Ultium™ Biomechanics Research System

3D Accelerometer® SmartLead User Manual

P-811 Rev B (May 2019)

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CE

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1 Introduction

1.1 Brief Description

This compact and lightweight acceleration SmartLead is an accessory to the Ultium EMG sensor (#810) that is especially designed for use with human and animal surfaces and body segments. Due to its size and mass, it is easy to attach and provides accurate data.

Attached to non-biological material and bodies, it can measure impact forces up to 400G. Due to its small size (21mm by 16mm), the sensor is easy to attach to any surface. The sensor's low weight (8.5gm) avoids sensor-related swinging artifacts.

The sensor construction guarantees an effective use in a variety of application areas, such as medical research, sports analysis, rehabilitation, ergonomics and robotics. It can be used to detect ground contact (heel strike) in walking and running, motion vibration in medical tremor analysis or impact and shock impulses in sports specific equipment or ergonomic tools.

1.2 Contradictions

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

2 Definitions

2.1 Graphic Symbols and Meaning

The following international icons and symbols may be found on the Ultium 3D Accelerometer SmartLead enclosures and in this user manual. Their meaning is described below.

	Read material in the Instruction Manual wherever this symbol appears.

1.3 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.

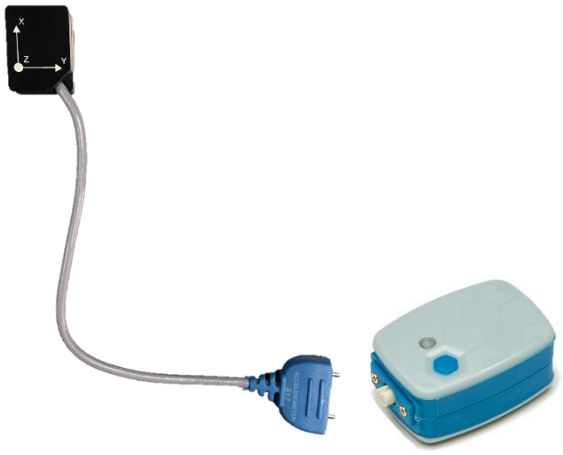
Ultium SmartLead – Refers to different data collection modalities. Each SmartLead measures a given type of physical parameter. Different SmartLeads can be combined in the same Ultium network. The most common Ultium SmartLead is EMG. Examples of other types include Accelerometers, Goniometers and Force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



3D Accelerometer SmartLead (Part #817)

3.2 Product Versions and Configurations

The model 817 Ultium 3D Accelerometer 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 Accelerometer 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 3D Accelerometer SmartLead to collect data from a person with an implanted pacemaker
- Never operate the Ultium 3D Accelerometer 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 3D Accelerometer SmartLead produces 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 3D Accelerometer 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 user manual

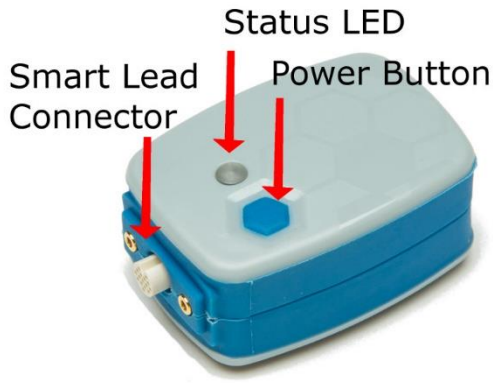
6 Preparing the Product for Use

6.1 Unpacking and Component Identification

	Ultium 3D Accelerometer SmartLead (Part #817)
Additional contents not illustrated	
Ultium 3D Accelerometer User Manual (part #817A) *This document*	

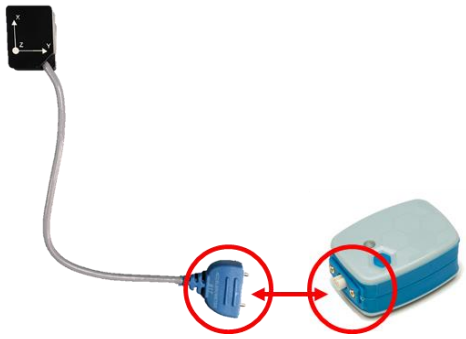
6.2 Component Inputs, Outputs, and Indicators

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 Component Interconnections

Step 1A



Connect the Ultium Sensor to the Ultium 3D Accelerometer 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.

6.4 Device Communication (Driver) Software Installation

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

6.5 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.

6.5.1 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

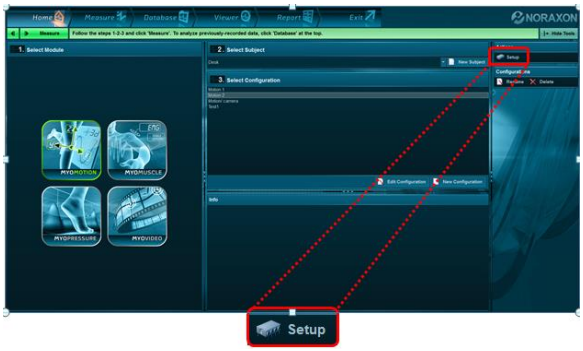
on the icon to start the MR3 software.

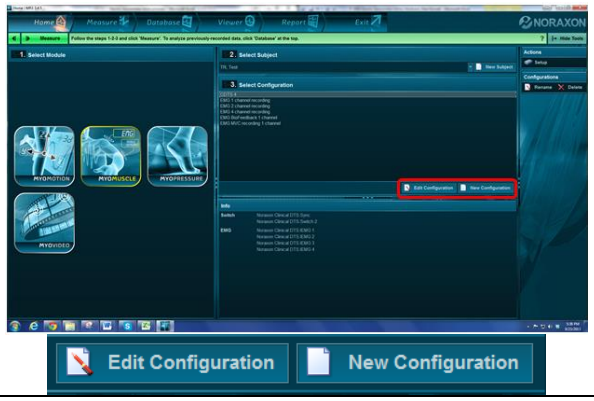
6.6 Companion Software Configuration

Before the Ultium 3D Accelerometer 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 3D Accelerometer 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 3D Accelerometer SmartLead.

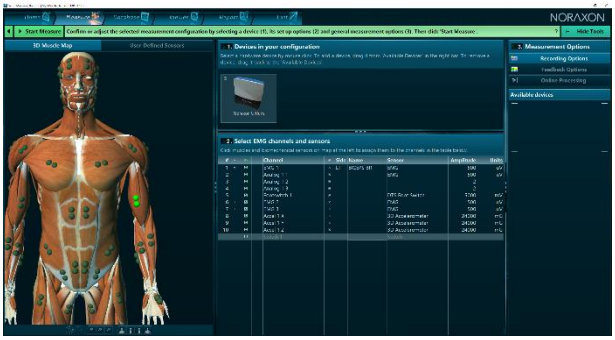
6.6.1 MR3 Configuration

	**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: 3D Accelerometer) 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

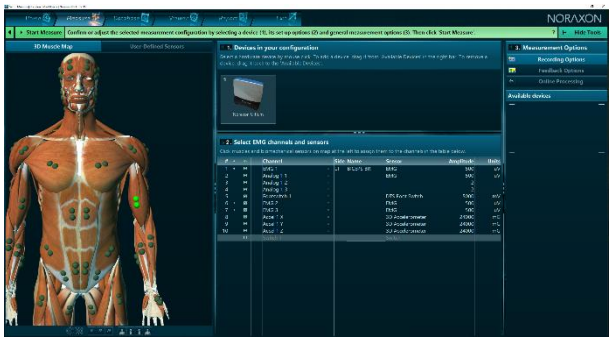
Once back in the Home screen, choose if you would like to create a new configuration or edit an existing configuration.



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

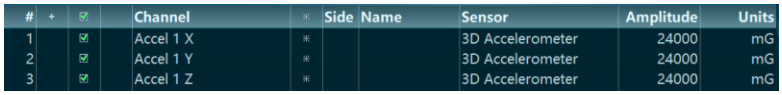
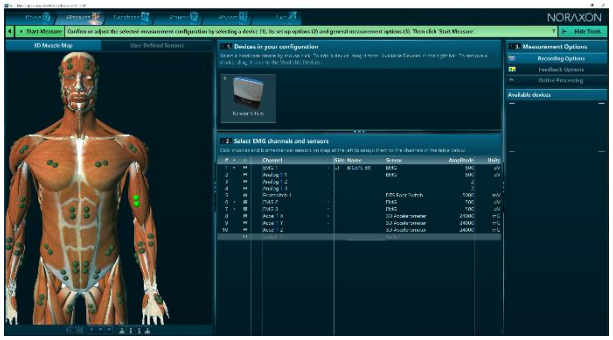
Step 4

In the measurement setup screen, insert the Ultium system into the Devices of your configuration box.



Step 5a

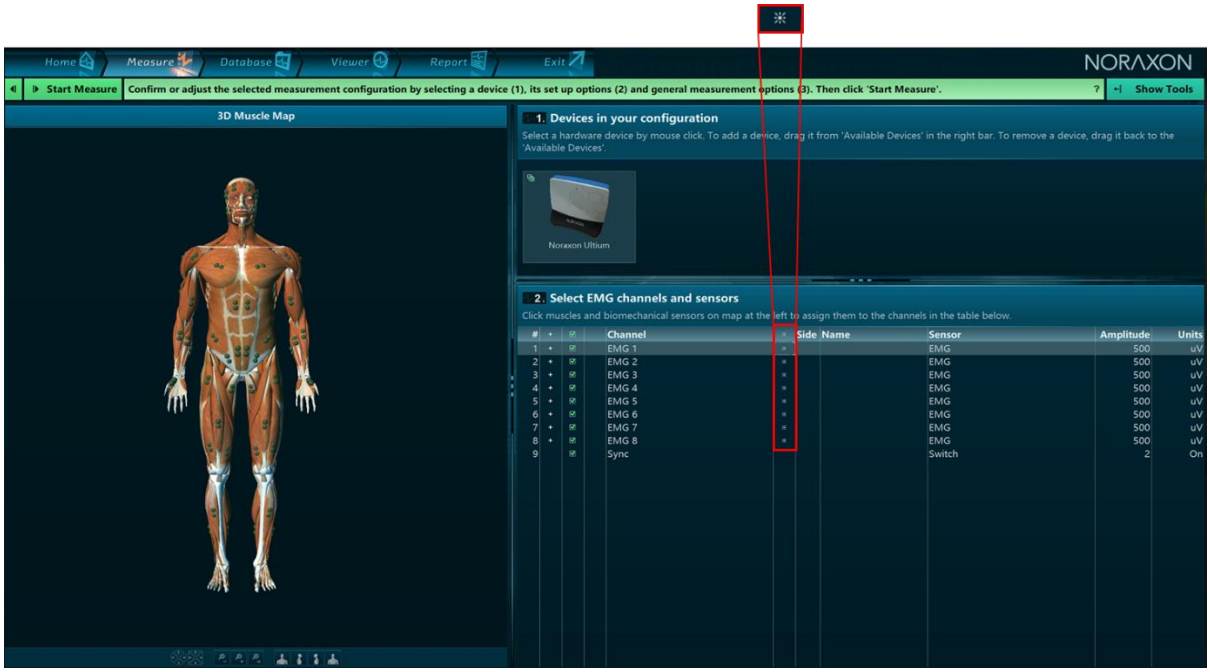
Once the Ultium system is inserted, the muscle map will appear to the left, and the EMG channels and sensors will appear below. The Ultium 3D Accelerometer SmartLead should automatically appear, as detected by the Ultium system (if it does not – refer to step 2a).

	To select the 3D Accelerometer SmartLead for use in a recording, check the boxes next to each “Accel” channel (X, Y, and Z).
	**Step 5b** Continue with the measurement setup as described in the Noraxon system’s hardware manual.

#	+	☑		Channel	✳	Side	Name	Sensor	Amplitude	Units
1		☑		Accel 1 X	✳			3D Accelerometer	24000	mG
2		☑		Accel 1 Y	✳			3D Accelerometer	24000	mG
3		☑		Accel 1 Z	✳			3D Accelerometer	24000	mG

6.6.2 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 used. 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.

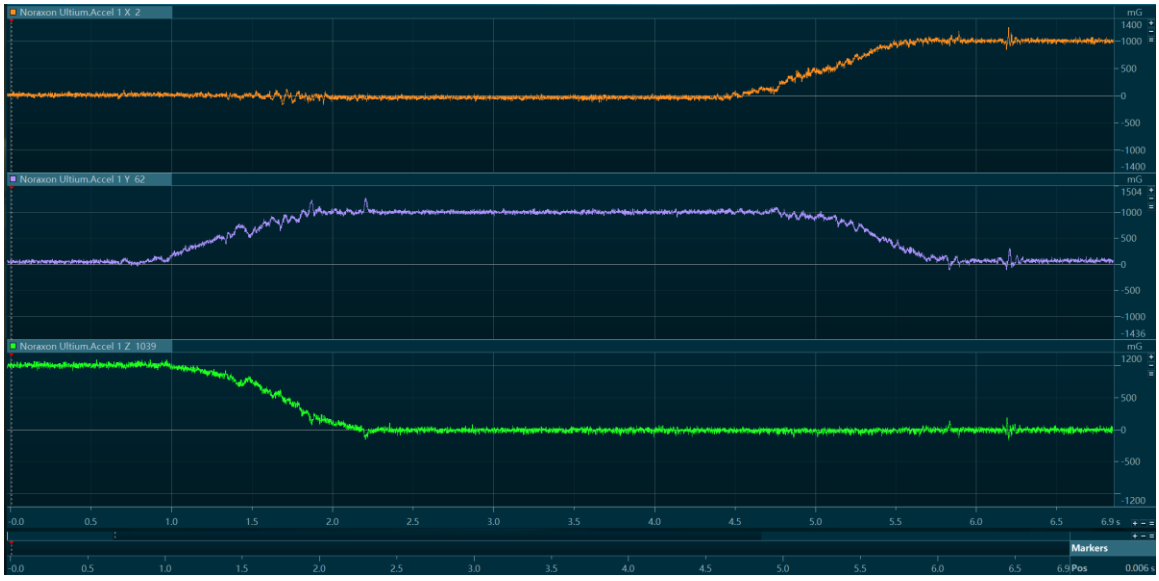
7 Pre-Use Check-Out

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 Ultium 3D Accelerometer is measuring properly, place the black sensor on a flat level surface and ensure that the axis pointing upwards reads approximately 1000 mG, while the other two axes measure around 0-50 mG. In the example below, the 3D Accelerometer is placed on a flat level surface and rotated so that the Z, then Y, then X axis points upwards, measuring around 1000 mG.



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 3D Accelerometer SmartLead displays and records signal 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 the Ultium System 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

Part No.	Image	Description
ES2		Elastic strap for adhering the sensor to the user
842C		Double sided tape for attaching Ultium sensors, 504 per package

As new accessories may be available after the time of printing, please check the Noraxon website at this link for the latest offerings

https://www.noraxon.com/

10 Cleaning

10.1 Safety Precautions When Cleaning

WARNING

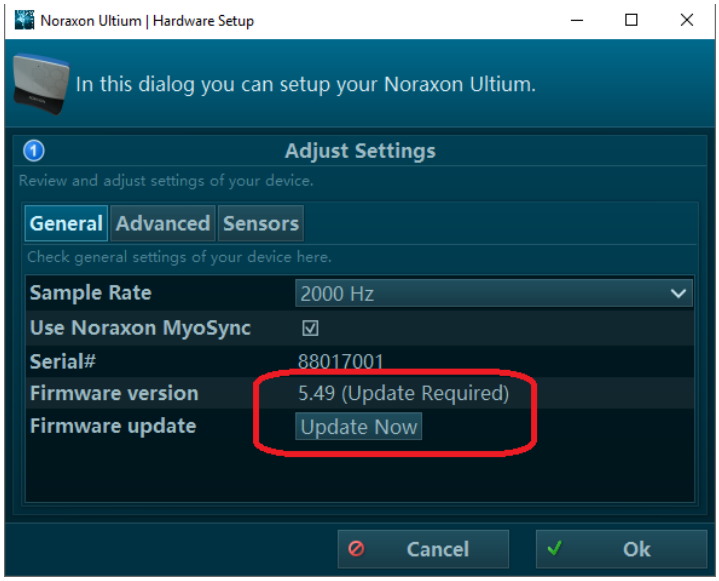
Only use a damp cloth with mild soap and water or isopropyl alcohol to clean the Ultium SmartLeads.

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	Check that the SmartLead is inserted Fully

Firmware in the Sensor is outdated. The EMG Sensor Status LED may be solid Yellow.	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

Part No.	Image	Description
ES2		Elastic strap, 36 inches long (cut to length) for securing Ultium sensors

15 Specifications of the Product

15.1 Expected Useful Lifetime

The Ultium FootSwitch SmartLead has a usable life of seven years.

15.2 Technical Specifications

Sensor Specifications

- Measurement Axes: 3 (X/Y/Z)
- Sample Rate: 500/1000Hz
- Input Range: +/-400g
- Resolution: 0.000976g (-16g to +16g)
  0.0234g (-400g to -16g, +16g to +400g)
- Typical Noise: 0.029g RMS
- Bandwidth: 0-250Hz (sample rate = 500Hz)
  0-500Hz (sample rate = 1000Hz)

- Analog Output scale factor: 12.5 mV/g

Physical Specifications

- SmartLead Dimensions:
  1.9 cm Width x 1.1 cm Thickness, Length varies slightly
- Sensor Dimensions:
  - 2.1 cm L x 1.6 cm W x 0.8 cm H

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 3D Accelerometer SmartLead Operation

The Ultium 3D Accelerometer collects linear accelerations along its three axes (X, Y, and Z). This sensor is capable of measuring accelerations up to 400G.

The SmartLead incorporates two MEMS accelerometers. The first measures accelerations up to +/-10G, while the other measures accelerations up to +/- 400G. This SmartLead measures small movements (> 10G) with the former, then switches to the latter for movements that accelerate above 10G.

Additionally, the Ultium 3D Accelerometer will read an acceleration of approximately 1G (from gravitational force) along the axis in the opposite direction of gravity.