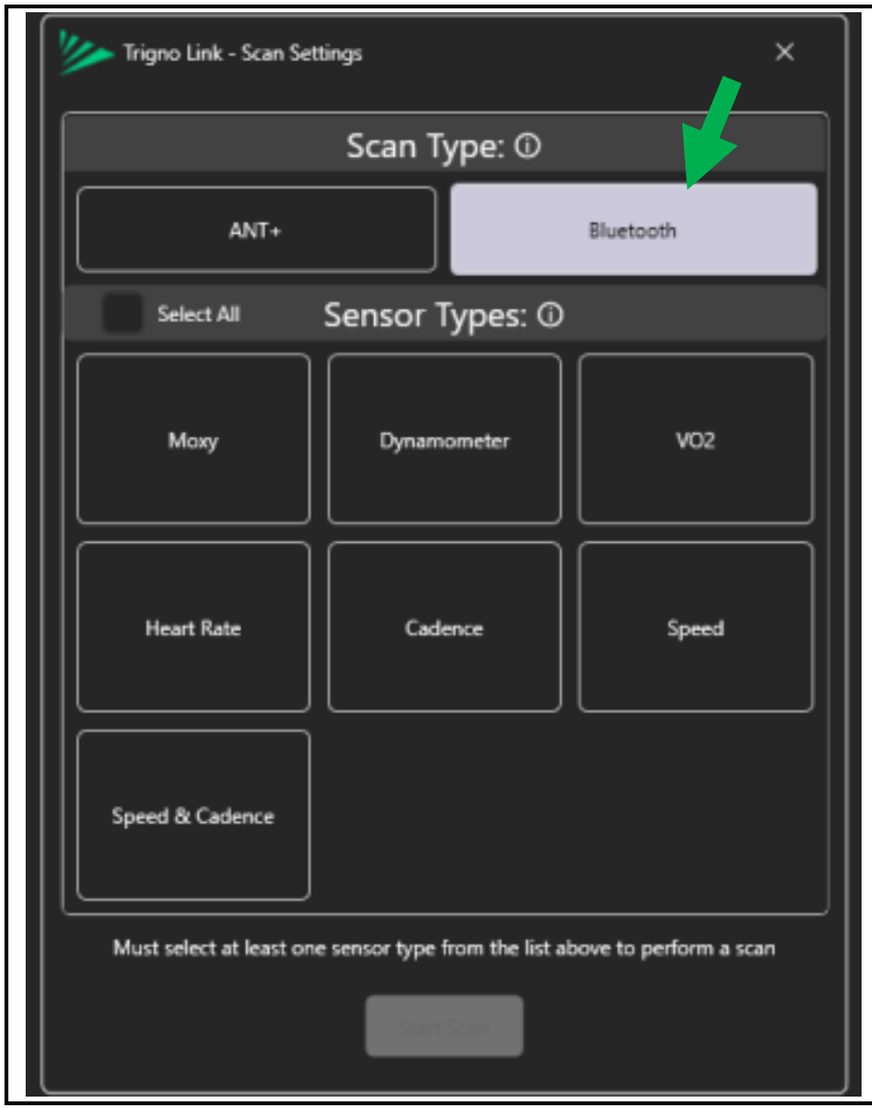


Figure 5: Selecting Bluetooth (BLE) in the Scan Settings option of the Trigno Link Control Utility in Trigno Discover software.

Figure 6: Selecting ANT+ in the Scan Settings option of the Trigno Link Control Utility in Trigno Discover software.

Once connected, sensors with options can be adjusted by selecting their gear icon and can be disconnected by right clicking and selecting "Disconnect Sensor" (Figure 7). Disconnecting may be necessary when changing sensor configurations, particularly on startup.

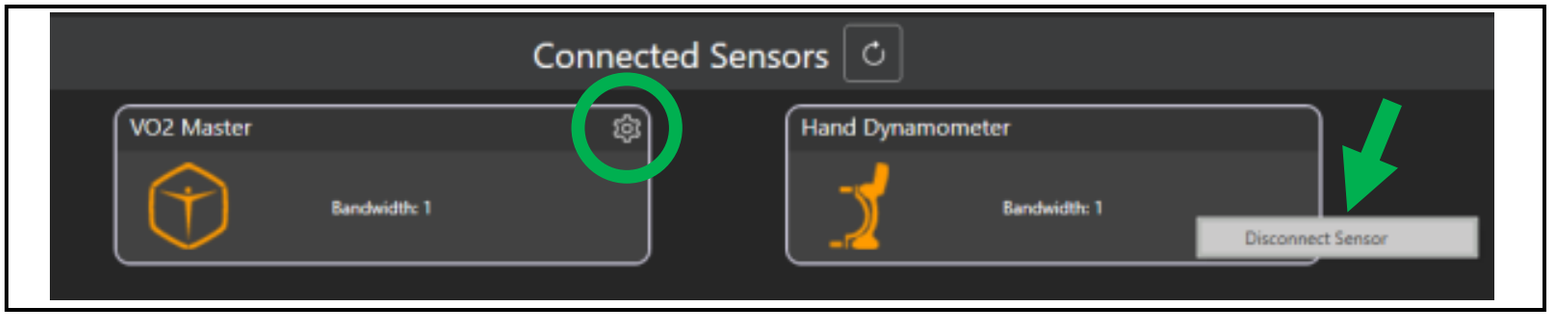


Figure 7: Identifying the options "gear" icon (left) and disconnecting sensors with a right mouse click (right).

Working with Jamar Dynamometer

This device can be operated manually or in Bluetooth mode, which will report hand grip force in lbs or kgs to the Link module as determined by the unit switch on the dynamometer device itself. Be sure to set the switch to the preferred unit prior to data acquisition. Refer to the device user's guide for additional details on how to engage Bluetooth mode and setting the unit switch.

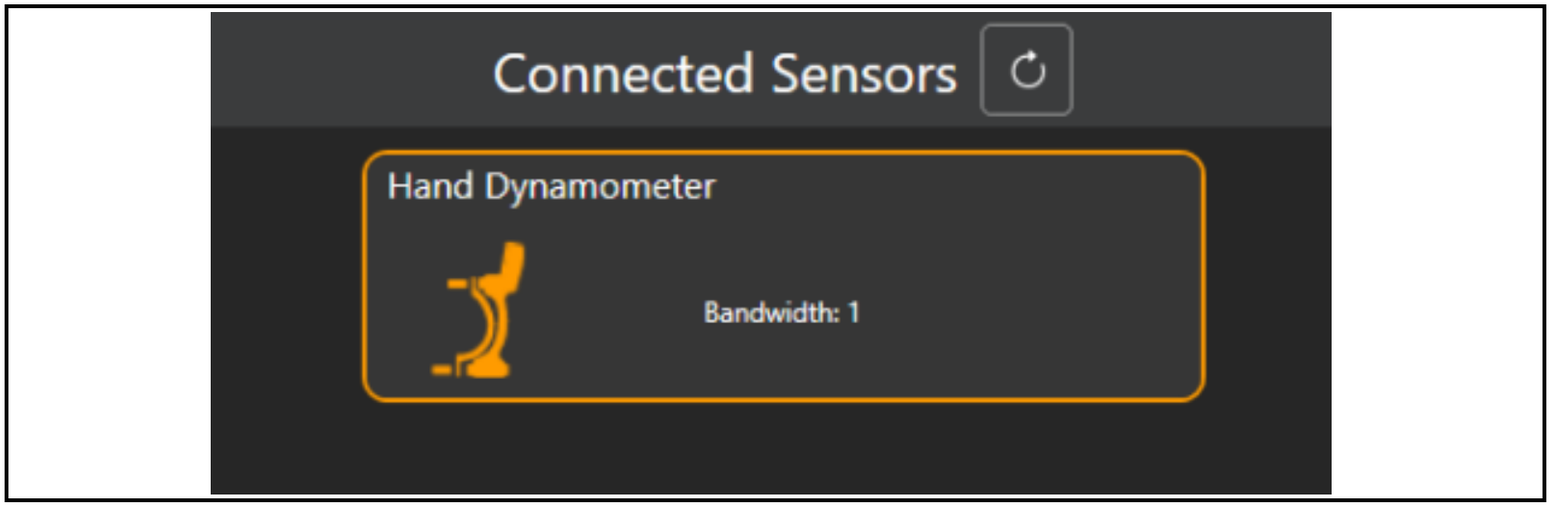


Figure 8: Jamar Hand Grip Dynamometer reported by the Link Control Utility.

Working with MoxyMonitor

The MoxyMonitor is a tissue oxygenation monitor that reports % saturation of the muscle tissue oxygen (SmO2) as well as total hemoglobin (THb). The device can be configured to a 0.5, 1.0, or 2.0 Hz (samples/second) update rate with or without signal smoothing. While the device can operate in Bluetooth mode or ANT+ mode, these device configuration options are only accessible when communicating via Bluetooth. Refer to MoxyMonitor documentation for additional details on device usage.

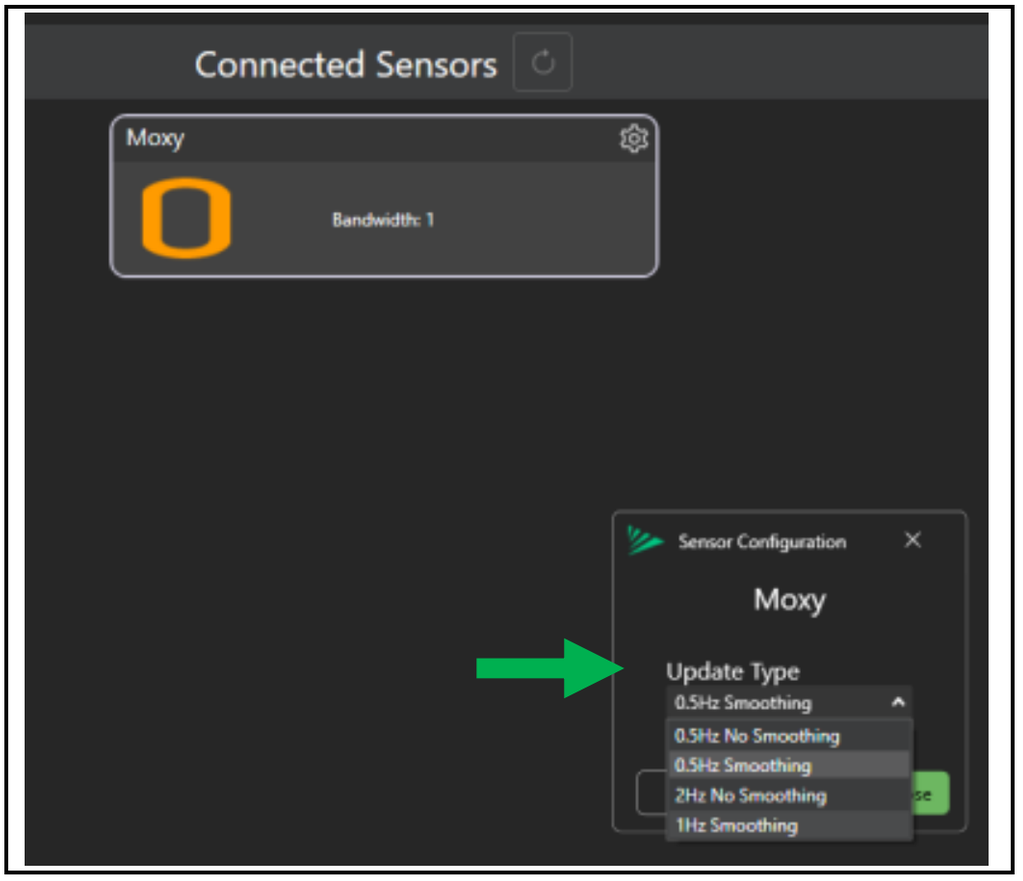


Figure 9: MoxyMonitor device settings.

Working with VO2 Master

The VO2 Master is a portable oxygen analyzer for tracking the following parameters: O_2 volume (L), O_2 tidal volume (L/breath), O_2 ventilation (L/min), respiration rate (breath/min), and fraction of expired oxygen (Fe O_2 %). For optimal results, ensure that the options for mask size (petite, extra small, small, medium, and large) are selected to match the mask size used and that the vent size is appropriately selected for the type of intended activity ("resting", "medium", or "large"). Optimal results are obtained when calibration is performed on the device.

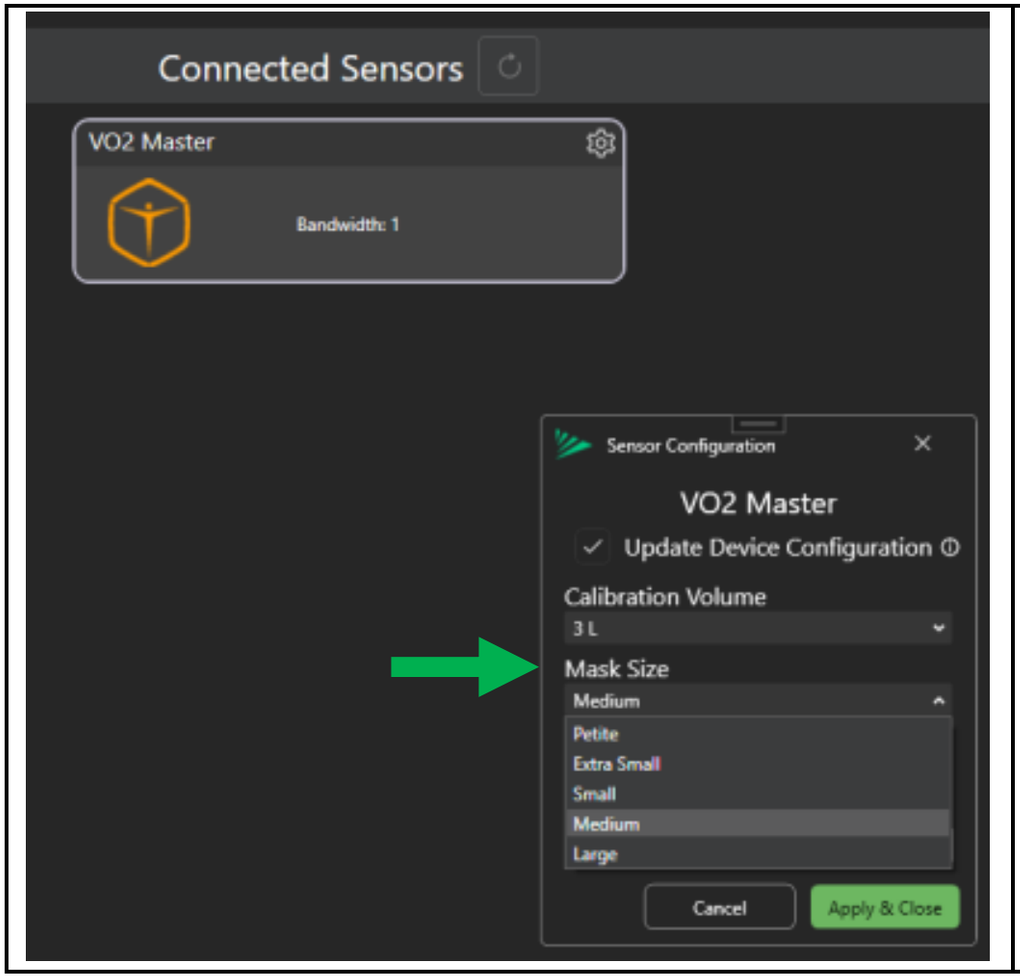


Figure 10: *VO2 Master device setting for mask size. Refer to VO2 Master documentation for information on these parameters.*

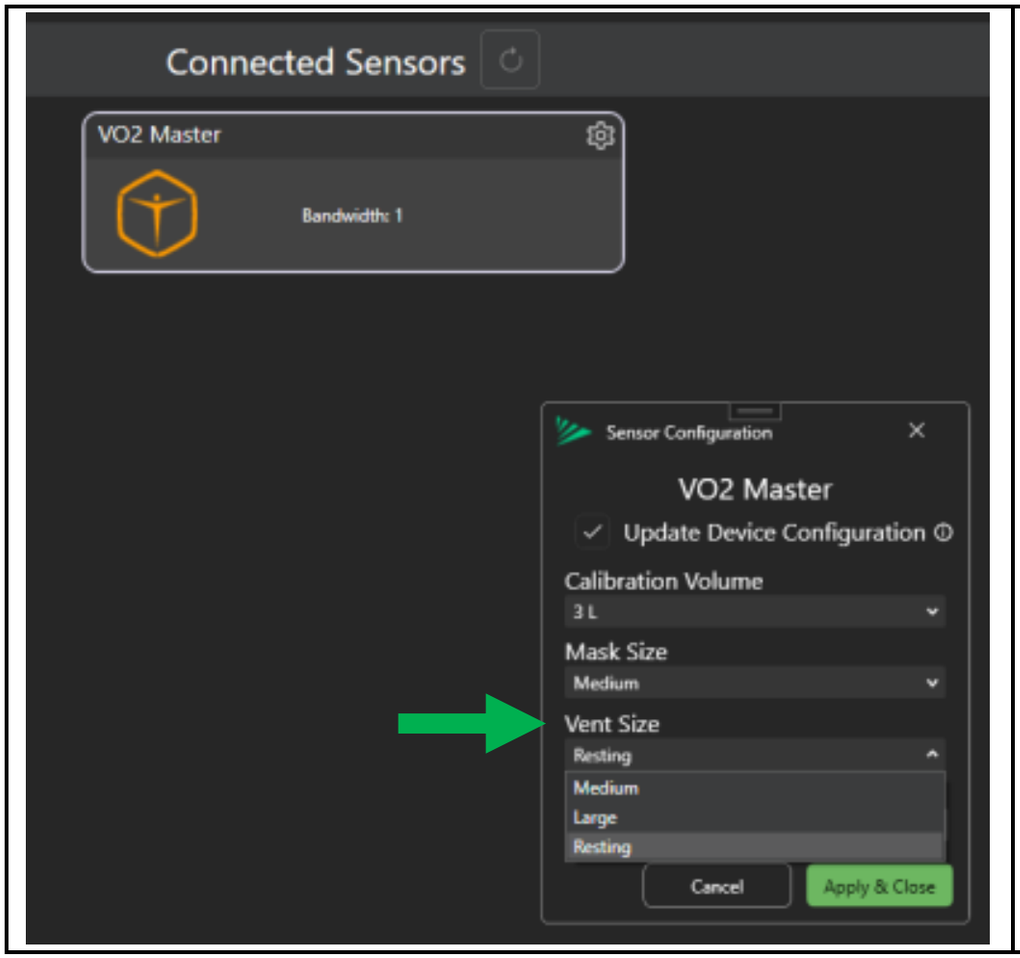


Figure 11: VO2 Master device setting for vent size. Refer to VO2 Master documentation for information on these parameters.

VO2 Master Calibration

The VO2 Master device supports two stages of calibration when used with the Link module:

a) ***Stage 1 – Idle Calibration***: This is a mandatory calibration phase that is automatically initiated upon device power up. This stage happens over the course of 5 seconds and requires the device to be idle (i.e., not worn and not moving). This stage occurs every time the device is power cycled, occurring only once during a usage cycle.

b) ***Stage 2 – Active Breathing Calibration***: This phase automatically follows Stage 1 calibration and requires the device to observe multiple cycles of breathing and to pass an expected volume of air as determined by the vent size selected. An improperly selected vent size will compromise this calibration. Breath cycles can be performed by wearing the device as intended or by using a volumetric syringe (refer to VO2 Master documentation for details on obtaining and using a calibration syringe). When data streaming is initiated in the software during this calibration phase, the calibration progress will be shown. Once calibration is completed, the progress bar will read 100% and the display will automatically switch to displaying device data.

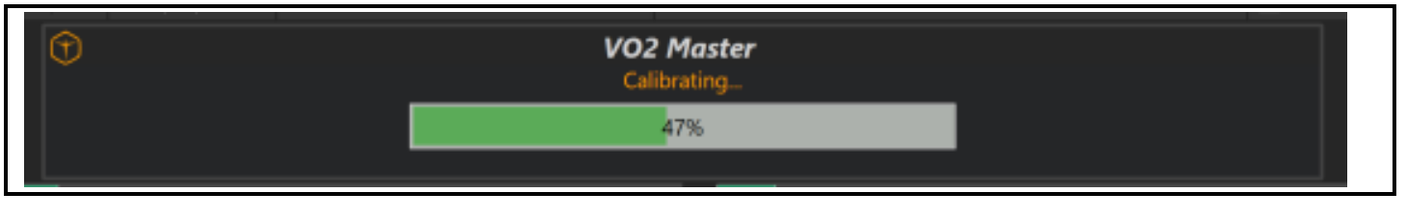


Figure 12: Stage 2 calibration progress of the VO2Master device.

Note that additional calibration options are available in the VO2 Master App. VO2 Master will maintain its calibration when switching from the App to Trigno Discover if the device is not turned off. Power cycling the device will restart the calibration process. Refer to the VO2 Master documentation for additional details.

Reference Specifications

Physical Specifications	
Dimensions	69.5mm x 50.5mm x 21.0mm
RF communication band	2400 – 2483 MHz
RF communication protocols	Trigno®, Bluetooth Low Energy 4.2, ANT+
PC Connection	USB 2.0 or higher
Typical operating distance	10 m
Max number of devices	6
Max Trigno Sensor Latency	<1 sampling period
Bluetooth Latency	<500 ms, device dependent
ANT+ Latency	device dependent
Power Consumption (max)	144 mW
Operating Temperature Range	0 – 45 deg C
Enclosure Material	ABS