Science Division
Thought Technology Ltd

MyoScan™
Thought
Technology Ltd.
Model 9503

A5015

MyoScan Sensor T9503M

Measure **More**
Sense **Better**

Technical Note Series

MYOSCAN EMG SENSOR (T9503M)

- Type BF Equipment
- Internally powered equipment
- Continuous operation

WARNING

- If the sensor is interfaced to non-Thought Technology devices without the use of a TT Sensor Isolator SE9405AM, an elevated risk of electrical shock may be present. In particular, if a client-connected sensor is connected to any line powered device(s) or equipment(s), it will be the responsibility of the qualified user to ensure the electrical safety in the setup.
- Explosion Hazard; Do not use in the presence of a flammable anesthetic mixture with air, or with Oxygen or Nitrous Oxide.
- Not to be immersed in water.

CAUTION

- Connection of customer supplied circuits to Thought Technology sensor products has the potential to damage the sensor. Such damage is not covered by warranty.

ATTENTION

- For research only. Not for use in diagnostic procedures.
- To prevent voiding warranty by breaking connector pins, carefully align white guiding dot on sensor plug with slot on sensor input.

MAINTENANCE AND CALIBRATION

- Wipe with a clean cloth
- Factory testing and calibration ensure equipment accuracy and frequency response.
- No preventative inspections required;

STORAGE

- Temperature -23C – +60C
- Humidity (non-condensing) 10% – 90%
- Atmospheric pressure 700 – 1060 KPa

TRANSPORTATION

- Temperature -23C – +60C
- Humidity (non-condensing) 10% – 90%
- Atmospheric pressure 700 – 1060 KPa

The MyoScan line of sensors is differential amplifiers of surface electromyography (sEMG). This means that whatever electrical activity is common to both sites is rejected, and what differs is amplified.

Surface EMG is a non-invasive measure of underlying muscle activity by detecting and amplifying tiny electrical impulses generated by muscle fibers when they contract.

The sensor detects and averages a complex addition of impulses from many muscle fibers within the recording area of the sensor, contracting at different moments and at different rates. The number of muscle fibers that are recruited, and the rate of firing (contraction) of each fiber, during any given contraction depends on the force required to perform the movement. Because of this, the intensity (amplitude) of the resulting electrical signal, under certain conditions, is proportional to the strength of the contraction.

For more information on SEMG and its applications, the following free books are available for download:
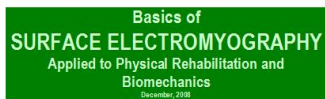
Basics of Surface Electromyography
Applied to Psychophysiology
www.thoughttechnology.com/semg.htm

The Basics of Surface Electromyography
Applied to Physical Rehabilitation and Biomechanics
www.thoughttechnology.com/semgbasic.htm

SKIN PREPARATION

Although it is possible to use the MyoScan sensor with dry electrodes and no skin preparation, doing so increases the chance that artifacts will distort the signal. As a general rule, skin preparation enhances signal quality, reduces artifacts and minimizes the need for post-recording artifact rejection.

At a minimum, make sure that before applying the EMG electrodes the skin surface is clean and dry by rubbing it with an alcohol pad. However, to significantly reduce artifacts, we recommend abrading the skin with an abrasive cream, such as NuPrep (10-30), to remove dead skin. If necessary, shave excess body hair.

SENSOR PLACEMENT

For best results, silver-silver chloride electrodes are recommended for electrical contact between skin and sensor. The single-use Triode electrode (T3402M) should be your first choice. It can be snapped directly on the sensor head, which makes it very easy to use and quick to position. The signal is then amplified right on the muscle site, which dramatically increases the SNR (Signal-to-Noise Ratio) and therefore limits pollution of the SEMG signal by surrounding electromagnetic fields and movement artifacts generated by wires being pulled.

The distance between the electrodes is also optimal (standard 2cm) for avoiding or limiting muscle crosstalk.

Conductive gel is recommended for optimal electrode-skin contact. The gel can be applied to the center (on the grey area only) before applying to the skin. Make sure the electrodes are placed firmly on the skin.

The UniGel electrodes (T3425) provide total freedom in term of placement. Their small size also allows placement on very tiny muscles (such as SCM). They are not attached together, which prevents them from moving on the skin when positioned on muscles with great deformation while contracting. These electrodes are pre-gelled and so do not require the addition of conductive gel, which reduces the time of preparation for this type of electrode. An EMG extender cable (T8720M) must be connected between the electrodes and the sensor.

TECHNICAL SPECIFICATIONS

Size (approx.)	37 mm x 37 mm x 12 mm (1.45" x 1.45" x 0.45")
Weight (approx.)	15g (0.5 oz)
Input Impedance	$\geq 10^{12}\Omega$ in parallel with 10pF
Signal Input Range	$0 - 2000\ \mu V_{RMS}$
Sensitivity	$< 0.1\ \mu V_{RMS}$
CMRR	> 130 dB
Channel Bandwidth	10 Hz-1 kHz
Signal Output Range	$0 - 1.0\ V_{RMS}$
Input / Output Gain	500
Supply Voltage	7.26 V ($\pm$0.02 V)
Current Consumption	0.7 mA ($\pm$0.25 mA)
Accuracy	$\pm 0.3\ \mu V_{RMS}$ plus $\pm$4% of reading @25°C to 30°C

ELECTRICAL COMPATIBILITY

The MyoScan sensor is designed to coexist with other Thought Technology bio potential sensors such as T9306 (or T9307) EKG sensor, T9305 EEG sensor, T7680 EEG-Z3 sensor, or SA9309M Skin Conductance sensor.

To ensure correct MyoScan sensor operation, if sensors from another manufacturer are in the same electrical circuit and connected to the same subject, their electrodes must function at a voltage within the specified operating bias range, 1.0 to 3.0 volts above sensor ground. To check whether another sensor is interfering with the MyoScan sensor operation, connect and disconnect the other sensor from the subject, and note whether this causes a change in the MyoScan sensor signal level, or whether connection of the other sensor appears to cause any signal artifacts in the EMG signal.

INTERFACING WITH 3RD PARTY DATA ACQUISITION SYSTEM

Recommended Connectivity for Electrical Safety

To ensure electrical safety in the user setup, Thought Technology recommends the use of TT Sensor Isolator SE9405AM when interfacing client connected sensor(s) to line powered equipment(s) or devices.


The TT Sensor Isolator SE9405AM is an interface device providing medical grade electrical isolation between the client connected sensors and the acquisition system. It provides the equivalent of Two Means of Client Protection under IEC 60601-1, and supplies battery power to the sensors. Using this device ensures Thought Technology sensors are safely interfaced to the analog inputs of line-powered systems such as computers with DAQ cards.

Note that this device isolates only between sensors and the DAQ interface, not between different sensor channels.

The TT Sensor Isolator can interface up to 4 sensors to a DAQ card. TT Sensor Isolator can be connected to the DAQ card in two ways:

- via two stereo jacks, or
- via a DB-15 connector; a BNC interface cable (SA9409BNC) or a pigtail cable (SA9409PGT) can be provided with the unit.
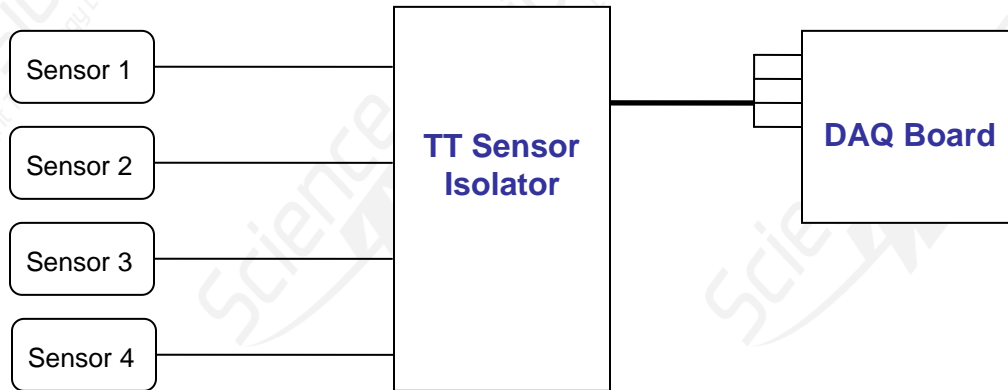
For more detailed information on the Sensor Isolator 4∞, consult the Thought Technology Science Division website or contact the sales department or an authorized distributor.

Direct Connectivity for Electrically Isolated Systems

The following notes are provided for qualified users to directly interface Thought Technology sensors with external systems.

WARNING: If the sensor is interfaced to non-Thought Technology devices without the use of a TT Sensor Isolator SE9405AM, an elevated risk of electrical shock may be present. In particular, if a client-connected sensor is connected to any line powered device(s) or equipment(s), it will be the responsibility of the qualified user to ensure the electrical safety in the setup and to ensure that the device or equipment provides sufficient isolation.

To interface with a sensor, a single sensor cable may be cut in half. Both sides can then be used to make custom interfacing cables by stripping the outer insulation of each required conductor. The sensor cable contains 4 color coded conductors. The table below shows the color coding and pin connector assignment.

Pin	Color code	Function	Note
1	metal (shield)	ground	Signal and power ground, connection required.
2	yellow	auxiliary (sensor ID)	No connection required.
3	green	signal	Sensor output signal
4	red	sensor power	Supply voltage, +7.26V referenced to ground. Note: sensor performance may be sensitive to supply voltage.
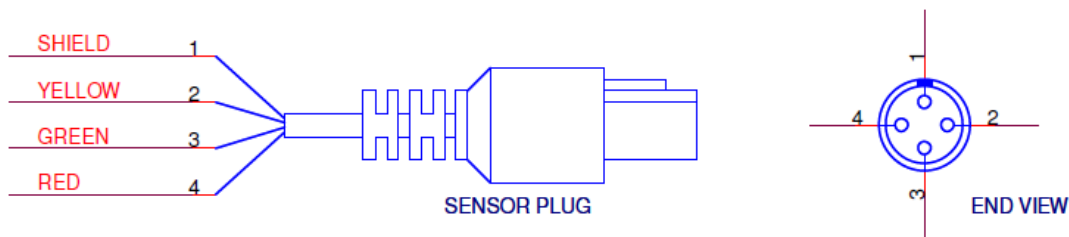
Notes:

1. The nominal supply voltage for this sensor is 7.26V. The sensor can safely be used with a supply voltage of up to 9V.

2. The output of the MyoScan sensor is AC (capacitive) coupled. Therefore, in order to set the DC level of the signal when connected to a DAQ system, it is usually necessary to connect a DC bias resistor between the signal (pin 3, green wire) and ground (pin 1, shield wire). A typical value for this resistor is 2.2 Mega ohms.

   If no resistor is connected, the DC signal level may be unstable. The signal may drift upward or downward and saturate the DAQ input. This condition will result in an unusable signal but will not typically cause any equipment damage.

Recommended Specifications for DAQ Hardware

- Recommended resolution of 0.15mV (16-bit ADC over 10V span) or better

- Minimum input range:

  - If connected via SE9405AM Sensor Isolator, choose 0-5V (unipolar) or ±5V (bipolar)

  - If directly connected to DAQ, choose ±5V (bipolar).

Simplified Transfer Function

$$V_{out} = 500V_{in} + V_{dc\_offset}$$

Conversion of measured input voltage (raw EMG signal) to sensor output voltage (to DAQ)

$$V_{in} = \frac{V_{out} - V_{dc\_offset}}{500}$$

Conversion of sensor output voltage (to DAQ) to measured input voltage (raw EMG signal)

Notes:

- The high pass effect of the sensor's AC is not shown in the Transfer Function. The function is accurate for frequency components within the specified bandwidth, and should adequately represent the scaling of an EMG signal.

- V_{dc_offset} depends on the chosen user connectivity:
  - if TT Sensor Isolator is used, V_{dc_offset} is 2.8V.
  - if directly connected to DAQ, V_{dc_offset} is 0V.

The table below lists Thought Technology accessories for the MyoScan.

Accessory	Product Number
	T8720M EXTENDER CABLE 21in, 53cm
	T3402M – Triode electrode (single use): The Triode should be your first choice. It can be snapped directly onto the sensor head, which makes it very easy to use and quick to position. The signal is then amplified right over the muscle site, which dramatically increases the SNR (Signal-to-Noise Ratio) and limits contamination of the SEMG signal from surrounding electromagnetic fields and from movement artifacts generated by wires being pulled.
	T3425 – UniGel electrodes (single use): UniGel electrodes provide complete placement freedom. Their small size allows placement on very tiny muscles (such as SCM). Since they are not attached together, they may adhere better at sites where the skin undergoes great deformation while underlying muscles contract. UniGel electrodes are also pre-gelled and do not require the addition of conductive gel, which can reduce preparation time. An EMG Extender Cable (T8720M) connects these electrodes to the sensor.
	SA2306 - EMG Headband (single client re-use): The EMG Headband enables easy EMG measurement from the forehead (frontalis), which is a common EMG placement for stress/relaxation biofeedback. The headband accommodates 3 snap electrodes (Ag-AgCl) that work with the EMG Extender Cable (T8720M).