NORAXON

MEASURING FOR EXCELLENCE

DTS LOSSLESS EMG SENSOR®

User Manual

Model 548
(Lossless)

P-5488 Rev B (Feb 2015)

For questions, concerns or additional assistance please contact Noraxon or its Authorized Representative as specified below.

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0473 Notified Body:
Clearance to market this product in the European Community has been certified by Notified Body #0473, AMTAC of the UK.

Table of Contents

Section 1: Introduction

Brief Description

The TeleMyo™ Direct Transmission System for EMG and other biomechanical sensors directly transmits data from the electrode or sensor site to a Receiver.

This direct transmission concept greatly simplifies the arrangement of EMG measurements by eliminating cable connections between the EMG electrodes and EMG amplifier. The small, lightweight probes are also beneficial for small subjects like children and small animals.

This unique concept gives the user the flexibility to operate the DTS system without limitations. The Telemyo DTS system is designed to operate any configuration between 1 and 16 channels.

The Lossless EMG sensor allows for data to be captured and stored within the sensor in the event that the sensor travels out of range of the Noraxon EMG receiver. This data is later transferred back into the recording once the recording is finished and the sensor is brought back in range of the receiver.

Note: The DTS Lossless EMG sensors are designed to capture brief moments of data loss, not to be used as a data logger for long periods of data loss.

Intended Use

Noraxon's DTS line of EMG systems are intended to measure and quantify muscle biopotential signals separately or in combination with other kinematic or kinetic signals. Additionally, these devices are compliant to the international standard for diagnostic EMG (IEC 60601-2-40).

Intended Users
Researchers or individuals trained in physical medicine, physical therapy, human performance or ergonomics

Subject Populations – Medical
Individuals with neurological disorders, physical injuries, pre/post-surgical or post stroke conditions

Subject Populations – Non medical
Athletes, workers at their worksite, subjects in new product trials

Common Applications
Gait analysis; identification of inconsistencies and abnormalities; tracking over time the outcome of surgical, therapeutic or orthotic interventions; identification of ergonomic stress factors in the workplace or new product designs

Risk-Benefit
There is **no identified risk of physical harm or injury** with use of the DTS EMG devices. The benefit provided by use of the device is the provision of objective measures to assess the severity of pathological human movement conditions and gauge any subsequent improvement offered by therapy, training or design changes.

Special Concerns
The DTS EMG devices operates by means of microwave radio frequency transmissions. Certain (older vintage) pacemaker devices may be susceptible to such microwave transmissions. Therefore use of the device is contra-indicated in individuals who have implanted pacemakers.

Contraindications

Use of the DTS EMG sensor is contra-indicated in individuals who have implanted pacemakers.

SECTION 2: DEFINITIONS

Graphic Symbols and Meaning

The following international icons and symbols are found on the Noraxon DTS EMG or Receiver enclosures and in this user manual. Their meaning is described below.

CE 0473	Approval to market this product in the European Community was certified by Notified Body #0473 AMTAC of the UK.
	The device generates radio frequency energy during operation.
⎓ 5V DC	A 5 Volt DC power source is applied to this connection.
	The USB cable is applied to this connection.
	The device is suitable for a direct electrical attachment to the body.
	Read material in the Instruction Manual wherever this symbol appears.
	Identifies the manufacturer of the device.
SN	Identifies the serial number of the device.
DOC	Additional information available in a separate document

Glossary of Terms

DTS – (Abbreviation for Direct Transmission System) A network of short-range wireless sensors where measured data is transmitted directly from each sensor into a receiver for subsequent display and analysis on a computer or intelligent handheld device.

DTS 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 position or acceleration).

DTS Sensor Type – Refers to different models of DTS Sensors. Each sensor model measures a given type of physical parameter. Different DTS Sensor Types can be combined in the same DTS network. The most common DTS Sensor Type is EMG. Examples of other types include Accelerometers, Goniometers and Force sensors.

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

Lossless – Term for DTS EMG sensors with logging capabilities used to prevent signal loss in case the sensor should travel out of range of the DTS receiver.

Probe – A generic term for any DTS Sensor.

RF – (Abbreviation for Radio Frequency) Wireless communication takes place on assigned radio frequencies or channels. For the Noraxon DTS System, RF transmissions occur at frequencies between 2.4 GHz and 2.5 GHz. Other wireless systems including WiFi and Bluetooth commonly operate at the same frequencies and can be a source of interference.

RF Channel – RF transmissions for the DTS System can be selected to occur on one of 8 different radio frequencies. The ability to operate over several different frequencies allows the DTS System to reposition its radio operation if needed to avoid interference.

RF Traffic – The presence of radioactivity present on a given frequency similar to the number of cars on an expressway. Several users (wireless devices) may be communicating using the same frequency. Best operation of the DTS System occurs when the RF Traffic is low (no other users) on the selected RF Channel.

Sensor Delay – The sensor delay used when retransmitting data from the sensor to the receiver.

Section 3: Identification

Model Designation

Model 548
DTS Lossless EMG Sensor

Product Versions and Configurations

The model 548 DTS Lossless EMG sensors can work in conjunction with the following Noraxon DTS systems:

Model 580 TeleMyo DTS Belt Receiver
Model 586 TeleMyo DTS Desk Receiver

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

As the DTS EMG System requires software to perform its function, the equipment is offered in combination with the following computer program packages:

Model 430 myoMUSCLE Data Acquisition
Model 431 myoMUSCLE Essential
Model 432 myoMUSCLE Clinical
Model 434 myoMUSCLE Master

Section 4: General Warnings and Cautions

Risks and Benefits

There is **no identified risk of physical harm or injury** with use of the DTS EMG sensor. The benefit provided by use of the device is the provision of objective measures to assess the severity of pathological human movement conditions and gauge any subsequent improvement offered by therapy, training, prosthetic alterations or ergonomic design changes.

Safety Information Summary

Cautions

- Never use the DTS Lossless EMG Sensor on a person with an implanted pacemaker
- Never operate the DTS Lossless EMG Sensor within 1 meter of any critical medical device

Warnings

- Do not immerse the DTS Sensors in any water or liquid
- Do not use the Noraxon DTS system on individuals undergoing MRI, Electro Surgery or Defibrillation
- The DTS Lossless EMG sensor 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 TeleMyo DTS equipment and be able to detect anomalies that could interfere with proper interpretation.

Section 5: Getting Started

Quick Start Guides

Please see the hardware manual for the appropriate DTS Receiver.

Section 6: Preparing the Product for Use

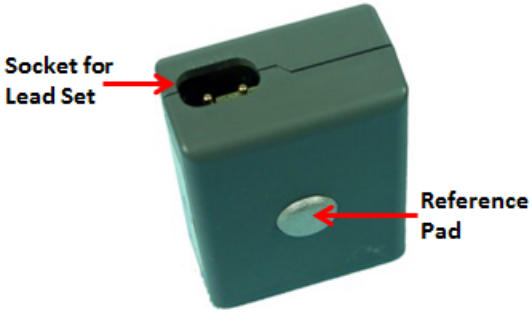
(Set-up Instructions)

Unpacking and Component Identification

	DTS Lossless EMG Sensor (part #548) Qty: 1 to 16 (shipped inside charging station)
	DTS EMG Lead Set (part # 542AP or #542AS) Qty: Matches number of EMG Sensors
Additional contents not illustrated	
DTS Lossless EMG User Manual (part #5488) *This document*	

If additional accessories have been included please see Section 9, Accessories for component identification.

Component Inputs, Outputs and Indicators

1A EMG Sensor (front) 	Status – Sensor operational indicator flashes green. Flash rate is faster when measuring, slower when idle. Charge – Indicator illuminates steady amber while sensor is charging. When the battery is fully charged the indication is off.
1B EMG Sensor (top and bottom edge) 	Charging Contacts – Sensor battery is charged through these two points. Serial Number – Unique 4 character serial number which identifies each DTS sensor.
1C EMG Sensor (bottom and top edge) 	Lead Set Socket – Attachment point for various styles of EMG electrode lead sets. Reference Pad – Metal pad must be applied to bare skin for stable EMG readings. All three above contact points must be kept clean and free of tape residue.

Component Interconnections

Step 1

Insert one EMG lead set (542AP) into each EMG probe (548).

Device Communication (Driver) Software Installation

No driver installation is needed. The sensors communicate their data with the DTS receiver.

Companion Software Installation

The Noraxon DTS System with the DTS Lossless EMG is compatible with the Noraxon MR3 myoMUSCLE software program.

MR3 Installation

1. Insert the MR3 USB flash drive into the PC
2. A menu will automatically pop up
3. Click on the Noraxon installation file and follow the Wizard's instructions

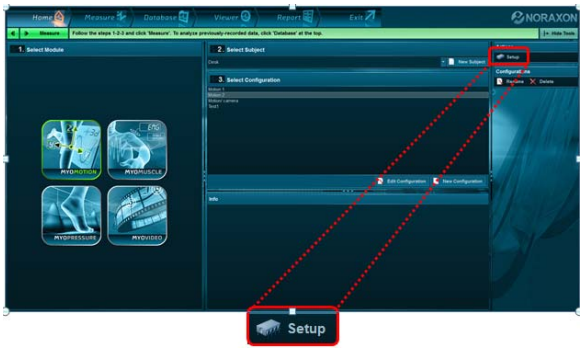
The installed companion software must be *activated* before unrestricted use is possible.

1. Open MR3 by double clicking the MR3 icon.
2. A dialog box will indicate how many more times MR3 can be opened.
3. Click on "Activate".
4. Enter the License ID provided on your USB flash drive and press "OK".
5. E-mail the provided activation ID to activation@Noraxon.com
6. Noraxon Support will respond via email with the Activation Code.
7. Enter the provided Activation Code to remove any restrictions on use.

Companion Software Configuration

Before the Noraxon DTS system can be used, the companion software must be configured to recognize the different components that make up the system. Refer to the following configuration instructions for the software program (MR3) supplied with the Noraxon DTS Receiver.

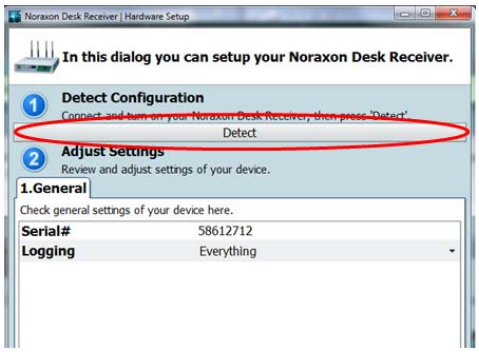
MR3 Configuration

	**Step 1** Open the MR3 program and click on the Setup button.
	**Step 2** Make sure the DTS Receiver is connected to the computer via USB or TeleMyo Receiver (hardware setup will vary based on DTS receiver. Please see the EMG receiver's hardware manual for setup). Click on the Insert Device button

Step 3

Double-Click on the appropriate Noraxon Receiver Icon to bring up the dialog of step 4.

Note:
The DTS Receiver Icon will not be displayed if the device is not connected to the computer. If absent go back to step 2.



Step 4

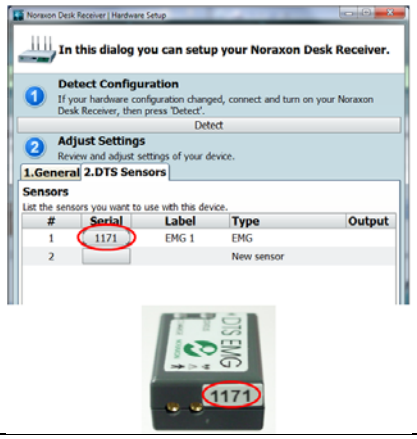
When the DTS Receiver is connected to the computer's USB port, the DTS Receiver Settings Dialog will appear.

Click Detect to auto Detect available or previously used sensors.

Step 5

Once detected, the following Dialog box will appear as shown.

Continue with steps 6 and 7 using the upper and lower parts of this dialog screen.



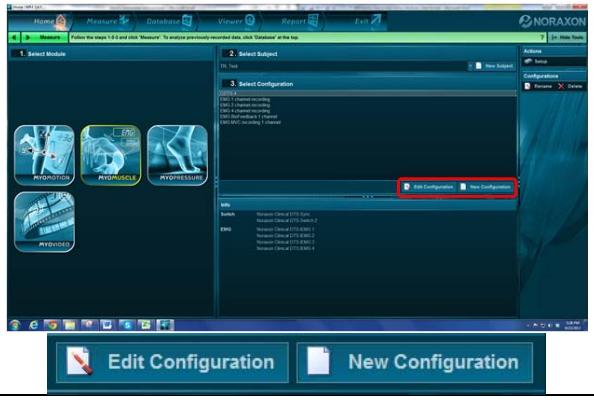
Step 6

For each DTS EMG Sensor identify its 4-character serial number and enter the value into the corresponding Serial column field.

Step 7

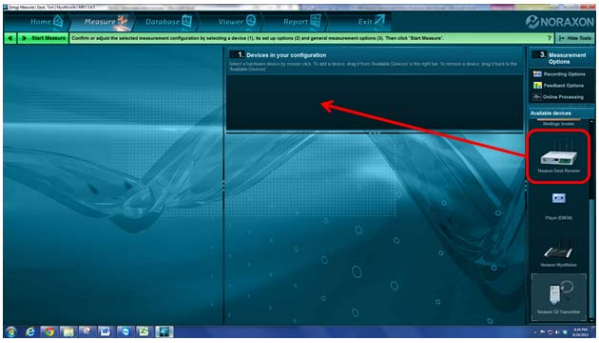
Set up Hardware Settings according to the receiver Hardware manual.

Click on OK (in the bottom of the dialog box) when done.



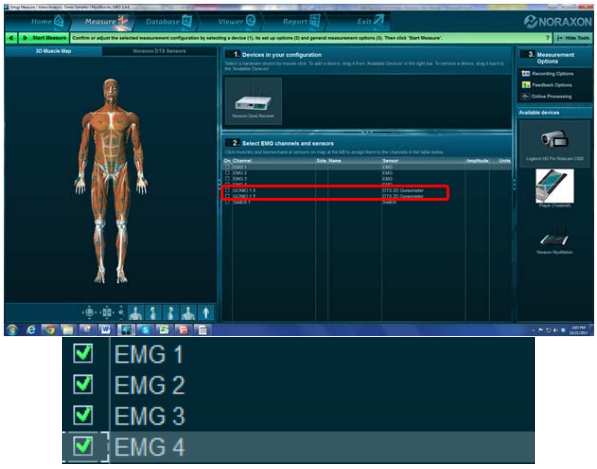
Step 8

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



Step 9

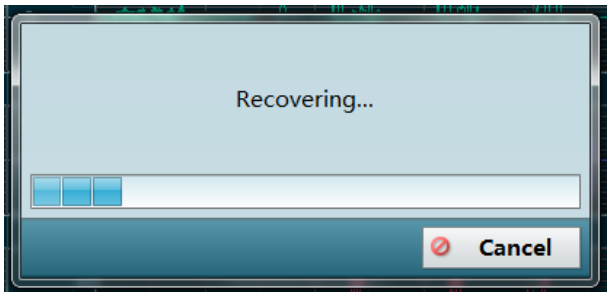
In the measurement setup screen, insert the DTS system into the Devices in your configuration box.



Step 10

Once the EMG system is inserted, the muscle map will appear to the left, and the EMG channels and sensors will appear below. All the channels with assigned sensors will automatically appear, as detected by the DTS system.

To select the channels for use in a recording, check the box next to the channel to be recorded.

	**Step 11** Continue with the measurement setup as described in the Noraxon EMG receiver's hardware manual.
	**Step 12** Begin a recording. When the recording is stopped, the sensors will recover any data that was lost during the recording.

Section 7: Pre-Use Check-Out

Normal Appearance of Signals

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

If the STATUS indicator is not flashing at all, the EMG Sensor must be placed in a powered charger station to be reactivated. This could be due to a depleted sensor battery or if the sensor has been deliberately placed in a special shut down mode.

Attaching the EMG Sensor to a Patient or Subject

Do not depend on the wire connection to the disposable electrodes as a means to secure the EMG sensor.

For proper operation the EMG Sensor must be applied to the measurement site so that the reference electrode pad on the bottom side is in direct contact with bare skin. The skin area in contact with the reference pad generally does not require any special preparation prior to applying the sensor. (Some skin preparation for the reference pad site may be beneficial if the EMG signal exhibits a wandering baseline. See Appendix C)

The EMG Sensors can be secured in place using Noraxon supplied double-sided adhesive tape and/or elastic straps. Straps are recommended if dynamic movements are expected.

The EMG Sensor allows for interchangeable terminal lead wires for attachment to disposable electrodes. The two lead wires are offset with one longer than the other by an amount equal to the standard 2 cm spacing for surface EMG electrodes. The 2-pin lead wire connector can be inserted either way into the EMG Sensor to facilitate attachment to the surface electrodes.

Both snap/button style and pinch (or clip) style wire terminations are available. Noraxon also offers longer lead wires for special needs.

Calibration

Instruct the subject to relax all muscles for one second at the start of each measurement. (Data collected during the first second of a measurement is used to correct for any offset present in the electrodes or electronics.)

Section 8: Operating Instructions

Safety Information Summary

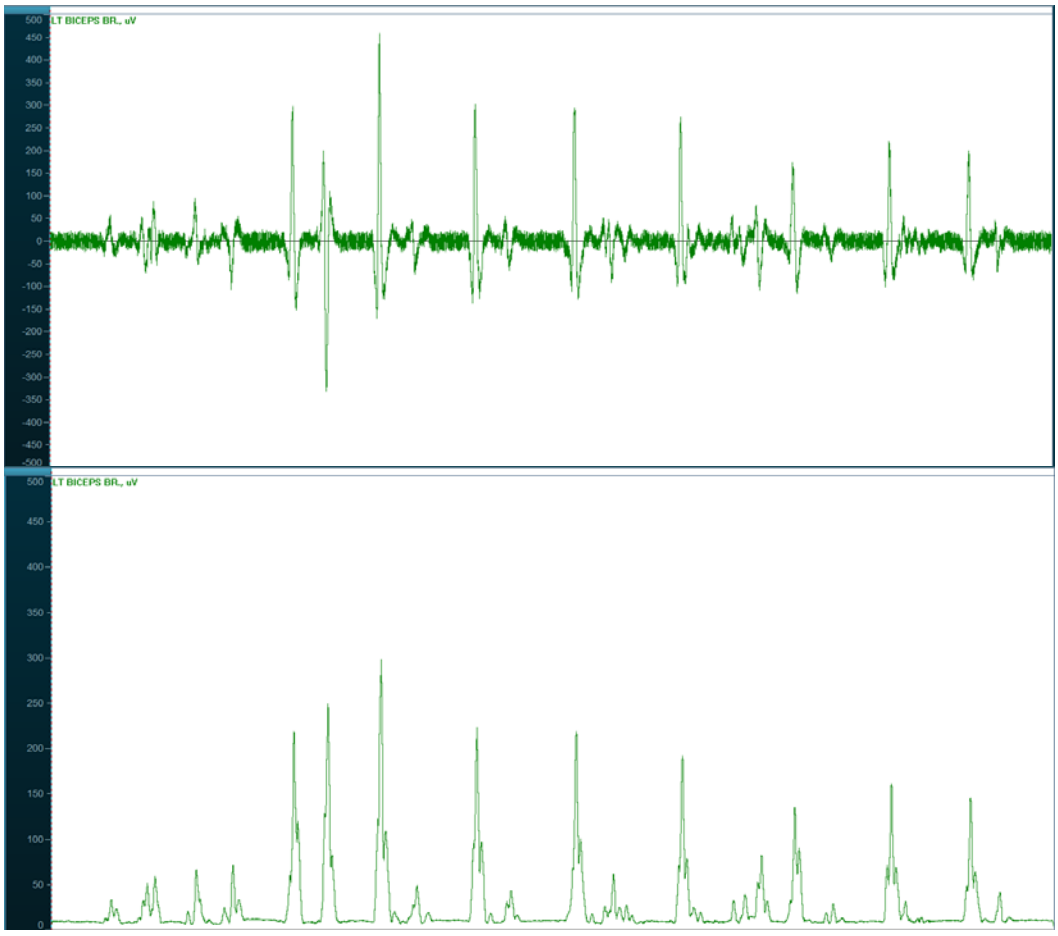
Strictly follow all safety practices given in section 4 of this manual. The most critical ones are repeated here.

CAUTIONS

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

Normal Functions with Interface to a PC

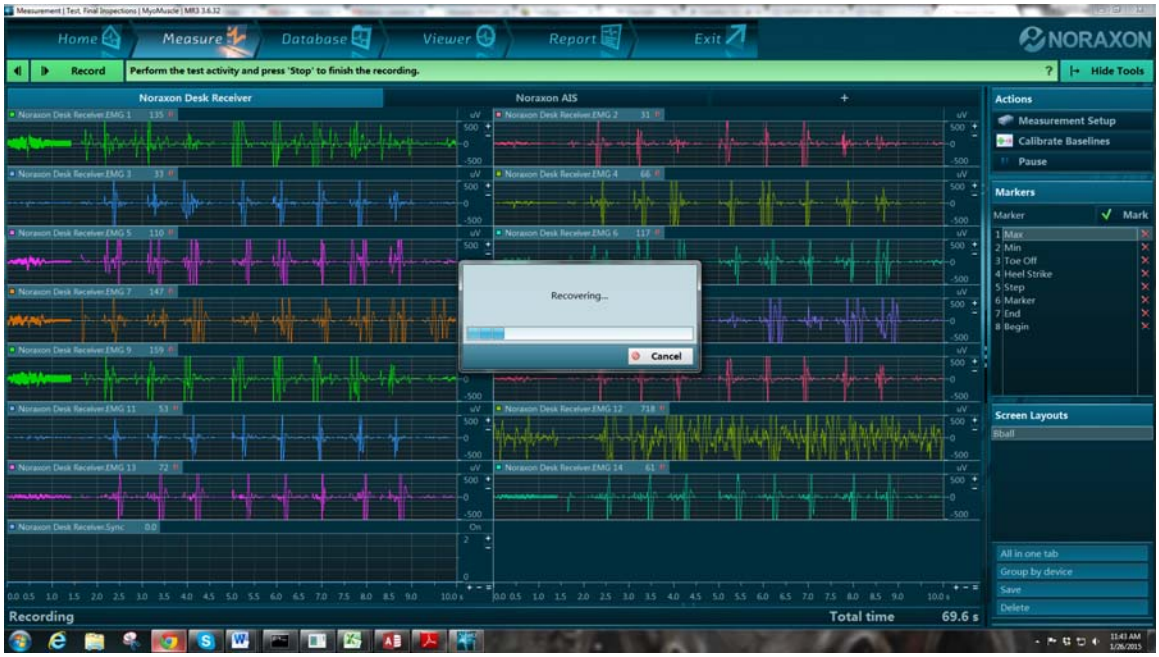
When used with the companion software the DTS System displays and records raw or processed EMG waveforms that will appear similar to the following.



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

Data Recovery

At the end of the measurement, the receiver will attempt to recover any data that was not successfully transmitted during the measurement and a “Recovery” dialogue box will appear. Once the data is done being recovered the dialogue box will disappear and the complete record will appear. The sensors should be close to the receiver for data recovery to increase the speed of transmitting data from the sensors to the receiver.



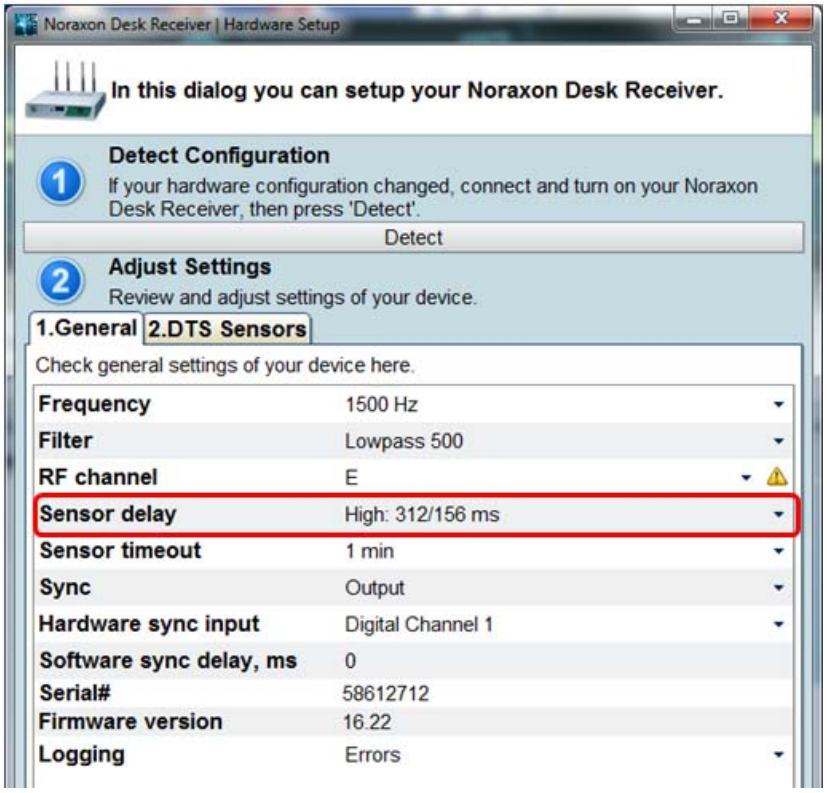
Sensor Delay

The sensor delay is adjustable in the software accompanying the DTS system. Longer delays are recommended as they allow more time to retransmit data in the event of RF interference. Shorter delay times should only be used if required by the application.

There are multiple sensor delay settings ranging from 36 to 312 ms. Because of buffer sizes, each setting produces a different delay value when used at 1500Hz and 3000Hz. The actual delay is listed in the Sensor Delay box.

Example: High (312/156ms) – The High setting produces a delay of 312ms at 1500Hz and 156ms at 3000Hz.

The Sensor Delay setting can be found in the Receiver Hardware Setup (Device Configuration).



Exceptional Functions/Situations (error messages)

Please see the appropriate Noraxon system's hardware manual for possible error messages.

Shutdown after Use

At the end of the day:

- Place all DTS sensors inside the sensor charging station
- Apply AC wall power to the charging station which disables the sensor radios

Storage and Protecting Between Usages

For extended storage or when travelling:

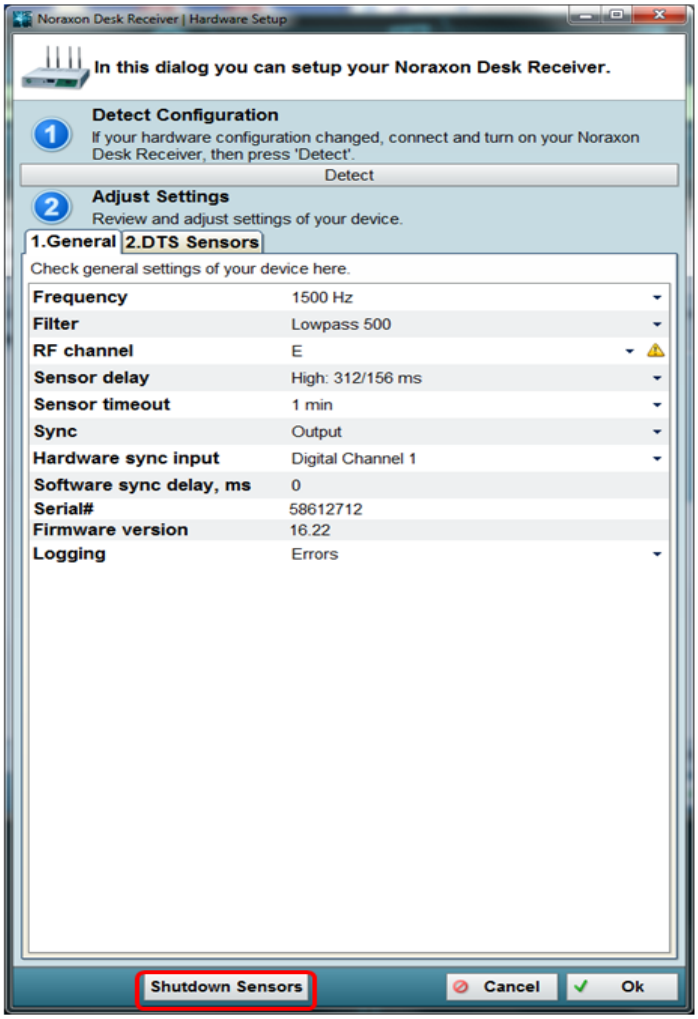
- Put the DTS sensors into sleep mode*****
- Place all sensors into the sensor charging station
- Position all components inside the system travelling case according to their prepared cavities. (see photo in section 6)

***** A special setting in the companion user software activates sensor sleep mode. (See section 6)

To access the shutdown mode in MR3:

- Click on the **Home** tab in the top navigation bar
- Click on the **Setup** button at the lower middle of the screen

- Click on the **Hardware** button in the right side Actions toolbar
- Click on the **Noraxon Desk Receiver** icon
- Click on the **Configure Device** button
- Click on the **Shutdown Sensors** Button



When the sensors are shutdown they will stop blinking completely. The sensors are reactivated by briefly charging them.

Section 9: Accessories and Optional Modules

Accessories

Part No.	Image	Description	More…
ES2		Elastic strap for adhering the sensor to the user	
542C		Double sided tape for attaching DTS sensors, 504 per package	
542AP		DTS EMG pinch lead	
542AS		DTS EMG snap lead	

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

http://noraxon.com/products/

Options

Part No.	Image	Description
548		DTS Lossless EMG sensor

Interfaces to Other Devices

Part No.	Image	Description	More…
580		TeleMyo DTS Belt Receiver	DOC
586		TeleMyo DTS Desk Receiver	DOC

SECTION 10: CLEANING

Safety Precautions When Cleaning

WARNING

Only use a damp cloth with mild soap and water or isopropyl alcohol to clean the bottom of the EMG Sensors.

Do not immerse EMG Sensors in any water or liquid.

Cleaning by Users

Clean the bottom of the EMG Sensors on a regular basis. The EMG Sensors can be cleaned with a cloth slightly dampened with a solution of mild soap and water or isopropyl alcohol.

The EMG Sensors are not constructed to withstand repeated application of any disinfectant solution. Likewise, the EMG Sensors are not warranted against exposure to any of the conventional forms of sterilization.

Section 11: Maintenance

Safety Precautions When Performing Maintenance

No precautions required.

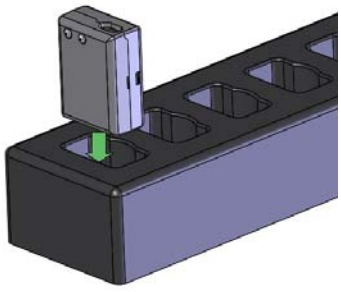
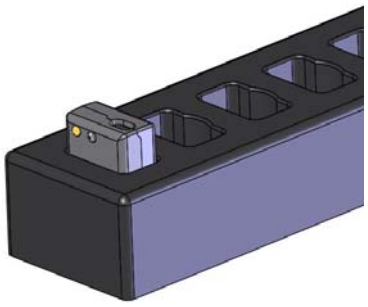
Maintenance by Users

Routine maintenance recommended for the DTS EMG sensor is cleaning the bottom pad of the EMG Sensor periodically. Because the DTS sensor batteries are Li-Ion, the only battery maintenance required is recharging.

Charging the DTS Sensors

The DTS Sensors may be charged using the DTS Sensor Charging Station

- Verify that all the sensors are correctly inserted into the DTS Sensor Charging Station (543).
- Plug the DTS Sensor Charger Power Source (PSU1) into the DTS Sensor Charging Station jack.
- Insert the DTS Sensor Charger Power Source into a Power Strip (recommended) or into the wall outlet (mains).
- Verify that the “charge” indicator on all sensors glows amber (yellow).
- Charge for approximately 3 hours or until each sensor “charge” indicator turns off.

1) Insert the DTS Sensor Charger Power Source (PSU1) into the charger jack on the DTS Sensor Charging Station (Part #543)  **2)** Insert the DTS Sensor(s) into the DTS Sensor Charging Station slots.	**3)** The Charge Indicator on the DTS Sensor will show an amber light while charging. The indicator will turn off when the charging cycle is complete. 

Maintenance by Qualified Individuals

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

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 http://noraxon.com/support-resources
- Download the Patch/Update file.
- To install the Patch/Update, click “Run” on the dialog box. No password is required.

Device Software (firmware) Updates

The internal program (firmware) inside the various DTS devices can be updated through the use of a special utility program available through a supplied link through the Noraxon website:

http://noraxon.com/support-resources

The installed program will permit updates to both the DTS Receiver and the DTS Sensors

Attention

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

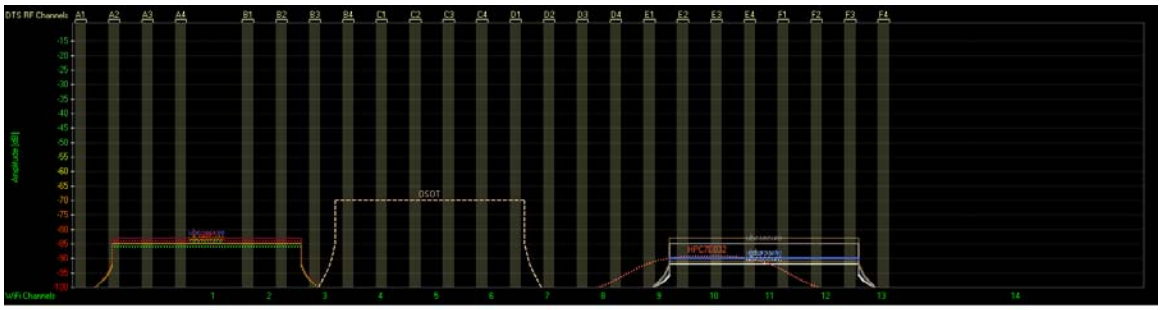
Maintaining an Optimal Wireless Connection

As wireless devices are increasingly more commonplace, the radio traffic in any given location can change often abruptly. The DTS Receivers operate in the 2.4 GHz band which is shared by wireless networks and personal communication devices. The DTS system can be set to operate at one of 8 or 24 different frequencies within the 2.4 GHz band as given in Appendix B.

Routine examination of the local wireless environment is recommended in order to select the best operating frequency for the DTS system as in Appendix A. A utility program (inSSIDer) that can be used to monitor WiFi activity is available for download at this link under Drivers and Firmware:

http://noraxon.com/support-resources

The WiFi monitoring program must be installed on a PC that has WiFi capability. The utility program uses the computer's WiFi radio to detect and report on activity on the various WiFi channels. The inSSIDer display will appear as follows.



Battery Replacement

The Lithium Polymer battery used in the DTS sensors is rated for a minimum of 300 charge-discharge cycles. Typical usage is 500 charge-discharge cycles. As the number of charge-discharge cycles increases the battery capacity slowly declines thereby reducing run time despite being fully charged.

Brand new batteries can operate up to 8 hours when fully charged. If the run time of the sensors drops to 5-6 hours, battery replacement should be considered. The replacement battery is part #BP7. It comes with a short pigtail wire and connector. No soldering is required.

The DTS sensor battery packs should not be replaced by the user. Only qualified technical personnel may perform maintenance.

Section 12: Trouble Shooting, Fault Diagnosis

Troubleshooting Chart

Symptom: **Problems with DTS Sensors communicating with the DTS Receiver**	
Possible Reason	**Remedial Action**
Sensors were not assigned to receiver	Assign sensors (see section 6)
Receiver battery is low	Retry after charging receiver
Interference on wireless channel	Use another radio channel (see receiver manual)
Symptom: **Problems with individual DTS Sensors**	
Possible Reason	**Remedial Action**
Sensor was not assigned to receiver	Assign sensor (see section 6)
Sensor battery is low (or sensor does not flash)	Retry after charging sensor for at least 15 minutes
Sensor shifts with very dynamic movements	Secure sensor with overlying elastic wrap
Symptom: **Problems with intermittent DTS Sensor signals**	
Possible Reason	**Remedial Action**
Electrode lead set is loose or disconnected	Check lead set connections at both the sensor and electrodes
Sensor reference pad is dirty or not in contact with bare skin	Clean reference pad if needed. Wipe and slightly abrade underlying skin if very dry
Sensor is too far from receiver	Move to within 30m (90 feet) of receiver
Sensor radio signal is partially blocked (absorbed) by subject's body (esp. at long distances)	Reposition sensor on subject to obtain a direct line-of-sight relationship between sensor and receiver

Website Link to FAQ

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

http://noraxon.com/suppoer-resources/faq

Other educational material is available at this link:

http://www.noraxon.com/support-resources/resource-center/

Radio Considerations

The Noraxon DTS radio system operates in the 2400 MHz ISM (Industrial, Scientific and Medical) radio band reserved for use in most countries of the world. The radio transfers data digitally using a proprietary wireless sensor protocol. Other devices operating in this frequency band include computer networks, microwave ovens, cordless phone sets and other WiFi enabled devices.

Despite all this competing radio activity the Noraxon DTS System is able to discern its particular information from all the surrounding radio traffic. Reliable transmission depends on good signal quality. Signal quality will fall with extended distances between the DTS Receiver and the DTS EMG Sensors. Obstructions (walls, metal structures, trees, etc.) between the DTS Receiver and the DTS EMG Sensors will also lower the signal quality.

While the DTS systems are quite immune to interference, they do transmit a deliberate radio signal that could affect nearby sensitive equipment. Users should always be aware of this possibility. In a similar manner, although the energy level of the radio is considered harmless to human beings, it is still prudent to minimize exposure.

Finally, although available worldwide, each country places certain restrictions on the operation of radios in the 2400 MHz ISM band. These restrictions include allowable transmitter power levels and broadcast frequencies.

Setting the Sensor RF Channel

The Sensor RF Channel is the frequency used for communication between the DTS Receiver and the EMG Sensors. Typically, the default option of RF Channel “A” (as set inside MR3 or in the receiver itself), works well. However, sometimes there is significant WiFi traffic in the area that may affect the data transmission between the DTS Receiver and the EMG Sensors.

If there is too much traffic on the selected RF Channel, significant data loss may occur. With the DTS Lossless EMG sensors, the data lost due to interference is stored on the sensor until the recording is ended and it can be resent. To avoid data loss, changing the RF Channel to another frequency may solve the problem.

If the RF Channel needs to be changed, select a different channel letter in the DTS Receiver Settings in MR3 and take another measurement to determine if the data loss problem is resolved.

If data loss is still a problem, please refer to Appendix A for instructions to select another RF Channel. Appendix B shows the actual frequency of each Sensor RF Channel. This information may be helpful in determining the best Sensor RF Channel.

Section 13: Service and Repair

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 DTS Lossless EMG sensor.

Submitting Service Requests

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

http://www.noraxon.com/support-resources/service-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.

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.

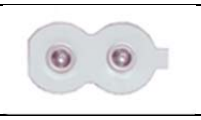
Send the equipment **postage prepaid** and **insured** to the address below. Include the RMA Number on the shipment label. Mark the package “Goods to be repaired – Made in USA” to avoid unnecessary customs charges. (Beware listing a Customs or Insurance value of $5,000.00 USD or more will result in a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

Section 14: Spare Parts and Consumables

Consumable Items

Part No.	Image	Description
272		Dual electrodes 8 per pouch or 200 per box
542C		Double sided tape for attaching DTS sensors, 504 per package

Replaceable Items

Part No.	Image	Description
542AP		EMG Lead set, 3 inches with pinch attachments
542AS		EMG Lead set, 3 inches with snap attachments
542AX		EMG Lead set, 7 inches with pinch attachments
BP7		Replacement battery for DTS Sensors
ES2		Elastic strap, 36 inches long (cut to length) for securing DTS sensors

Section 15: Taking Product out of Operation

Disposal of Equipment and Batteries

The DTS Lossless EMG Sensors contain Li-Polymer batteries, which may be hazardous if disposed of incorrectly. Please check with the governing authorities in your location before disposing of the DTS Lossless EMG sensor and its contents.

Section 16: Specifications of the Product

Expected Useful Lifetime

The DTS EMG sensors operate with a rechargeable Lithium Ion battery, as do all DTS Sensors. The battery capacity will decline with ongoing use and require replacement after 300+ discharge/charge cycles to preserve the device's rated 8 hours of operating time.

Dimensions and Weight

- EMG Sensor Dimensions
  1.34" L x 0.95" W x 0.55" H (3.4 cm x 2.4 cm x 1.4 cm)
- EMG Sensor Weight: Less than 14 g.

Performance Characteristics

Output & Transmission Frequency (Depending on country)

- Up to 2.5 mW (depending on country allowance)
- DSSS 2403-2472 MHz on (up to) 24 selectable radio channels

EMG Preamplifier Leads

- No notch (50/60 Hz) filters are used
- 1st order high-pass filters set to 10 Hz +/- 10% cutoff
- Baseline noise < 1 uV RMS
- Input impedance > 100 Mohm
- CMR > 100 dB
- Input range: +/- 6.3 mV
- Electronic Gain: 200
- Overall Gain: 500
- Measurement Function Accuracy: +/- 2uV_{RMS} (EMG)
- Sensor operation up to 8 hours on a fully charged battery (recharge time 3 hours)
- Snap-style or Pinch-style terminal electrode connections

548 Lossless EMG Sensors

- 16 bit resolution
- Selectable Sample Rate: 1500Hz or 3000Hz
- Selectable low-pass cutoff: 500Hz, 1000Hz or 1500Hz
- Selectable delay from 36 ms to 312 ms

Energy Consumption, Condition of Use

- Sensors are powered by a rechargeable Lithium Ion battery

Environmental Conditions for Storage and Transport

- Ambient Temperature: -40C to +70C
- Relative Humidity: 10% to 100%
- Atmospheric Pressure: 500hPa to 1060hPa

IP (Ingress Protection) Rating

The DTS EMG device enclosures have a low ingress protection rating (IP20). The DTS Sensors are not waterproof. Care must be taken to avoid exposure to all liquids. Heavy perspiration may present problems if the DTS Sensors are secured to bare skin with an over wrap of tape or elastic belting. In such cases it is advisable to first add adsorptive material or cloth over the DTS Sensor before covering the sensor with tape or elastic bands.

Section 17: Technical Information

Block Diagram

Model 548 DTS EMG

Coming Soon…

Theory of Operation

The DTS wireless systems are based on a pre-certified transceiver module. This radio module operates in the 2.4 GHz bands with an output power level of 1 mW and is based on a Wireless USB product by Cypress Semiconductor.

Part 548 DTS Lossless Transmitter (EMG Sensor)

Each DTS lossless transmitter module (part #548) incorporates one transceiver module together with an EMG preamplifier / data acquisition motherboard. The 548 is powered by one 382030 battery (190maH). Each transmitter module is identified by a unique serial number.

The EMG module has 3 patient contact points (applied parts). Two points are standard snap receptacles for attachment to disposable EKG style electrodes. The snap wires are removable. The third patient contact point is a metal disk on the bottom of the EMG sensor enclosure. This disk is intended to be in contact with bare skin. Double-sided tape secures the sensor to the patient.

The opposite end of the transmitter has two recessed contact pads for recharging its battery. To recharge the battery the DTS transmitter module is placed inside a charging station. The EMG sensor cannot be applied to the patient and charged at the same time.

Electro-Magnetic Compatibility Tables

Guidance and manufacturer's declaration – electromagnetic emissions		
The DTS system is intended for use in electromagnetic environment specified below. The customer or the user of the DTS system should assure that it is used in such an environment.		
Emissions Test	**Compliance**	**Electromagnetic environment - guidance**
RF emissions CISPR 11	Group 2	The DTS system must emit electromagnetic energy in order to perform its intended function. Nearby electronic equipment may be affected.
RF emissions CISPR 11	Class A	The DTS system is suitable for use in all establishments other than domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic Emissions IEC 61000-3-2	Not applicable	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Not applicable	

Guidance and manufacturer's declaration – electromagnetic immunity			
The DTS system is intended for use in electromagnetic environment specified below. The customer or the user of the DTS system should assure that it is used in such an environment.			
Immunity Test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 64000-4-2	±6 kV contact ± 8 kV air	±6 kV contact ±6 kV air	Device user should avoid touching subject and sensor probes while a measurement is active.
Electrical fast transient/burst IEC 61000-4-4	±2kV for power supply lines ±1kV for input/output lines	±2kV for power supply lines Not applicable	For battery charging mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1kV differential mode ±2kV common mode	±1kV differential mode ±2kV common mode	For battery charging mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5 % U_T (>95 % dip in U_T) for 0,5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) For 25 cycles <5 % U_T (>95 % dip in U_T) For 5 sec	Not applicable to operation Not applicable to operation Not applicable to operation Not applicable to operation	For battery charging mains power quality should be that of a typical commercial or hospital environment.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE U_T is the a.c. mains voltage prior to application of the test level.			

Guidance and manufacturer's declaration – electromagnetic immunity

The DTS system is intended for use in electromagnetic environment specified below. The customer or the user of the DTS system should assure that it is used in such an environment.

Immunity Test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
			Portable and mobile RF communications equipment should be used no closer to any part of the DTS system, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance**
Conducted RF IEC 61000-4-6 (Charging System)	3 Vrms 150 kHz to 80 MHz	3Vrms	$d = 1.2\sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2,5 GHz	3V/m	$d = 1.2\sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ 800 MHz to 2,5 GHz where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and *d* is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,[a] should be less than the compliance level in each frequency range.[b] Interference may occur in the vicinity of equipment marked with the following symbol: 

NOTE 1 At 80 MHz and 800 MHz, the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

[a] Field strengths from fixed transmitters, such a base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the DTS system is used exceeds the applicable RF compliance level above, the DTS system should be observed to verify normal operation. If abnormal operation is observed, additional measures may be necessary, such as reorienting or relocating the DTS system.

[b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Recommended separation distances between portable and mobile RF communications equipment and the DTS EMG Sensor

The DTS system is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the DTS system can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the DTS system as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter W	**Separation distance according to frequency of transmitter** m		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	**80 MHz to 800 MHz** $d = 1.2\sqrt{P}$	**800 MHz to 2,5 GHz** $d = 2.3\sqrt{P}$
0,01	0.12	0.12	0.23
0,1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters rated at a maximum output power not listed above, the recommended separation distance *d* in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1 At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

SECTION 18: APPENDICES

Appendix A – Interference Between WiFi and DTS Radio Frequency Channels

Because any neighboring WiFi radios and the DTS System share the 2.4GHz frequency spectrum there is the possibility that the RF channels may overlap and interfere with each other resulting in lost data. To avoid interference, use the chart below to identify DTS System RF and WiFi channels that do not interfere with each other. For example, the DTS System RF Channels starting with the letter “A” do not interfere with WiFi Channels 4-11. The DTS System RF Channel Set D does not interfere with WiFi channels 1-4 and 11.

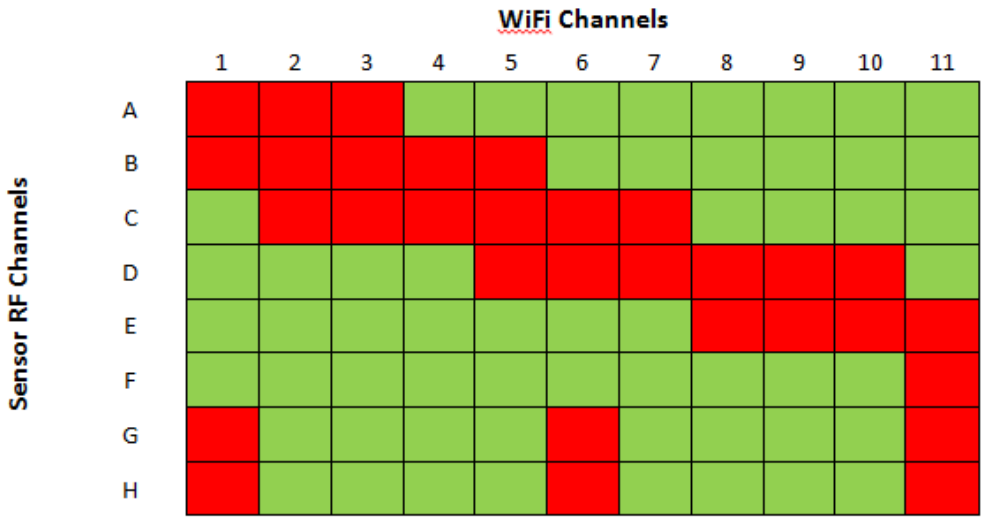
If you are aware of WiFi activity in the vicinity of the DTS system, it is helpful to identify which combinations of the eleven WiFi channels are being used. Once this is determined, use the chart below to select a DTS channel set (A-F) that avoids, as much as possible, WiFi channels that share the same radio frequencies.

Instructions to change the RF channel:

Use a network sniffer program to determine which WiFi RF channels are being used in your area. InSSIDer” is a network sniffer with a graphical display that is available as a free download from the Noraxon website under “Drivers and Firmware”:

http://www.noraxon.com/support-resources/

This network sniffer is compatible with Windows XP, Vista and 7 (32 and 64-bit). You can use most 802.11 a/b/g wireless adapters, e.g. PC internal WiFi, PCMCIA card Wireless network adapter and USB Wireless network adapter, to scan the networks in the area. Once the busy WiFi channels are identified, change the DTS Sensor RF Channel to avoid those WiFi channels.



Note: G and H will not work is any of the channels above in red are being used.

Appendix B – Sensor RF Channel Frequencies

The EMG Sensors and Biomechanical Sensors operate on a RF channel. The RF Channels (A-H and A1-F4) are assigned to the RF frequencies according to the table below.

Channels A-H for use with the TeleMyo DTS Belt Receiver and Desktop Receiver

RF Channel	Frequency (GHz)
A	2.400-2.409
B	2.415-2.424
C	2.427-2.436
D	2.439-2.448
E	2.451-2.460
F	2.463-2.472
G	Various frequencies
H	Various frequencies

Appendix C – Use of Disposable Electrodes

While the DTS EMG Sensors can operate with reusable electrodes, they are typically used with disposable surface electrodes. Any good quality silver/silver chloride electrode is acceptable. Noraxon provides several types of quality disposable electrodes for a wide variety of Surface EMG applications. Other electrodes may be used, but it is recommended that any electrodes used with the DTS EMG sensors satisfy the requirements for standard ANSI/AAMI EC12-1991 Disposable ECG electrodes.

- Because disposable electrodes have a shelf life, it is important not to use expired parts.
- Bulk disposable electrodes come packaged in a sealed container or bag.
- The expiration date can be found printed on the package container.
- After the sealed bulk container is opened, the remaining electrodes should be used before their gel begins to dry out.
- Always keep the remaining electrodes in their bulk package until they are used.
- If the electrode package does not seal itself, closing the package with tape or using a zippered plastic bag is recommended.
- Do not store the electrode package in the direct sun, as this will accelerate drying.
- Avoid using electrodes that are randomly found lying outside of their bulk packaging as their expiration date is uncertain and their gel has been exposed to accelerated drying.

Be aware that when disposable electrodes are removed, some individuals may notice a faint red skin discoloration over the site previously occupied by the electrode. This skin discoloration is typically benign and temporary and may be due to a mild allergic reaction to the adhesive or simply be a slight abrasion caused by peeling away the tape. It will usually disappear within 24 hours**.**

Noraxon discourages any attempt to reuse a disposable electrode, even if it is simply pulled off to slightly reposition the electrode's muscle placement. Some of the electrode gel may remain on the original site and the EMG signal may be affected. Also, sometimes the electrode adhesive may not adhere to the skin as well when it is reapplied. Noraxon strongly recommends against the use of dried out electrodes that are re-wetted with electrode gel.

Electrode Application Guidelines and Facts

1. If the subject has a fair amount of hair at the electrode application site, the hair should be clipped. Shaving is not necessary and may irritate the skin.
2. The electrode application site should be clean and dry. The preferred method of cleaning is with soap and water plus drying the skin with a dry cloth. Dry skin contributes to good electrode adhesion and good trace quality.
3. Cleaning with isopropyl alcohol should be limited to situations where electrode adhesion is an issue (diaphoresis, excessively oily or lotion covered skin), since it may dehydrate the skin thereby causing skin impedance to increase. If alcohol is used, allow it to dry prior to electrode application.
4. Noraxon recommends attaching the lead wire to the electrode prior to placing the electrode on the skin. This will eliminate the potential for discomfort if snap lead wires are pressed onto the electrode after the electrode has been applied. It will also prevent the electrode gel from seeping out. Additionally, this method will prevent unattached leads from coming into accidental contact with other conductive objects.
5. Electrode application sites may need to be abraded to lower the skin impedance. Fine sand paper or electrode prep gel, e.g. NuPrep, can be used to abrade the skin.

6. Electrodes are the weak link in the EMG measurement chain. Lack of proper attention to electrode quality or site preparation is by far the most common cause of inferior recordings.
7. It may take up to 5 minutes for disposable electrodes to fully stabilize electrically once applied to the skin. If extremely critical or precise measurements are intended, the electrodes should be applied several minutes in advance of the recording.

Appendix D – Radiation Exposure Information Regarding Use of DTS Sensors

Each DTS sensor contains a radio frequency transmitter. The radiated power emitted from each individual DTS sensor is very low. To put this in perspective, at full power each DTS sensor transmits at less than 0.1% of the power of a typical active cell phone. Radiation exposure from a single DTS sensor is thus extremely low.

The DTS sensors are designed to operate at two different power levels in order to keep the already very low levels of radiation exposure to an absolute minimum. The DTS sensors activate their higher power level only during periods of actual data collection. During idle times (at setup and in between actual measurements) the DTS sensors reduce their radiated power to an even lower level (less than 0.01% of the power of a typical active cell phone).

The effects of non-ionizing radiation on biological tissue are still being studied and published 'safe levels' of exposure are subject to review. Today, cell phone usage is widespread and declared 'safe,' although the long-term cumulative effect of cell phone usage has yet to be determined. In contrast, the DTS sensors operate at power levels 1000 to 10,000 lower than typical cell phones while limiting exposure to a single episode over a brief time interval.

Because there can be multiple DTS sensors applied in intimate contact with the body, their sum total collective radiation effect may be questioned. Based on comparative power levels, a full complement of 4 DTS sensors emit a combined (distributed) radiation level still several orders of magnitude lower than that of a typical cell phone, which radiates all of its energy from one focal point (next to the person's head).

At present, Noraxon identifies no restrictions on use and placement of the DTS sensors on any portion of the human body. The DTS sensors operate at radio frequencies known to effect older style pacemakers. Because the effects are not known at this time, Noraxon advises against using the DTS system on anyone with an implanted pacemaker.

In summary it is prudent to keep in mind that due to biological diversity, certain individuals may have higher sensitivity to radiated emissions. Although it has never been known to occur, the use of the DTS system should be stopped if the person being monitored reports any unusual sensations.

Appendix E – Radio Regulatory Statements

FCC Statement

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Caution: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device contains modules with FCC ID: Coming soon...

Industry Canada Statement

This product contains Unigen Wireless USB module Canadian Cert No IC: Coming soon…