ultium™ EMG

Analog Input SmartLead

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Ultium™ Biomechanics Research System

Analog Input® SmartLead User Manual

P-811 Rev B (May 2019)

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EC	REP

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CE

CE Mark: This symbol indicates the clearance to market this product in the European Community.

1 Introduction

1.1 Analog Input SmartLead Brief Description

The Ultium Universal Analog Input Probe SmartLead is an accessory to the Ultium EMG sensor (#810) which accepts non-Noraxon sensors within the specifications required for the Analog Input Probe. This probe gives users the freedom to select the appropriate sensor for their application.

1.2 Contradictions

Use of the Ultium system is contra-indicated in individuals who have implanted pacemakers.

Section 2: Definitions

1.1 Graphic Symbols and Meaning

The following international icons and symbols may be found on the Ultium Analog Input SmartLead enclosures and in this user manual. Their meaning is described below.

	Read material in the Instruction Manual wherever this symbol appears.

1.2 Glossary of Terms

Ultium Sensor -- A small individual radio transmitter typically worn on the body used to measure and transmit bio-potential signals (such as EMG) or motion related signals (such as acceleration). The Ultium Systems can accommodate up to 16 body worn Ultium Sensors in one network. Two Ultium Systems may be used in parallel, on separate RF networks, to accommodate up to 32 body worn sensors.

Ultium SmartLead – Refers to different data collection modalities. Each SmartLead measures a given type of physical parameter. Different SmartLeads can be combined in the same Ultium network. The most common Ultium SmartLead is EMG. Examples of other types include Accelerometers, Goniometers and Force sensors.

Ultium Serial Number – A unique five-character tag used to identify each Ultium Sensor or Ultium SmartLead. The members of any Ultium network are determined by their serial numbers. Also, Ultium Sensor Types are grouped into a predefined range of serial numbers. Thus, by serial number the Ultium system can automatically determine the type of signal parameter being transmitted from any Ultium Sensor or Ultium SmartLead in the network.

Multi-Channel Sensor – Certain Ultium Sensor Types provide more than one signal. An example is a 3-D Accelerometer that provides acceleration data for the x, y and z directions.

3 Identifications

3.1 Model Designation

Analog Input SmartLead (Part #811)

3.2 Product Versions and Configurations

The model 811 Ultium Analog Input SmartLead must be utilized in conjunction with the Ultium EMG Sensor (Part #810) and the Ultium Receiver (Part #880).

For additional equipment details refer to Section 9 of this manual.

As the Noraxon Systems require software to perform its function, the equipment is offered in combination with the following computer program packages:

Part# 402 MR3 myoMuscle Module

4 General Warning and Cautions

4.1 Risks and Benefits

There is no identified risk of physical harm or injury with use of the Ultium Analog Input SmartLead. The benefit provided by use of the SmartLead is that it provides users with the freedom to select the appropriate sensor for their application.

4.2 Safety Information Summary

Cautions

- Never use the Ultium Analog Input SmartLead to collect data from a person with an implanted pacemaker
- Never operate the Ultium Analog Input SmartLead within 1 meter of any critical medical device

Warnings

- Do not immerse the Ultium sensors in any water or liquid
- Do not use the Ultium equipment on individuals undergoing MRI, Electro Surgery or Defibrillation
- The Ultium Analog Input SmartLead product may produce results that are informative, not diagnostic. Qualified individuals must interpret the results

Attention

- The operator must be familiar with typical characteristics of the signals acquired by the Ultium Analog Input SmartLead and be able to detect anomalies that could interfere with proper interpretation.

5 Getting Started

5.1 Quick Start Guides

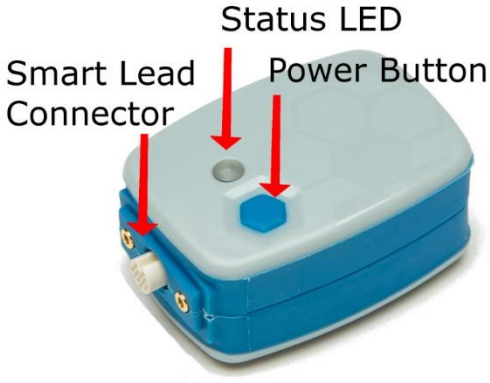
Please see the hardware manual for the appropriate EMG system.
P-880: Ultium hardware user manual

6 Preparing the Product for Use

6.1 Unpacking and Component Identification

	Ultium FootSwitch SmartLead with 2.5mm TRRS Mating Connector (Part #802) OR
	Ultium FootSwitch SmartLead with Exposed Input Wires (Part #802)
Additional contents not illustrated	
Ultium Analog Input User Manual (part #811A) *This document*	

6.2 Component Inputs, Outputs, and Indicators

1 Ultium Sensor (front and top edge) 	SmartLead Connector – Connector for SmartLeads to change function of the Ultium sensor. Status LED – Sensor operational indicator flashes green when measuring. Solid Yellow when charging. Power Button – Power the sensor On/Off. Hold for 3+ seconds for a hard reset.
2 EMG Sensor (back and bottom edge)	

	Charger Contacts – Sensor battery is charged, and sensor data is exchanged through these points. Serial Number – Unique 5-character serial number which identifies each EMG sensor.
3. Analog Input SmartLead 	Serial Number: Unique 5-character serial number which identifies each SmartLead.

6.3 Signal Source Setup

The Analog Input SmartLead is manufactured in two forms:

Exposed Wires

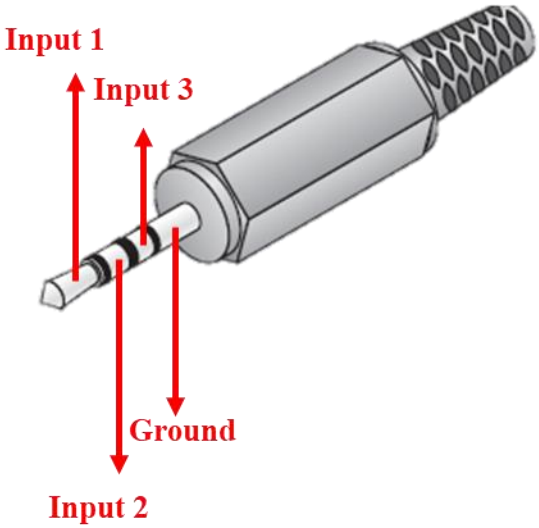
2.5 mm TRRS Mating Connector

Connect Ultium Analog Input SmartLead to the desired signal source. The Ultium Analog Input SmartLead allows for the user to collect up to 3 signals.

1) When utilizing the exposed wire version of the product the wire colors correspond to:

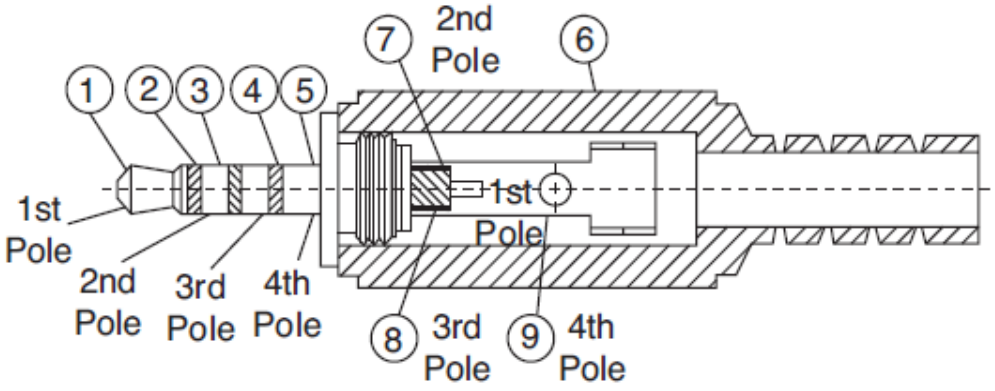
Input 1 = Red
Input 2 = Black
Input 3 = White
Reference/Ground = Green

2) When utilizing the Analog Input SmartLead version with the 2.5 mm TRRS Mating Connector (For more information refer to Section 9 of this manual), one may utilize the following diagram for assistance soldering personal circuitry to the connector:



Input Number Relation to Pole Number	
Input 1	Pole 1
Input 2	Pole 2
Input 3	Pole 3
Ground	Pole 4

The below image corresponds to the inner workings of the TRRS Mating Connector. This component can be customized to allow the user to collect three separate signals. The user shall solder their desired wires to the proper poles. If the user solders a desired electrical output to Pole 1, and the circuit's ground to Pole 4, the signal will be displayed in MR3 as the input 1 signal. Similarly, Pole 2 corresponds to input 2 and Pole 3 corresponds to input 3.



Attention

- The Ultium Analog Input SmartLead (both versions) provides a single, shared Ground wire. The operator must ensure that the system they are attaching to is compatible with this configuration.

6.4 Component Interconnections

Analog Input SmartLead: 2.5mm TRSS Mating Connector Version:

Step 1A

Connect the Ultium Sensor to the Ultium Analog Input SmartLead. The Status LED will flash Violet 3 times if the SmartLead was successfully detected. If the LED is solid Yellow, see the Troubleshooting section of this manual.

Step 1B

Connect the Ultium Analog Input SmartLead to the 2.5 mm TRSS Mating Connector. To connect the connector to the desired signal, refer to 'Signal Source Setup' above.

Open Wire Version:

Step 1A

Connect the Ultium Sensor to the Ultium Analog Input SmartLead. The Status LED will flash Violet 3 times if the SmartLead was successfully detected. If the LED is solid

	Yellow, see the Troubleshooting section of this manual.
Step 1B 	Connect the Ultium Analog Input SmartLead to the desired circuitry (see below: Signal Source Setup).

6.5 Device Communication (Driver) Software Installation

No driver installation is needed. The Ultium Receiver communicates over the USB port.

6.6 Companion Software Installation

The Ultium sensors are compatible with several different software programs. Identify the companion software that accompanies the equipment (MR3) and follow the appropriate instructions given next.

6.6.1 MR3 Installation

1. Insert the MR3 feature map into the PC
2. A menu will automatically pop up
3. Click on “Install MR3” and follow the Wizard’s instructions
4. Double click 

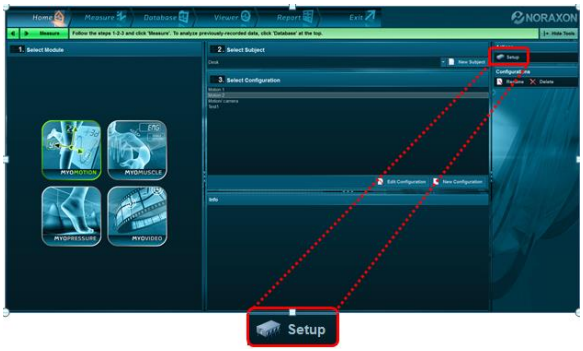
on the icon to start the MR3 software.

6.7 Companion Software Configuration

Before the Ultium Analog Input SmartLead can be used with the Noraxon Ultium system, the companion software must be configured to recognize the different components that make up the system. Refer to the Ultium system’s hardware manual for instructions for the program (MR3 myoMUSCLE) supplied with the Noraxon system. For specific settings for the Ultium Analog Input SmartLead see below:

When assigned to a channel using the ‘detect sensors in charger’ feature (see below for instructions), the software should automatically detect the sensor as a Ultium Analog Input SmartLead.

6.7.1 MR3 Configuration

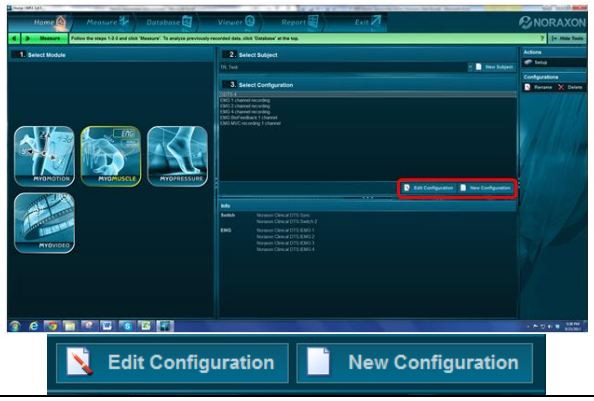
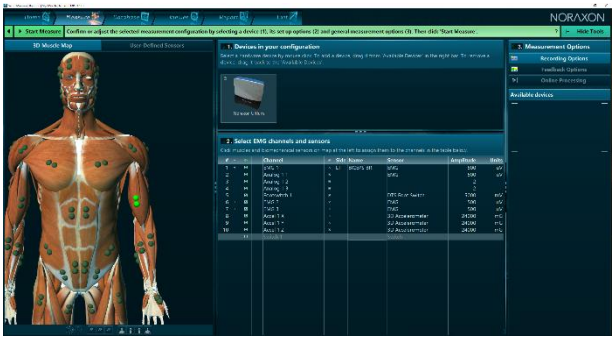


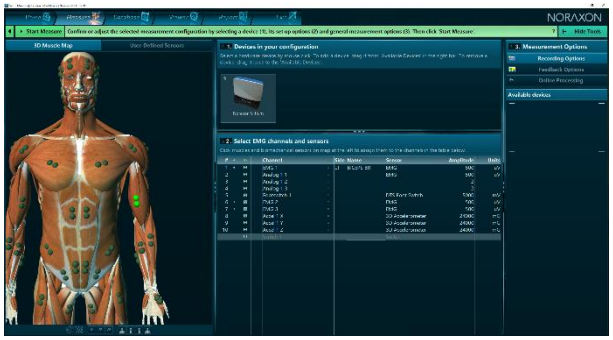
Step 1

Enter the Hardware Setup screen and setup the Noraxon EMG system in accordance with its provided hardware manual.

Step 2

Click 'Detect Sensors in Charger' (All sensors which you would like to use must be in the charger) – this will add the SmartLead(s) to the list of sensors (only if the unique SmartLead is connected to their corresponding sensor). If the unique SmartLead (ex: Analog Input) is not connected to the corresponding sensor during detection, MR3 will assume you are using the sensor to collect EMG data. Click OK.

	Step 3 Once back in the Home screen, choose if you would like to create a new configuration or edit an existing configuration.
	Step 4 In the measurement setup screen, insert the Ultium system into the Devices of your configuration box. *It is recommended that you redetect sensors in the hardware configuration every time the SmartLeads are removed from the Ultium sensor (redetection is necessary to revert to the use of the sensors EMG functionality). This will prevent configuration errors leading to the inability to collect a measurement. If an error message pops up when starting a measure, and you are using SmartLeads, this is a good first troubleshooting step (1. Redetect sensors in hardware set-up; 2. Double check the configuration). ** See Find My Sensor section below

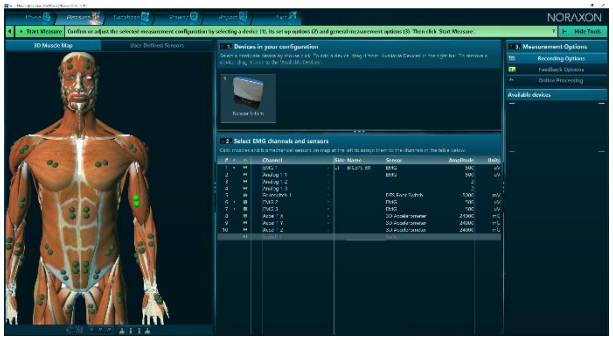


#	+		Channel		Side	Name	Sensor	Amplitude	Units
1		☑	Analog 1 1				5V Input	5000	mV
2		☑	Analog 1 2				5V Input	5000	mV
3		☑	Analog 1 3				5V Input	5000	mV

Step 5a

Once the Ultium system is inserted, the muscle map will appear to the left, and the EMG channels and sensors will appear below. The Ultium Analog Input SmartLead should automatically appear, as detected by the Ultium system (if it does not – refer to step 2a). If you would like to change the sensor type for the Analog Input SmartLead, refer to the below protocol. **

To select the Analog Input SmartLead for use in a recording, check the box next to the Analog Input channel. If one would like to customize the input from the Analog Input SmartLead (designate the signal type and the units), refer to the below instructions. **



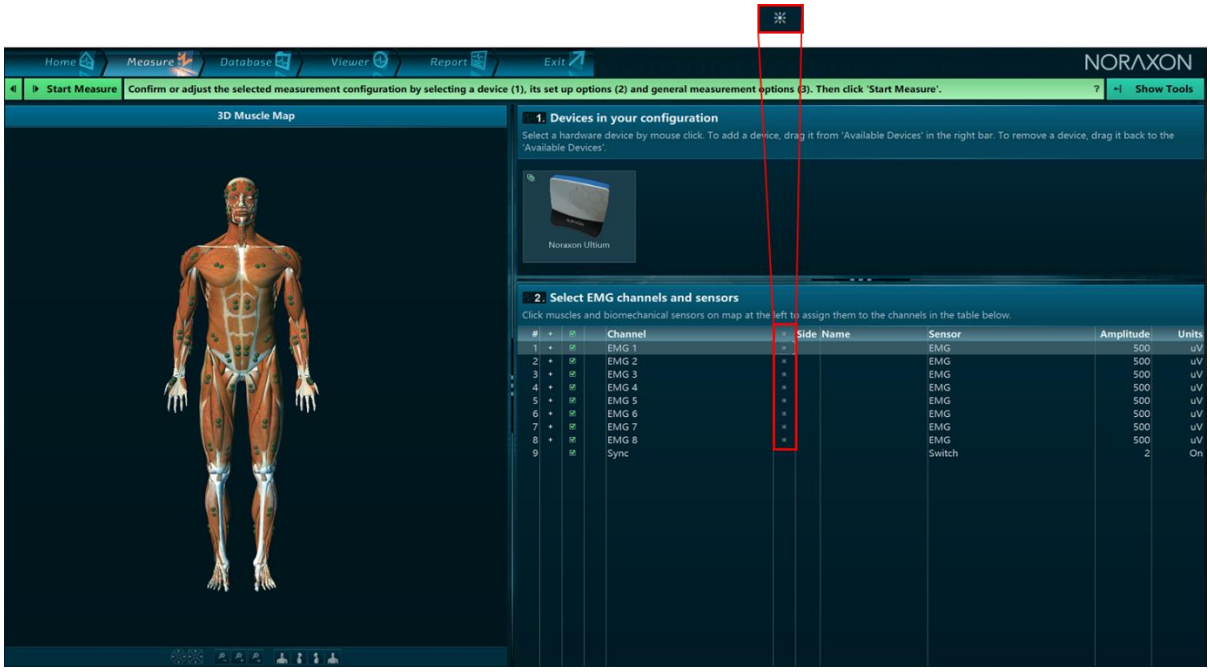
Step 5b

Continue with the measurement setup as described in the Noraxon system's hardware manual.

6.7.2 Find My Sensor Feature

Allows the user to quickly locate a specified Ultium sensor while creating/editing a MR3 configuration (refer to section 7 for guidance on how to create or edit a configuration). If one of the stars (refer to the figure below) is clicked, the corresponding sensor will repeatedly blink light purple

in bursts of 3. If the topmost star is clicked, every sensor that is currently in the configuration will execute the same blinking pattern.

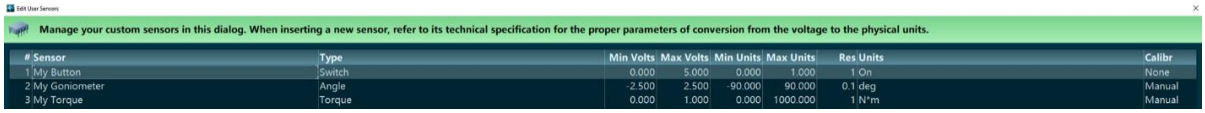


If a SmartLead is connected to a sensor when the sensors are detected in the MR3 hardware setup (Section 6 -> MR3 Configuration) it will override the EMG functionality of that sensor. Therefore, if the SmartLead is moved to a new sensor, Step 1-5 of Section 6 (MR3 Configuration) must be recompleted.

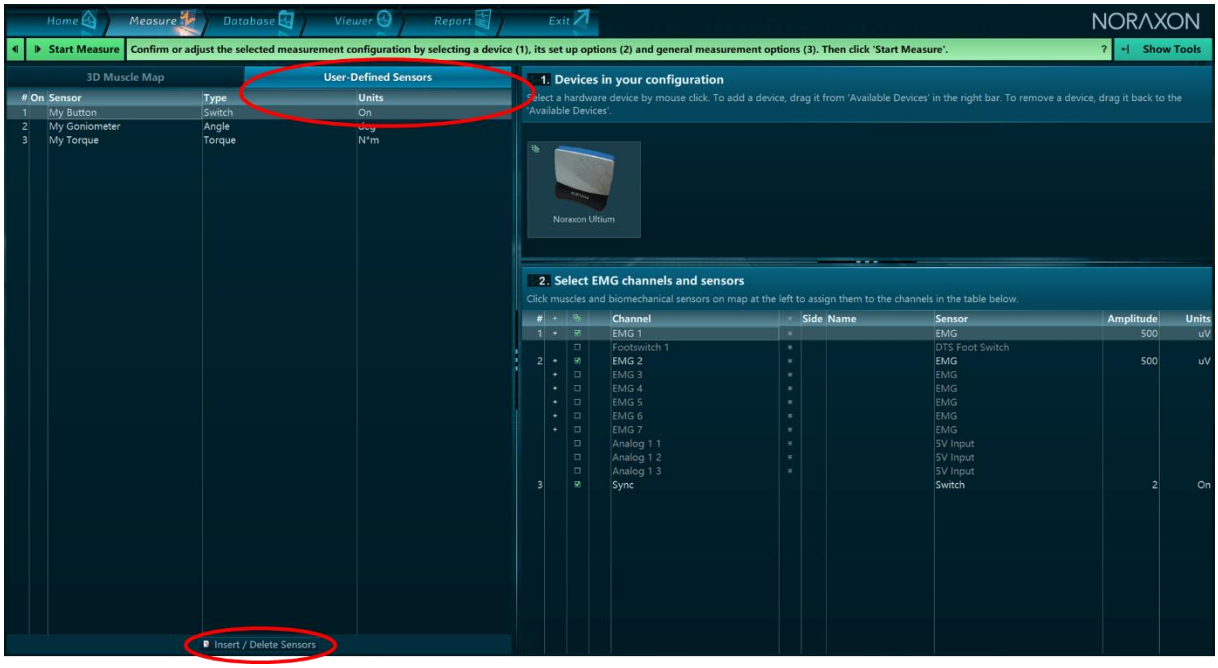
To check if the SmartLeads are currently connected to the proper Ultium sensor, the Find My Sensor feature may be useful. Click the topmost star (shown in the above figure). If all lights blink (white color), then they are properly connected. If one of the sensors blinks (red color), the SmartLead that is connected to this sensor should be connected to another sensor. It is recommended to recomplete Steps 1-5 of Section 6 above if this does occur.

6.7.3 Custom User-Defined Channel Types

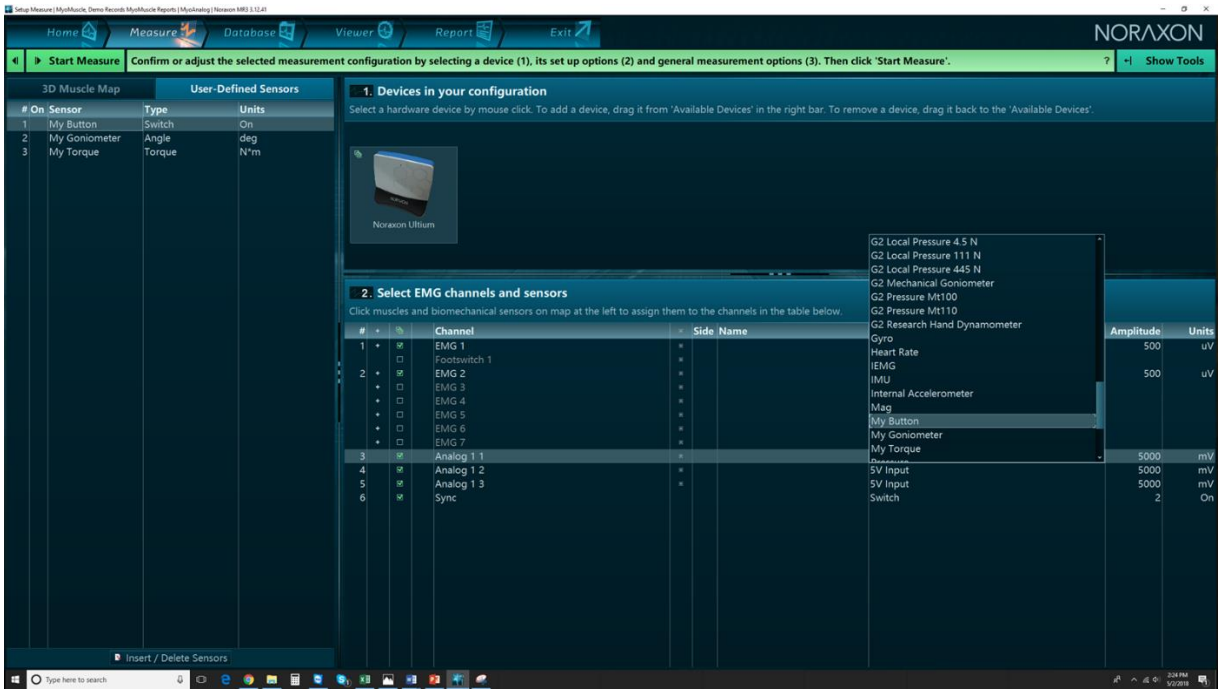
When using the Analog Input SmartLead, it may be of interest to customize the settings (Units, Minimum Voltage, Maximum Voltage, Resolution, etc.) for the signal that is to be analyzed.



This can be done within the configuration setup (Step 3-5: Section 6). Select 'User Defined Sensors' – demonstrated in the image below. To edit the settings, select 'Insert/Delete Sensors.



Once the sensors have been selected, double click on the sensor type for the desired Analog Input channel, then select the desired sensor type.



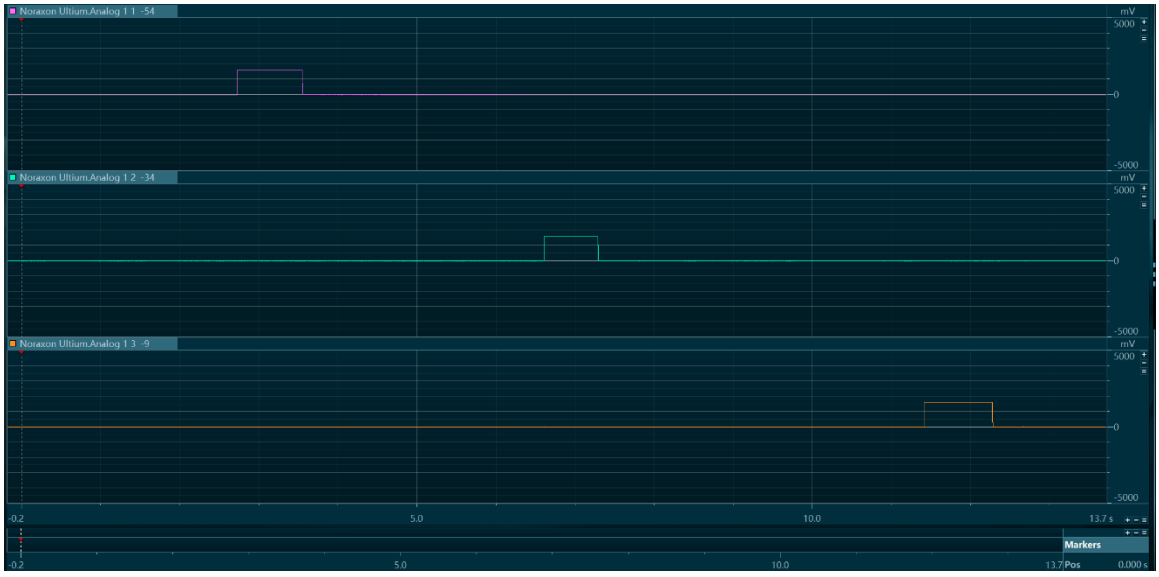
7 Pre-Use Check-Out

7.1 Normal Appearance of Signals

The sensor's STATUS LED provides a means of communicating its operational state. In the idle state, the STATUS LED will flash blue at a low, once per second rate. When the sensor is actively measuring a signal, the STATUS LED will flash recognizably faster (green).

Quick Testing:

To ensure that the Analog Input SmartLead is wired properly, each of the signals can be wired to a known voltage in series as demonstrated below with a 1.5 Volt signal.



8 Operating Instructions

8.1 Safety Information Summary

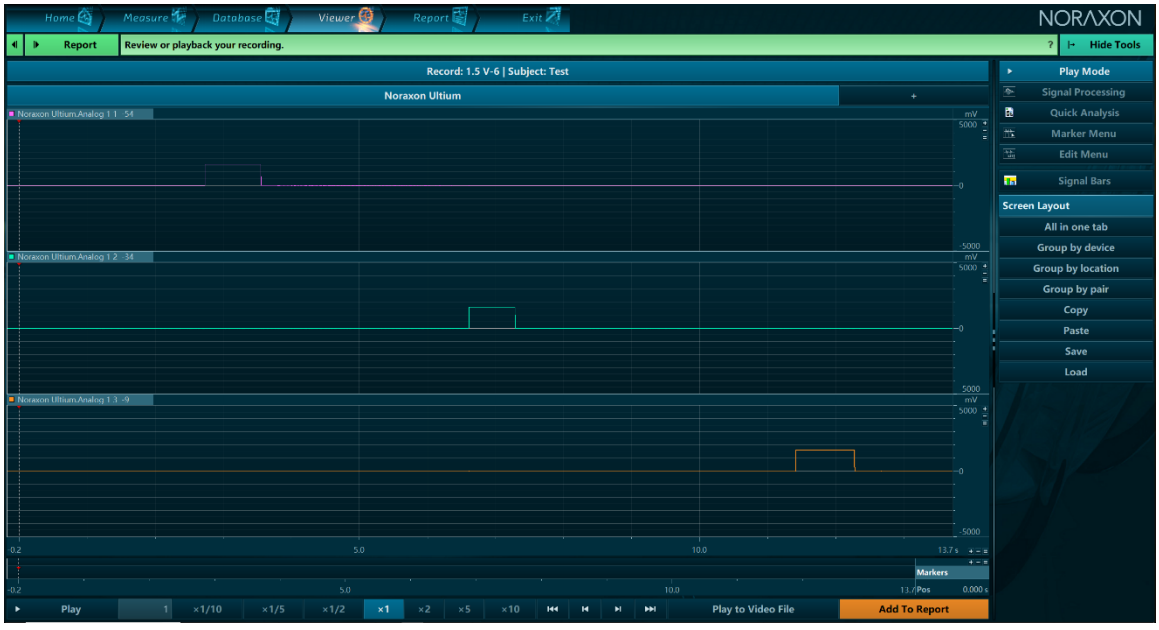
Strictly follow all safety practices given in section 4 of this manual. The most critical ones are repeated here.

CAUTIONS

- Never use the Noraxon Ultium System on a person with an implanted pacemaker
- Never operate the Noraxon Ultium System within 1 meter of any critical medical device

8.2 Normal Functions with Interface to a PC

When used with the companion software, the Analog Input SmartLead displays and records signals like the image below:



Consult the user manual for the companion software for descriptions of the setup, playback and analysis of the data acquired by the Ultium system.

8.3 Exceptional Functions/Situations (error messages)

Please see the appropriate Ultium hardware manual (P-880) for possible error messages.

8.4 Shutdown after Use

At the end of the day:

- Place all EMG sensors inside the sensor docking station(s).
- Tap the Sensor Power touch button on the Receiver to power all sensors off.

8.5 Storage and Protecting Between Usages

For extended storage or when travelling:

- Place all sensors into the sensor docking station and power them off (Slide your finger across the sensor power touch button. When the sensors are shutdown they will stop blinking completely. The sensors are reactivated by briefly charging them).
- Position all components inside the system travelling case according to their prepared cavities. (see photo below)

9 Accessories and Optional Modules

9.1 Accessories

The Analog Input SmartLead is either open wired (displayed in Section 6 – no accessories) or used in conjunction with a 2.5 mm TRRS Mating Connector as displayed below.

10 Cleaning

10.1 Safety Precautions When Cleaning

WARNING

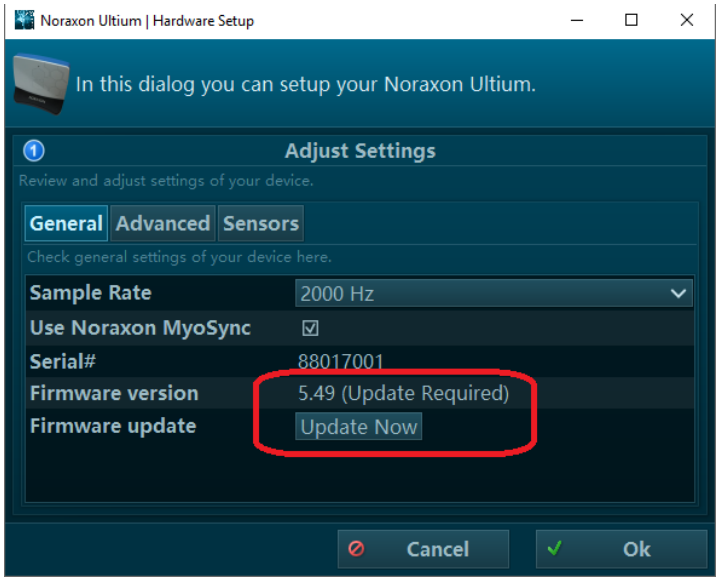
Only use a damp cloth with mild soap and water or isopropyl alcohol to clean the Ultium SmartLeads.

Do not immerse Ultium Sensors or SmartLeads in any water or liquid.

11 Maintenance

11.1 Device Software (firmware) updates

The internal program (firmware) inside the various Ultium devices can be updated via MR3. The user will be notified within the Ultium System hardware setup if an update is required. Ensure that all sensors are placed in the Ultium charging doc and that the charging doc is connected to the Ultium receiver prior to initiating the firmware update. If you start the update prior to completing this step, you may need to update again (firmware update button will still be present in hardware setup).



11.2 Maintenance by Qualified Individuals

The following activities should only be undertaken by PC support (IT) personnel, equipment technicians or those with suitable training.

11.3 Companion Software Updates

- Perform a backup of the data folders to a separate drive as a precaution.
- Click on the Patch/Update link provided in the email or as given on the Noraxon website.
- Download the Patch/Update file.
- To install the Patch/Update, click "Run" on the dialog box. No password is required.

Attention

All EMG sensors should be fully charged before a firmware update is performed.

12 Troubleshooting

Symptom: Problem with the EMG Sensor recognizing the SmartLead

Possible Reason	Remedial Action

SmartLead is disconnected or loose Firmware in the Sensor is outdated. The EMG Sensor Status LED may be solid Yellow.	Check that the SmartLead is inserted Fully Sensor firmware is periodically updated to support newly designed SmartLeads. Make sure you have installed the latest version of MR3 and run a firmware update if needed.

12.1 Website Link to FAQ

Answers to common questions can be found at Noraxon's Frequently Asked Questions (FAQ) website page at this link:

https://www.noraxon.com/support-learn/technical-support/faqs/

Other educational material is available at this link:

https://www.noraxon.com/support-learn/technical-support/

13 Service and Repair

13.1 Availability of Circuit Diagrams and Component Lists

Noraxon will make available on request circuit schematics, component parts lists and calibration instructions to assist qualified technical personnel in the service and maintenance of the Ultium SmartLeads, where applicable.

13.2 Warranty Information

Noraxon equipment including optional items is guaranteed to be free from defects in material and workmanship for 1 year from the date of purchase. The warrant period begins on the date of product shipment from Scottsdale, Arizona.

Warranty coverage does not apply to damage incurred through accident, alteration, abuse or failure to follow instructions contained in this document.

An optional extended warranty is available. Please contact Noraxon USA for further details.

13.3 Submitting Technical Support Requests

A Support Request can be submitted using the online form available at this link:

https://www.noraxon.com/support-learn/support-request/

Provide all information requested by the form including a **detailed** description of the problem being experienced and your telephone number or e-mail address.

13.4 Returning Equipment

Be sure to obtain an RMA Number (return material authorization) before returning any equipment. Completing the online service request form will assign an RMA Number. Otherwise contact Noraxon USA.

https://www.noraxon.com/support-learn/rma-request/

Send the equipment **postage prepaid** and **insured** to the address below. Include the RMA Number on the shipment label. Mark the package "Goods to be repaired – Made in USA" to avoid unnecessary customs charges. (Beware listing a Customs or Insurance value of $5,000.00 USD or more will result in a delay at United States Customs.)

Noraxon USA
15770 N. Greenway-Hayden Loop
Suite 100
Scottsdale, AZ

85260, USA

If you are shipping from outside the USA please use UPS, FedEx, DHL, or EMS (US Postal Service) and **not a freight-forwarder.** Using a freight-forwarder incurs additional brokerage fees. If a package is shipped to Noraxon via a carrier other than the ones listed above, it may be refused.

14 Spare Parts and Consumables

14.1 Consumable Items

There are not any consumable items for this product.

14.2 Replaceable Items

There are not any replaceable items for this product.

15 Specifications of the Product

15.1 Expected Useful Lifetime

The Ultium Analog Input SmartLead has a usable life of seven years.

15.2 Technical Specifications

Sensor Specifications

- Input Channels: 3
- Sample Rate: 500/1000Hz
- Input Range: +/-5V or +/-20V (To verify which version you have, check the labeling on the SmartLead itself.)

- Resolution: 0.61mV
- Accuracy: +/- 2% full scale
- Noise: < 2 mV
- Analog Output scale factor: 250 mV/V
- Input Impedance: 2.1 Mohm

Physical Specifications

- SmartLead Dimensions:
  - 1.905 cm Width x 1.12 cm Thickness, Length varies slightly

15.3 Environmental Conditions for Storage and Transport

- Ambient Temperature: 0C to 38C
- Relative Humidity: 10% to 100%
- Atmospheric Pressure: 70kPa to 107kPa

15.4 Ultium Analog Input SmartLead Operation

The Ultium Analog Input SmartLead allows a device with up to 3 analog signals to be used with the Ultium system. This sensor gives users freedom to select the appropriate device for their research.

The device must be self-powered because the sensor does not provide power to the device attached to it.

The input range of the SmartLead was initially +/-5V. However, Noraxon has increased this to +/-20V in later revisions. Be sure to check the label on the connector of the SmartLead before measuring signals larger than +/-5V.

The input stages of the 3 input channels include resistor dividers. This creates an input impedance of 2.1 Mohms.