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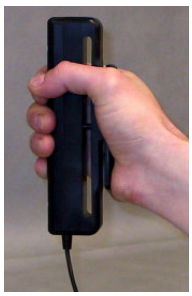
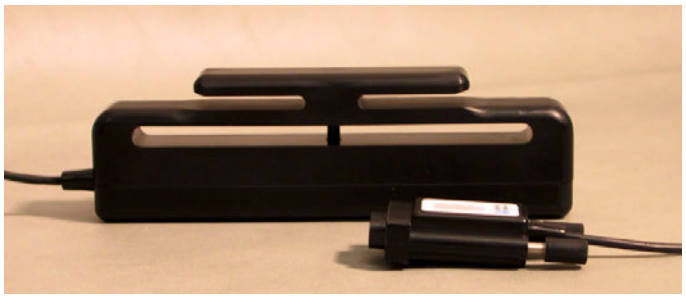
12.07.16

Application Note 144: Hand Dynamometer Calibration





SS25LA/LB Hand Dynamometer

This application note details the hardware, software and calibration procedure for the SS25LA, SS25LB and TSD121C Hand Dynamometers.

Use the hand dynamometer to measure grip force—use in isolation or combine with EMG recordings for in-depth studies of muscular activity. The lightweight, ergonomically designed transducer provides direct readings in kilograms or pounds. The simple calibration procedure makes this device easy to use for precise force measurements, and the isometric design improves experiment repeatability and accuracy. The SS25LA/SS25LB is a basic unit, designed for student lessons; it can also be used in the MRI, with proper module setup, since it employs plastics in the spring constant.

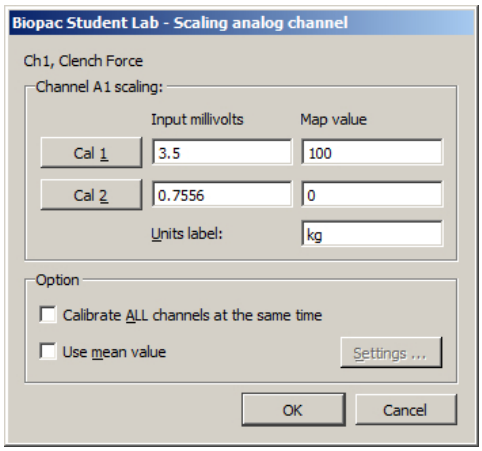
SS25LA HARDWARE SETUP

Connect the SS25LA Simple Sensor to a CH input on the front panel of an MP3X/45 unit.

Proper grip: Place the palm across the shorter bar and wrap fingers to center the force.

SS25LA SCALING — SOFTWARE SETUP

1) Select **Set Up Data Acquisition > Channels** under the MP menu and enable one analog channel.
2) Select the desired **Clench Force** Preset (kg or lbs, the example to the right is shown in units of kg.)
3) Click the **Setup** button.
4) Click the **Scaling** button to activate a dialog box similar to the one shown at right.
5) In the **Map value** column, note the default scaling of “0” for **Cal2** and “100” for **Cal1**. These represent 0 and 100 kilograms, respectively.
6) Place the SS25LA on a flat surface.

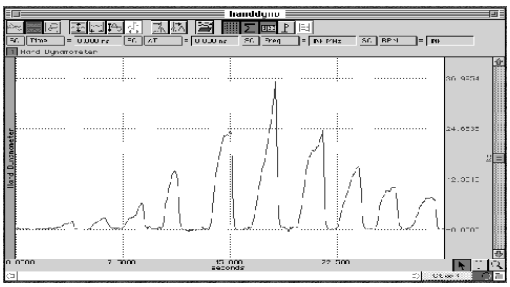


7) Click the **Cal2** button to obtain an initial calibration reading. A value similar to the above example “0.7556” will appear.
8) To obtain the **Cal1** input value, add the **Cal2** input value to the default **Cal1** 3.5 mV per 100 kg value. (In this example, this value would be 0.7556 mV + 3.5 mV = 4.2556 mV.)

Note: The above instructions are for BSL 4 and higher. In BSL 3.7.7 and earlier, placement of the CAL1 and CAL2 scale values are reversed.

OPTIONAL CALIBRATION CONFIRMATION

a) Click “Start” to begin data acquisition.
b) Place the SS25LA on a flat surface and then place a known weight on the uppermost portion of the grip.
c) Review the data to confirm that the known weight is reflected accurately in the data (sample at right).
d) Adjust the Scaling parameters and repeat steps a-c as necessary.



SS25LB HARDWARE SETUP

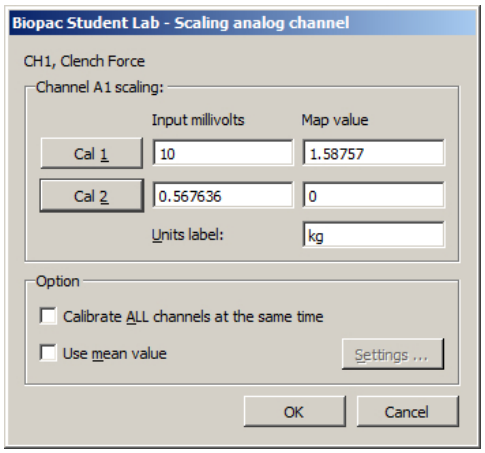
Connect the SS25LB Simple Sensor to a CH input on the front panel of an MP36/36R/35/45 unit.

Proper grip: Place the palm across the shorter bar and wrap fingers to center the force.

SS25LB SCALING—SOFTWARE SETUP

Note: When using with Biopac Student Lab, the SS25LB is compatible with versions 4.1 and higher only.

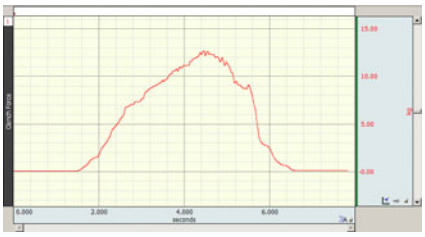
1) Select **Set Up Data Acquisition > Channels** under the MP menu and enable one analog channel.
2) Select the desired **Clench Force (SS25LB)** Preset in units of kg, lbs, or N. (Example above is units of kg.)
3) Click the **Setup** button.
4) Click the **Scaling** button to activate a dialog box similar to the one shown at right.
5) In the **Map value** column, note the default scaling of "0" for **Cal 2** and "1.58757" for **Cal 1**. These represent 0 and 1.58757 kilograms, respectively. **The MAP values must not be altered**.
6) Place the SS25LB on a flat surface.
7) Click the **Cal 2** button to obtain an initial calibration reading. A value similar to the above example will appear.



8) To obtain the **Cal 1** input value, add the **Cal 2** input value to the default **Cal 1** 10 mV per 1.58757 kg value. (In the above example, this value would be 0.567636 mV + 10 mV = 10.567636 mV.)

OPTIONAL CALIBRATION CONFIRMATION

a) Make sure the SS25LB is connected to the same channel as enabled in Step 1 above.
b) Click "Start" to begin data acquisition.
c) Place the SS25LB on a flat surface and then place a known weight on the uppermost portion of the grip.
d) Review the data to confirm that the known weight is reflected accurately in the data (sample above).
e) Adjust the Scaling parameters and repeat steps a-c as necessary.



TSD121C HAND DYNAMOMETER

The highest performance dynamometer is the TSD121C, which employs a four terminal, laser-trimmed, Wheatstone bridge built onto metal elements.

TSD121C is an isometric dynamometer that measures gripping (compression) or pulling (tension) forces associated with a wide variety of muscle groups. The isometric design improves experiment repeatability and accuracy. Forces are easily recorded in pounds, grams, kilograms force or in Newtons.

The TSD121C can be used for both compression (gripping) and tension (pulling) muscle strength studies under isometric constraint.

- For compression measurements, simply squeeze the handle of the transducer just below the eyelets. This simple operation makes for very simple and quick hand strength measurements.
- For tension measurements, the attached sturdy metal eye loops can be threaded using rope or chain. In this configuration, arm curling, leg lifting and digit activation forces can be measured. For these measurements, one loop is clamped securely and the other loop is attached, via cabling, to the appropriate body location under test.

The TSD121C has a 3-meter cable terminated in a connector that interfaces with the DA100C general-purpose transducer amplifier. The ergonomic soft handle design and simple calibration procedure make this device very easy to use.

For in-depth studies of muscular activity, combine TSD121C force recordings with EMG recordings; see the EMG100C amplifier for more information.

TSD121C CALIBRATION

With the proper equipment and correct scaling techniques described below, precise force measurements can be obtained.

EQUIPMENT

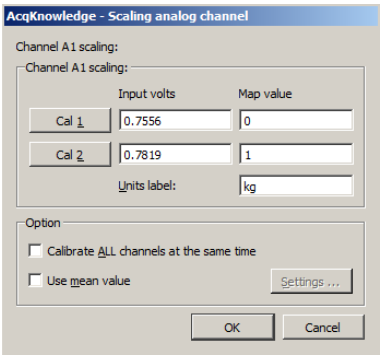
TSD121C Hand Dynamometer

MP System and DA100C General Purpose Transducer Amplifier

HARDWARE SETUP

Connect the TSD121C to the DA100C. When using this type of transducer, proper hand placement is at the uppermost portion of the foam grip, directly below the eyelets.

SOFTWARE SETUP



1. Select **MP160/150** > **Set Up Data Acquisition > Channels** and enable one analog channel; make sure this channel matches the Analog Output Channel physically selected on the DA100C amplifier.)
2. Select **Setup** > **Scaling**. A dialog similar to the example shown at right will be generated.
3. In the **Map value** fields, enter the values 0 and 1 respectively. These represent 0 and 1 kilograms.
4. Enter “kg” for the **Units label,** as shown.
5. Place the TSD121C on a flat surface and click the **Cal 1** button.
6. Note the value appearing in the **Cal 1** Input field.
7. Add 13.15 μV per volt of excitation (V_{ex}) to this value and enter the result in the **CAL 2** Input field.

The DA100C amplifier is factory set to a default 2 V (±1 V) of excitation. If the amplifier has been set to a different level of excitation, use the following equation wherein: V = volts of excitation per 1 kg and G = gain setting on the DA100C or TEL100C module:

$$(13.15\ \mu V * G * V_{ex}) + \text{Cal 1} = \text{Cal 2}$$

To more precisely tune the **Cal 2** value for tension measurements, proceed to alternate Steps 6a and 7a:

6a. Hang a known weight from the eyelets of the TSD121C and enter that weight value in the **CAL 2** MAP value field.

7a. Click the **CAL 2** button.

If using the TSD121C dynamometer to record hand clench compression measurements, modify the **CAL 2** value to reflect ~80% of the **CAL 2** value resulting from the eyelet (tension) method of calibration. This 80% derating suggestion accounts for the shifting of the collective applied force vector - resulting from hand clench - closer to the pivot axis of the TSD121C (near bottom).

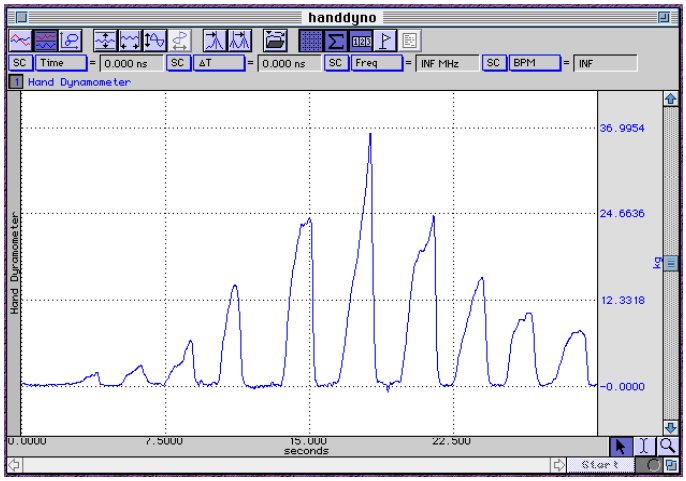
Another way to correct for handle derating is to create a calculation channel using the expression A1 * 1.466, where A1 is the analog channel receiving the signal from the TSD121C. This correction assumes that the user is gripping the unit right under the eyelets.

In Acq*Knowledge* 4.1 and higher, simply use **Set Up Data Acquisition** > **Channels** > **Add New Module**. Choose DA100C as the module type. Choose the correct physical channel switch position and select the TSD121C from the transducer list. Then follow the calibration prompts.

TESTING CALIBRATION

To see if the calibration is correct for the MP System:

1. Start acquiring data.
2. Place the hand dynamometer on a flat surface.
3. Place a known weight on the uppermost portion of the grip.
4. Check the data — the weight should be reflected accurately in the data acquired.



Sample Data