

Application Note 141 – Tri-Axial Accelerometers

- SS26LB, TSD109C3 and TSD109C2-MRI (± 5 g)
- SS34L and TSD109J1 (± 200 g)
- BioNomadix BN-ACCL3

NOTE: The SS26LA (± 5 G) was discontinued in September of 2013 and the SS27L and TSD109F (± 50 G) were discontinued in May of 2015. Contact BIOPAC for information about these older models.



*Tri-axial accelerometer
uses 3 channel inputs*

Description

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.

- ± 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.

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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 MECMRI-7 cables provided.

MRI Use (TSD109C2-MRI): MR Conditional to 3T

Note: Use with provided MECMRI-7 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 HLT100C/AMI100D High Level Transducer module.
- The TSD109C2-MRI is intended for MRI use and ships with a longer (10 m) cable, plus an MECMRI-HLT (2 m) interface cable and filter set (MRIFIF).

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 HLT100C/AMI100D 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

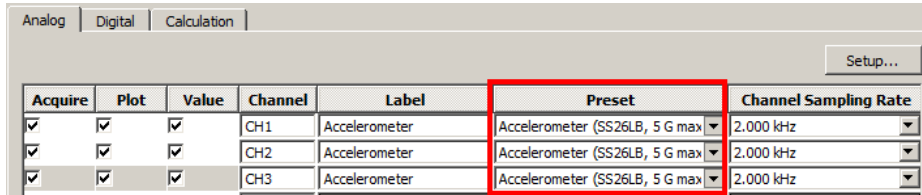
Make sure the selected channel is **not** already assigned to any other BIOPAC module; up to 5 Accelerometers can be used with a single MP System. **If contention exists, the channel data will be corrupted.**

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

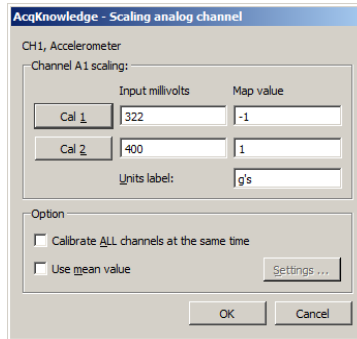
Software Setup

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 **Setup** and then click **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.

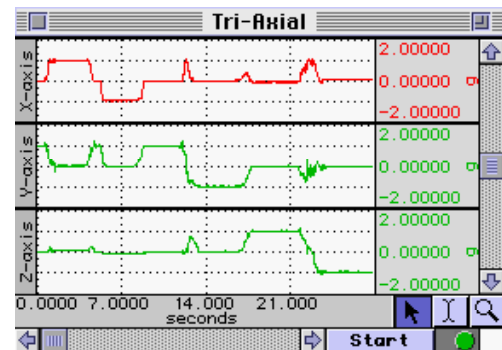
TSD109 Series:

- a) Select **MP160/150 > Set Up Data Acquisition > Channels > Add New Module**.
- b) Choose **HLT100C-A1** or **AMI100D-A1** from the module type list and click “Add.”
- c) Choose **TSD109C (5 g)** or **TSD109J (200 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 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.

Accelerometer Specifications (SSL/TSD)

	SS26LB / TSD109C3 / TSD109C2-MRI	SS34L / TSD109J1
Range (Output):	±5 G	±200 G
Noise:	0.5 mG/SQRT[Hz] (rms)	4.3 mG/SQRT[Hz] (rms)
Bandwidth:	DC-500 Hz (-3 dB)	DC-1000 Hz (-3 dB)
Nonlinearity:	0.2% of Full Scale	±0.5%
Transverse axis sensitivity:	±2%	±1.4%
Alignment error:	±1°	N/A
Power:	+5 V @ 25 mA	+5 V @ 10 mA
Interface:	MP36/35 Data Acquisition Unit (SS26LB, SS34L) MP160/150/HLT100C/AMI100D Module (TSD109J1, TSD109C3, TSD109C2-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)	
Operational Temp:	0-50° C	
Operational Humidity:	0-95% non-condensing	

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