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TRI-AXIAL ACCELEROMETERS

TSD109A and TSD109A-MRI (±2 g)

SS26LB, TSD109C3, and TSD109C2-MRI (±5 g)

SS34L and TSD109J1 (±200 g)

BN-ACCL3

Tri-Axial Accelerometers connect directly to BIOPAC hardware and require no additional amplification. They provide three outputs, each simultaneously measuring acceleration in the X, Y, and Z directions. They are the same size and can be used on any part of the body or on external equipment.

Tri-axial accelerometer uses 3 channel inputs

- ±**2 g** accelerometers are optimal for measuring fine motor movement, ballistocardiography, tremor, respiration, and other activities requiring high resolution measurements.
- ±**5 g** accelerometers are optimal for measuring accelerations when performing slow movements, such as walking.
- ±**200 g** accelerometers are optimal for measuring quick movements, such as swinging a tennis racket or high impact events commonly encountered in exercise physiology experiments.

The transducers can be used on any part of the body or attached to external equipment. The pliable and unobtrusive design conforms readily to body contours and includes a Velcro® strap for easy attachment.

For the TSD109C2-MRI: Strap the accelerometer on finger, wrist, toe, or foot. To minimize artifact associated with cable tugging, during movement activities, tape the sensor securely in place using TAPE1. The sensor cabling can be secured to the subject via a thermally insulating sleeve, such as nylon wire loom. The loom will permit the cable to travel freely during subject motion.

The frequency response extends from DC to 500 Hz. The accelerometers are extremely accurate and can easily be calibrated by simply changing their orientation in three-dimensional space, so that gravity (G=1) acts only upon the desired axis. Trace metallic parts do not make contact to the subject; must be used with 3-axis MECMRI-9 cables provided.

MRI Use (TSD109C2-MRI and TSD109A-MRI): MR Conditional to 7T

Note: Use with provided MECMRI-9 cable and MRIRFIF filter. Conductive parts of transducer are electrically and thermally isolated from subject.

Equipment

- The SS26LB/SS34L accelerometers connect to the MP36/35 Data Acquisition Unit.
- The TSD109 series accelerometers connect to the AMI100D or HLT100C High Level Transducer module.
- The TSD109C2-MRI and TSD109A-MRI are intended for MRI use and ship with a longer (10 m) cable, plus an MECMRI-HLT/AMI (2 m) interface cable and filter set (MRIFIF).

Accelerometer Specifications (SSL/TSD)

	SS26LB / TSD109C3 / TSD109C2-MRI	SS34L / TSD109J1	TSD109A / TSD109A-MRI
Range (Output):	±5 G	±200 G	±2 G
Noise:	0.25 mG/SQRT[Hz] (rms)	4.3 mG/SQRT[Hz] (rms)	0.05 mG/SQRT[Hz] (rms)
Bandwidth:	DC-500 Hz (-3 dB)	DC-1000 Hz (-3 dB)	DC-145 Hz (-3 dB)
Nonlinearity:	±0.2% of FSR	±0.5%	±0.5%
Cross-axis Sensitivity:	±1% of FSR	±1.4%	±2%
Package Alignment Error:	±1°	N/A	N/A
Interaxis Alignment Error:	±0.1°	N/A	N/A
Supply Current:	0.5 mA	0.5 mA	0.68 mA
Supply Voltage:	+5 V (nominal)	+5 V (nominal)	3.3 V (nominal)
Supply Voltage Range:	4 V – 6 V	4 V – 6 V	2.4 V – 3.6 V
Interface:	MP36/35 Data Acquisition Unit (SS26LB, SS34L) MP160/150/AMI100D/HLT100C Module (TSD109J1, TSD109C3, TSD109C2-MRI, TSD109A, TSD109A-MRI)		
Package:	Compliant silicone housing		
Dimensions:	16 mm (L) x 17 mm (W) x 8 mm (H)		
Weight:	4.5 grams		
Sterilizable:	Yes (contact BIOPAC for details)		
Cable length:	3 meters (10 meters for TSD109C2-MRI and TSD109A-MRI)		
Operational Temp:	0-50° C		
Operational Humidity:	0-95% non-condensing		

NOTE: The SS26LA (±5 G) was discontinued in September of 2013 and the SS27L and TSD109F (±50 G) were discontinued in May of 2015.

The TSD109C2 and TSD109J were discontinued in February of 2019. Current offerings are TSD109C3 and TSD109J1 to support AMI100D and HLT100C interface module compatibility.

Gain Constant and Offset Specifications (SSL/TSD)

Type	Gain Constant	Offset @ 0 G (Typical)
SS26LB	125 mV/g	1 V
SS34L	1.6 mV/g	340 mV
TSD109C3 / TSD109C2-MRI	200 mV/g	1.5 V
TSD109J1	7 mV/g	1.45 V
TSD109A / TSD109A-MRI	660 mV/g	1.65 V

Hardware Setup

The accelerometers have three output connectors, one each for the X, Y, and Z axes. Each output connector must be connected to an **MP3X** input channel (SS26LB/SS34L,) or to the appropriate AMI100D/HLT100C input channel (TSD109 series). For example, connect the X-axis to Channel 1, Y-axis to Channel 2, and Z-axis to Channel 3.

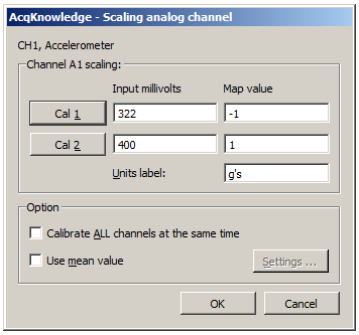
IMPORTANT

Make sure the selected channel is **not** already assigned to any other BIOPAC module; up to 5 Accelerometers can be used with a single MP System. **If contention exists, the channel data will be corrupted.**

See also: Setup notes for external devices and channel contention issues.

Software Setup

SS26LB/SS34L:



a) **Select MP3X** > **Set Up Data Acquisition > Channels** > **Setup** and enable three analog channels, one for each axis.

b) For each channel, select the appropriate **Accelerometer Preset** (5 g or 200 g) from the **Preset** list.

c) Click on **Setup** and then click on **Scaling**:

d) In the **Map value** fields, enter the scaling factors required, -1 for Cal 1 and 1 for Cal 2.

e) Enter "g" for the **Units label,** as shown. (This unit should appear by default in Accelerometer presets.)

f) Take the accelerometer and rest it in the upright position on the tabletop.

g) Calibrate the device by rotating it through 180° and taking a calibration reading at each point.

h) To calibrate the Y-axis, start with the transducer sitting on the table, face up, and click Cal 1. Rotate the transducer 180°, so that it is now sitting upside down, and click the Cal 2 button. This procedure must be followed for each axis. A label on the front of the transducer displays the X- and Y-axes. The Z-axis rotates from the end with the label and the end with the cable.

TSD109 Series:

a) Select **MP160/150** > **Set Up Data Acquisition > Channels** > **Add New Module**.

b) Choose **AMI100D** or **HLT100C-A1** from the module type list and click "Add."

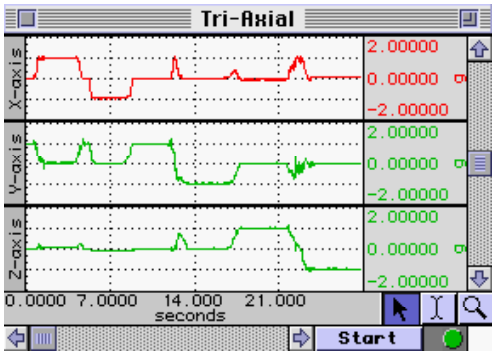
c) Choose **TSD109C (5 g), TSD109J (200 g),** or **TSD109A (2 g)** from the transducer list and click "OK."

d) Follow the onscreen calibration dialogs.

e) Repeat steps a-d for channels A2 (Y-Axis) and A3 (Z-axis).

Testing Calibration

To see if the calibration is correct:



a) Start acquiring data (for the test procedure, a sample rate of 50 samples per second should be used).

b) Rotate the accelerometer 180° through each axis.

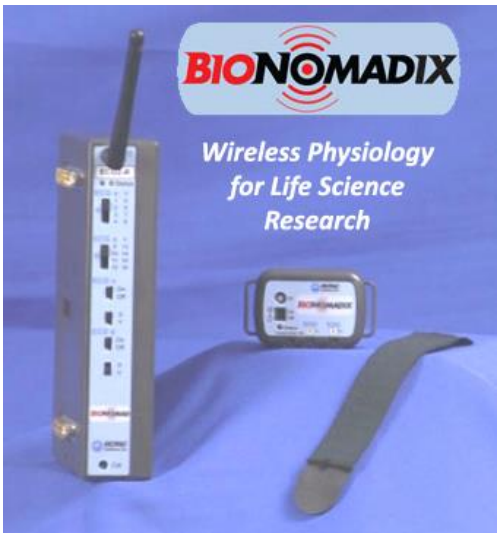
c) Set the vertical scale to 1 and the midpoint to 0 for all channels.

d) Repeat the calibration procedure (by rotating the transducer 180°) through each axis.

e) Visually confirm the correct calibration.

The screen shot above shows a tri-axial accelerometer being rotated through each axis. Channel 1 (X-axis) shows the signal moving from 1 g to -1 g as the transducer is rotated. Likewise, Channel 2 (Y-axis) shows the same phenomenon as previously described. Finally, Channel 3 (Z-axis) has also been tested and the calibration confirmed.

BIONOMADIX WIRELESS ACCELEROMETER



The BioNomadix wireless Tri-axial Accelerometer (BN-ACCL3) is a broad spectrum acceleration measurement system. The transmitter can be attached to any part of the subject's body to measure three-axis acceleration associated with movement in that particular location.

The system comes factory preset to support an operational range of ±16 G, with a maximum system bandwidth of 400 Hz. Ranges can be set to as low as ±2 G with bandwidths as low as 3 Hz.

The system can also be configured to act as a "tap detector," detect either single or double taps. In this mode, the system can act as an event recorder for self-report. When "double-tapped," for example, the system will output a pulse to precisely mark the time location of the observed event.

In Acceleration measurement mode, the BN-ACCL3 will output X, Y and Z acceleration values on three associated channels. The system is very well suited for mobile applications. The system can measure the acceleration of gravity (static) for tilt-sensing and can also measure very fast-changing, dynamic acceleration resulting from rapid movement or impact.

BN-ACCL3 Specifications

BioNomadix	**BN-ACCL3**
Signal type:	G (X, Y, Z)
Bandlimits *Max*: *Factory preset*: *Filter Options:* Alternative signal:	±2, ±4, ±8 or ±16 G ± 16 G at 400 Hz LP DC to 3.13 Hz LP up to 400 Hz LP (in power of 2 steps) Tap Event Mark Mode (*replaces* G)
Resolution**:**	X: 5 mg (rms), Y: 6 mg (rms), Z: 9 mg (rms) (±2 G scale at 400 Hz LP)
Signal range:	*Selectable:* ±2, ±4, ±8 or ±16 G
Output Voltage range:	±10 V (receiver output)
Transmitter type & rate	Type: Ultra-low power, 2.4 GHz bi-directional digital RF transmitter Rate: 2,000 Hz (between transmitter and receiver)
Delay:	Large fixed component (12.5 ms) and small variable component (±0.5 ms)
Operational range:	10 meters (line-of-sight) typical in standard laboratory setups. See also: *Operational Range and Characteristics*.
Operational temp:	5-45° C
Operational humidity:	0-95% non-condensing
Transmitter Battery: Charger:	BioNomadix transmitters use an L-ion battery: full charge takes approx. 1 hour to provide maximum operating time. A battery charger is included with each module pair. See BN-CHARGER for charge time and recharge cycle details.
Operating time:	72-90 hours
Receiver Power:	Use with an MP Research System or with isolated power supply IPS100C/D for 3rd-party data acquisition system.
Included strap:	33 cm - BN-STRAP33
Size & Weight:	Transmitter (approx.): 6 cm x 4 cm x 2 cm; 54 grams; Receiver (approx.): 4 cm x 11 cm x 19 cm; 380 grams
Input:	Attach BioNomadix transmitter to subject – no additional hardware input required; sensor is internal to transmitter.

See also: Tri-Axial Accelerometer Application Notes 141, 266 and 273 here.