

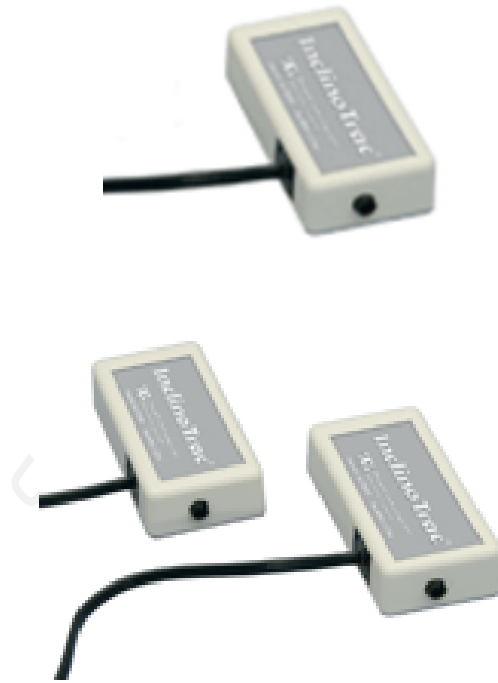


**INCLINOTRAC T7650
& DUAL-INCLINOTRAC T7655**

**Measure More
Sense Better**

Technical Note Series

INCLINOTRAC (T7650) & DUAL-INCLINOTRAC (T7655)



IMPORTANT OPERATION INFORMATION



- Type BF Equipment
- Internally powered equipment
- Continuous operation



WARNING

- 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

PRODUCT OVERVIEW

InclinoTrac is a single inclinometer that measures the inclination angle relative to the ground.

Dual-InclinoTrac is a dual inclinometer that measures relative angle (between back and head, for instance).

InclinoTrac and Dual-InclinoTrac use solid-state micro-machined sensors and microprocessor technology to provide rapid settling and high resolution (0.1°) and accuracy (1.0°). They are the ideal choice for Range of Motion (ROM) assessment.

They can be used in various ways: simply put on the examinee, or attached with straps on either the examinee or the workout machine.

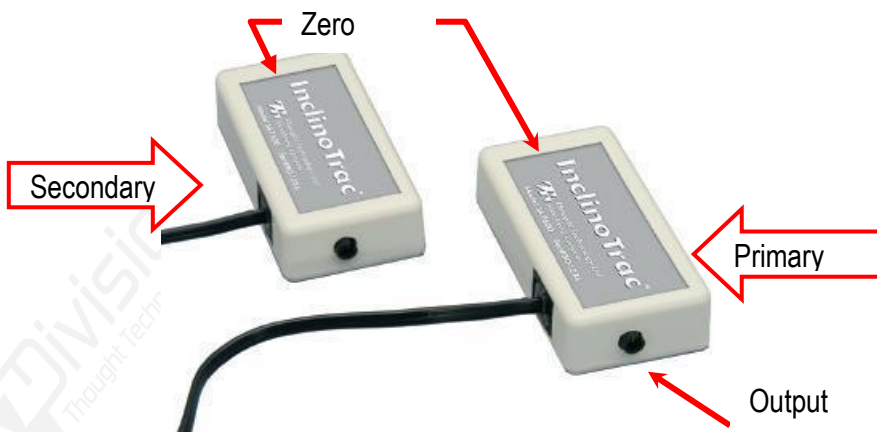


OPERATING PRINCIPLES

This section gives recommendations for ensuring accuracy and consistency of measurement.

Being familiar with the tools

The single inclinometer is called InclinoTrac. The dual inclinometer is called Dual-InclinoTrac (see picture below), and consists of two InclinoTracs connected together.

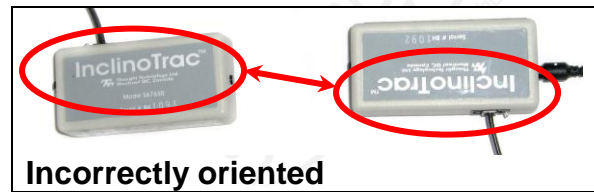
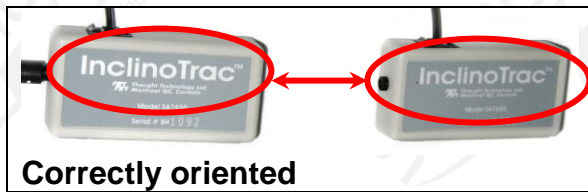


Dual-InclinoTrac

The plug at one end is used to connect the inclinometer to the DAQ. The Zero button at other end is used to mark the neutral zero.

Two devices are connected together by a cable. The connector is on the side of the device (see picture above). The inclinometer connected to the DAQ is then called the “**primary**”. The other one is called the “**secondary**”.

The dual inclinometer outputs the angle between the primary and secondary devices. The primary and secondary must be oriented so that the “InclinoTrac” labels face the same way. Either zero button can be used to mark the neutral position.



Calibrating the Inclinometer (zeroing)

Make sure your inclinometer is properly calibrated. The inclinometer must be recalibrated if you press the zero button and the screen does not display the value "0" (zero).

Straps or No Straps?

Straps were designed to be used for dynamic ROM assessment, ROM therapy and for the static ROM assessment of the extremities. Manually holding the inclinometers is strongly recommended in the case of static spine assessment. However, straps may be used to assist you in holding the inclinometers (on the head, for instance) to avoid having them slip, or when you assist the examinee in a passive motion.

If you manually handle the inclinometers, make sure you apply a constant pressure throughout the range of motion.

If you use a strap to attach the inclinometer, make sure that the strap is secured and cannot move against the body part during the motion.

Also check that the inclinometer is firmly fixed to the strap. To do this, press it against the strap and twist it sideways two or three times, so that the hooks and loops are thoroughly enmeshed.



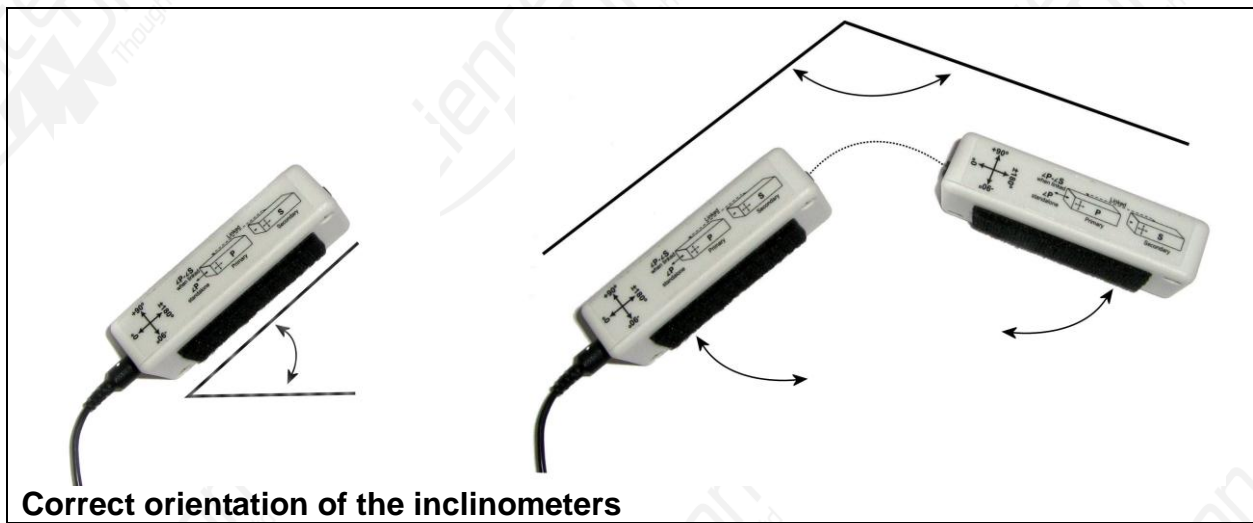
Twist the inclinometer sideways two or three times while holding it firmly against the strap

This will ensure the inclinometer keeps the same orientation against the body part in motion and does not slip from its original position.

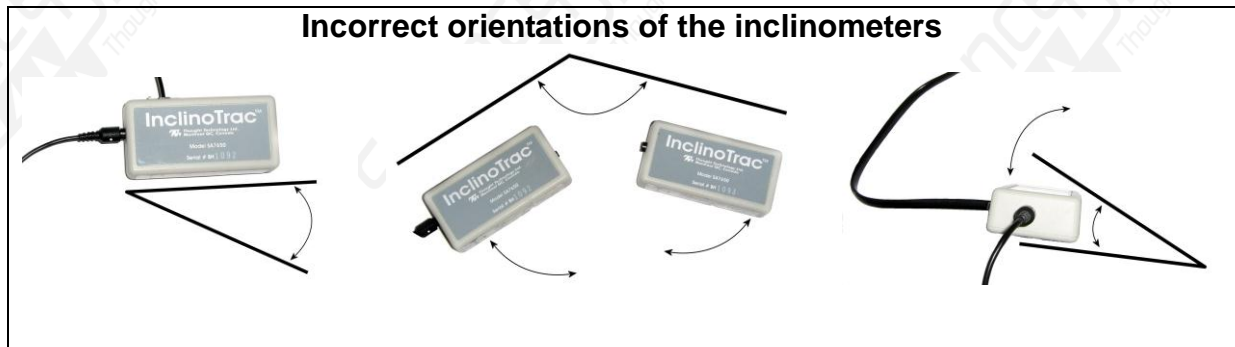
Proper orientation

The guide suggests positions of the inclinometers for each range of motion. You may find that different positions are more convenient for you or the examinee.

However, you have to pay attention to the orientation of the inclinometers. The **first motion** of the two (for instance, “flexion” in “flexion/extension”) must give a **positive angle** and the **second motion** (“extension”) a **negative angle**. The system will rectify the angles in the report according to this rule.



Always keep the side with the inclinometer plug within 45° of the vertical plane and parallel to the plane of motion.



SENSOR PLACEMENT

This section proposes typical sensor placements with AMA normative data (Andersson Gunnar B. J. & Cocchiarella Linda. (2007). *Guides to the Evaluation of Permanent Impairment, 6th Edition*. American Medical Association).

SROM – Cervical Spine

Flexion/Extension



Type of Inclinometer:	Dual-Inclinometer		
Examinee Position:	Seated on a chair or standing upright		
Inclinometer Position:	Primary back on T1 parallel to the spine; secondary back on the top of the head, perpendicular to the shoulders.		
Normal ROM:	Flexion	50°	Validity of the trials: Within 5° or 10% of another
	Extension	60°	

Left/Right Lateral Flexion



Type of Inclinometer:	Dual-Inclinometer		
Examinee Position:	Seated on a chair or standing upright		
Inclinometer Position:	Primary side on T1 parallel to the spine; secondary on the head		
Normal ROM:	Left Lateral Flexion	45°	Validity of the trials: Within 5° or 10% of another
	Right Lateral Flexion	45°	

Left/Right Rotation

Neutral Position**Left Rotation****Right Rotation**

Type of Inclinometer:	Dual-Inclinometer		
Examinee Position:	Knees and hands on the floor, head horizontal, or in supine position		
Inclinometer Position:	Primary side on T1 perpendicular to the spine; secondary on the head		
Normal ROM:	Left Rotation	80°	Validity of the trials: Within 5° or 10% of another
	Right Rotation	80°	

SROM – Thoracic Spine**Flexion/Extension****Neutral Position****Flexion****Extension**

Type of Inclinometer:	Dual-Inclinometer		
Examinee Position:	Standing upright		
Inclinometer Position:	Primary on T12 and secondary on T1; both parallel to the spine.		
Normal ROM:	Flexion	60°	Validity of the trials: Within 5° or 10% of another
	Extension	10°	

Left/Right Rotation



Type of Inclinometer:	Dual-Inclinometer		
Examinee Position:	Standing position, bending forward		
Inclinometer Position:	Primary on T12 and secondary on T1; both perpendicular to the spine.		
Normal ROM:	Left Rotation	30°	Validity of the trials: Within 5° or 10% of another
	Right Rotation	30°	

SRM – Lumbar Spine

Flexion/Extension



Type of Inclinometer:	Dual-Inclinometer		
Examinee Position:	Standing upright		
Inclinometer Position:	Primary on S1 and S2, secondary on T12; both parallel to the spine.		
Normal ROM:	Flexion	50°	Validity of the trials: Within 5° or 10% of another
	Extension	20°	

Left/Right Lateral Flexion

Neutral Position



Left Lateral Flexion



Right Lateral Flexion

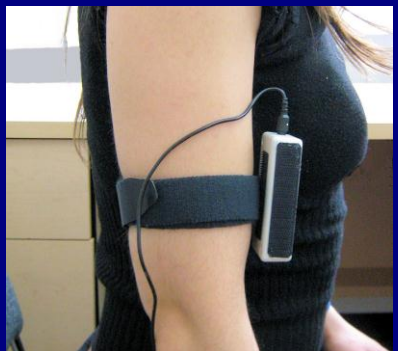


Type of Inclinometer:	Dual-Inclinometer		
Examinee Position:	Standing upright		
Inclinometer Position:	Side of primary on S1 and S2, side of secondary on T12; both parallel to the spine, front facing left.		
Normal ROM:	Left Lateral Flexion	30°	Validity of the trials: Within 5° or 10% of another
	Right Lateral Flexion	30°	

SROM – Shoulder

Flexion/Extension

Neutral Position



Flexion



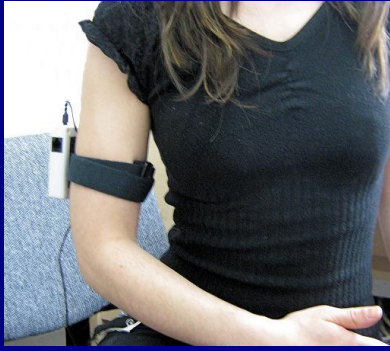
Extension



Type of Inclinometer:	Single-Inclinometer with strap		
Examinee Position:	Seated, uninvolved shoulder flexed 90°.		
Normal ROM:	Flexion	180°	Validity of the trials: Within 5° or 10% of another
	Extension	50°	

Abduction/Adduction in 30° Flexion

Neutral Position



Abduction



Adduction



Type of Inclinometer:	Single-Inclinometer with strap		
Examinee Position:	Seated, uninvolved shoulder abducted 90°. For adduction: involved shoulder flexed 30°.		
Normal ROM:	Abduction	160°	Validity of the trials: Within 5° or 10% of another
	Adduction	30°	

External/Internal Rotation

Neutral Position



External Rotation



Internal Rotation

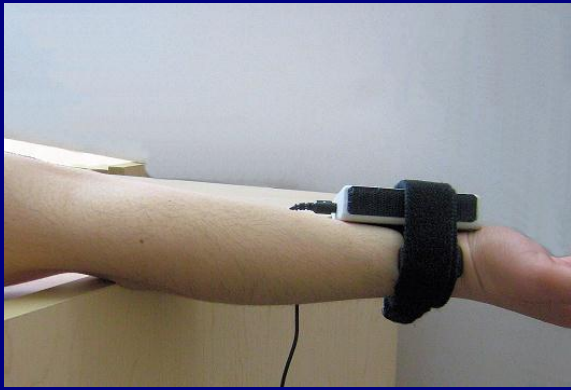


Type of Inclinometer:	Single-Inclinometer with strap		
Examinee Position:	Seated, shoulder abducted 90° and elbow flexed 90°.		
Normal ROM:	External Rotation	90°	Validity of the trials: Within 5° or 10% of another
	Internal Rotation	90°	

SROM – Elbow

Flexion/Extension

Neutral Position



Flexion



Type of Inclinometer:	Single-Inclinometer with strap		
Examinee Position:	Seated, or supine position with elbow stabilized on examining table.		
Normal ROM:	Flexion	135°	Validity of the trials: Within 5° or 10% of another
	Extension	0°	

SROM – Forearm

Supination/Pronation

Neutral Position



Supination



Pronation



Type of Inclinometer:	Single-Inclinometer		
Examinee Position:	Seated, elbow flexed 90°, uninvolved side abducted 90°.		
Normal ROM:	Supination	90°	Validity of the trials: Within 5° or 10% of another
	Pronation	90°	

**SROM – Wrist
Flexion/Extension**

Neutral Position



Extension



Type of Inclinometer:	Single-Inclinometer		
Examinee Position:	Seated, or with pronated forearm stabilized on examining table.		
Normal ROM:	Flexion	50°	Validity of the trials: Within 5° or 10% of another
	Extension	60°	

Radial/Ulnar Deviation

Neutral Position



Radial Deviation



Ulnar Deviation



Type of Inclinometer:	Single-Inclinometer		
Examinee Position:	Seated, or with forearm stabilized on examining table.		
Normal ROM:	Radial Deviation	20°	Validity of the trials: Within 5° or 10% of another
	Ulnar Deviation	30°	

SROM – Hip

Flexion/Extension

Neutral Position



Flexion



Extension



Type of Inclinometer:	Single-Inclinometer with strap		
Examinee Position:	For flexion: in supine position with pelvis and lower extremities stabilized on the table For extension: trunk and pelvis in prone position on the table, uninvolved hip in 90° flexion.		
Normal ROM:	Flexion	100°	Validity of the trials: Within 5° or 10% of another
	Extension	30°	

Abduction/Adduction in 30° Flexion

Neutral Position



Abduction



Adduction



Type of Inclinometer:	Single-Inclinometer with strap		
Examinee Position:	Side-lying on the table.		
Normal ROM:	Abduction	45°	Validity of the trials: Within 5° or 10% of another
	Adduction	30°	

External/Internal Rotation

Neutral Position



External Rotation



Internal Rotation



Type of Inclinometer:	Single-Inclinometer with strap	
Examinee Position:	Supine	
Normal ROM:	External Rotation 50° Internal Rotation 40°	Validity of the trials: Within 5° or 10% of another

SROM – Knee

Flexion/Hyperextension

Neutral Position



Flexion



Type of Inclinometer:	Single-Inclinometer with strap	
Examinee Position:	Prone, with foot vertical in rest position and knee beyond the end of the table.	
Normal ROM:	Flexion 150° Hyperextension 0°	Validity of the trials: Within 5° or 10% of another

SROM – Ankle

Flexion/Extension



Type of Inclinerometer:	Single-Inclinometer		
Examinee Position:	Prone, with foot vertical in rest position (beyond the end of the table)		
Normal ROM:	Flexion	40°	Validity of the trials: Within 5° or 10% of another
	Extension	20°	

TECHNICAL SPECIFICATIONS

Dimensions	32mm x 18mm x 71mm
Weight	26g
Range	± 180°
Accuracy (operated in vertically-oriented plane) ≤ 2.0° (dual mode, angle difference)	≤ 1.0° (standalone mode)
Output gain	4.44mV / degree inclination
Output voltage span	2.200 ± 0.8V
Power supply	7.26V
Current consumption, maximum	9.5 mA (standalone mode) 19.0 mA (dual mode)
Link cable	RJ-11, 2 pairs, reversed (this is not a standard telephone cable)

INTERFACING WITH 3RD PARTY DATA ACQUISITION SYSTEM

Recommended Connectivity for Electrical Safety

Thought Technology recommends the use of TT Sensor Isolator SE9405AM when interfacing client connected sensor(s) to line powered equipment(s) or devices.

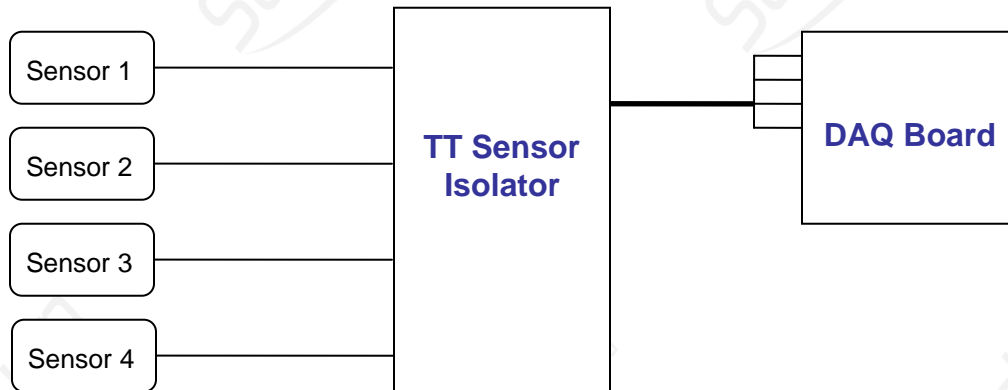


The TT Sensor Isolator SE9405AM is an interface device providing medical grade electrical isolation between the client connected sensors and the acquisition system. It provides the equivalent of Two Means of Client Protection under IEC 60601-1, and supplies battery power to the sensors. Using this device 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.



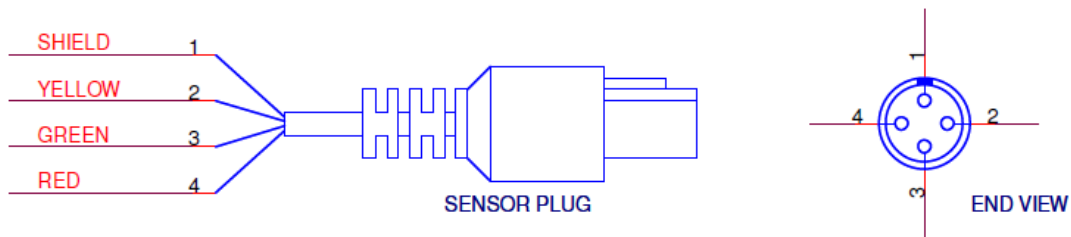
For more detailed information on the Sensor Isolator 4 ∞ , consult the Thought Technology Science Division website or contact the sales department or an authorized distributor.

Direct Connectivity for Electrically Isolated Systems

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

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.

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 $\pm 5V$ (bipolar)
 - If directly connected to DAQ, choose $\pm 5V$ (bipolar).

Simplified Transfer Function

$$\theta_{\text{deg}} = 225V_{\text{out}} - 495$$

Conversion of voltage [V] to output angle in degrees