WORLD
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INSTRUMENTS

INSTRUCTION MANUAL

SI-BAM21-LCB/SI-BMFA

Signal Conditioning Amplifier System for SI Systems

Serial No._____

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090619

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ABOUT THIS MANUAL

The following symbols are used in this guide:

This symbol indicates a **CAUTION**. Cautions warn against actions that can cause damage to equipment. Please read these carefully.

This symbol indicates a **WARNING**. Warnings alert you to actions that can cause personal injury or pose a physical threat. Please read these carefully.

NOTES and **TIPS** contain helpful information.

Fig. 1—Signal Conditioning Amplifier System configured for the SI-MB4 Muscle Bath

INTRODUCTION

The Signal Conditioning Amplifier System provides a flexible electronic platform intended to process force transducer outputs. The system consists of an 8-channel, rack-mountable frame that includes an ultra quiet, shielded power supply. The system has a small footprint and may be stacked to provide as many channels as you need.

When the system is ordered with an:

- **SI-MB4**, it includes fo ur **SI-BAM21-LCB** amplifier modules and four expansion slots
- **SI-MB8**, the system includes eight **SI-BAM21-LCB** amplifier modules.

NOTE: The system is flexible and configurable. A variety of modules are available for the chassis, and you can mix and match the modules to suit your requirements.

Features

This system offers eight expansion slots, configured at the factory to meet your requirements.

NOTE: The system for the **SI-MB4** or **SI-MB8** is configured at the factory. If you need to add additional modules, contact Technical Support at 941.371.1003 or TechnicalSupport@wpiinc.com.

Parts List

After unpacking, verify that there is no visible damage to the instrument. Verify that all items are included:

(1) **Signal Conditioning Amplifier System** with the appropriate number of amplifier modules

(1) Power cord

(1) **13661** Potentiometer Adjustment Tool

(1) Instruction Manual

Unpacking

Upon receipt of this instrument, make a thorough inspection of the contents and check for possible damage. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed damage should be reported at once to the carrier and an inspection requested. Please read the section entitled "Claims and Returns" on page 19 of this manual. Please contact WPI Customer Service if any parts are missing at (941) 371-1003 or customerservice@wpiinc.com.

Returns: Do not return any goods to WPI without obtaining prior approval (RMA # required) and instructions from WPI's Returns Department. Goods returned (unauthorized) by collect freight may be refused. If a return shipment is necessary, use the original container, if possible. If the original container is not available, use a suitable substitute that is rigid and of adequate size. Wrap the instrument in paper or plastic surrounded with at least 100mm (four inches) of shock absorbing material. For further details, please read the section entitled "Claims and Returns" on page 19 of this manual.

INSTRUMENT DESCRIPTION

Front Panel

Fig. 2—The front panel of a 95350 (chassis configured for an SI-MB4) has four SI-BAM21-LCB cards.

Optical Transducer Amplifier–The **SI-BAM21-LCB** powers the force transducer and converts the output of the transducer to an amplified analog voltage that is proportional to the force applied to the transducer. The output signal can be multiplied by a factor of 1, 2, 5 or 10 to provide better resolution for a minimal change in applied force.

Expansion Slots–These empty slots allow room for four other **Signal Conditioning Amplifier System** modules to be added in the future.

Power Switch–This system has two power switches, one on the back panel and one on the front. Both switches must be on to power the system.

Back Panel

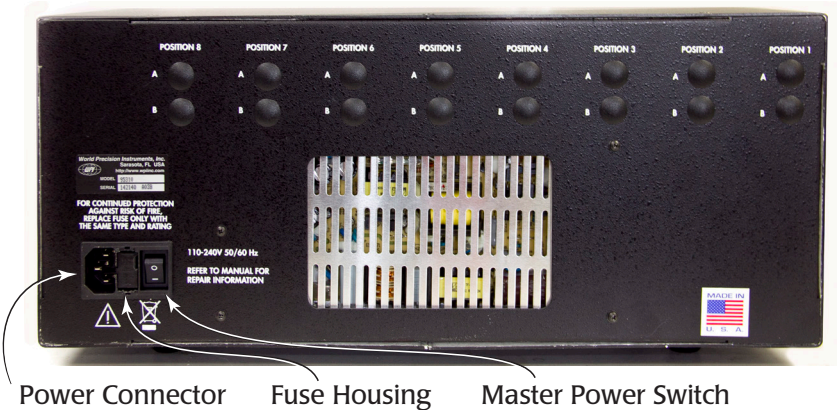

Fig. 3—The back panel of the SI-BMFA chassis has a master power switch that is usually left on.

Power Connector–Insert the power cord into the power connector, and plug the cord into a standard wall AC outlet.

Fuse Housing–This housing contains the fuse for the chassis system.

Master Power Switch–The signal conditioning chassis distributes sub-regulated DC power (12V) to the individual modules through a backplane of the chassis. For convenience, the unit has two power switches, and both must be on to power the system. All the modules power on/off simultaneously. When your system is set up, just leave this power switch in the on (I) position

NOTE: The 16 plugs marked with A or B are for future development. They are not used at this time.

SI-BAM21-LCB

The **SI-BAM21-LCB** KG Optical Force Transducer Amplifier is used in conjunction with the SI-H tissue bath and muscle physiology systems. The **SI-BAM21-LCB** powers the force transducer and converts the output of the transducer to an amplified analog voltage that is proportional to the force applied to the force transducer. The output signal can be multiplied by a factor of 1, 2, 5 or 10 to provide better resolution for a minimal change in applied force.

NOTE: An optional factory setting increases the multiplier by a factor of 10, allowing the signal to be multiplied by 10, 20, 50 and 100.

NOTE: The **SI-BAM21-LC** is the standalone version of this optical force transducer amplifier.

Features

The **SI-BAM21-LCB** amplifier works with KG optical force transducers to:

- Generate an analog output (-10VDC to +10VDC) that is proportional to the force applied to the tissue sample.
- Supply a DC voltage that powers the KG force transducer to which it is connected.

How the Amplifier Works

In a typical setup, a muscle is held by a force transducer and suspended in a tissue bath. The force transducer is connected to the **SI-BAM21-LCB**. As the muscle contracts or releases, the force transducer converts the force into an electrical current signal which is proportional to the force applied to the force transducer. The **SI-BAM21-LCB** converts the current signal into a voltage signal that can be displayed on the screen of the recording device.

Before initiating an experiment, the **SI-BAM21-LCB** must first be zeroed. This sets the baseline for measurements to follow.

The output signal is buffered and multiplied by 1, 2, 5 or 10, depending on the Gain switch setting on the front panel of the amplifier module. The X10 setting is useful when output signals are extremely small. Finally, the force proportional signal is sent through the output amplifier circuit.

The analog output has a range of –10V to +10V that drives a data acquisition system, multimeter or oscilloscope.

Notes and Warnings

NOTE: The **SI-BAM21-LCB** is only designed for use with KG optical force transducers. Use with any other type of transducer may cause damage to either the transducer or the amplifier, or both.

Front Panel

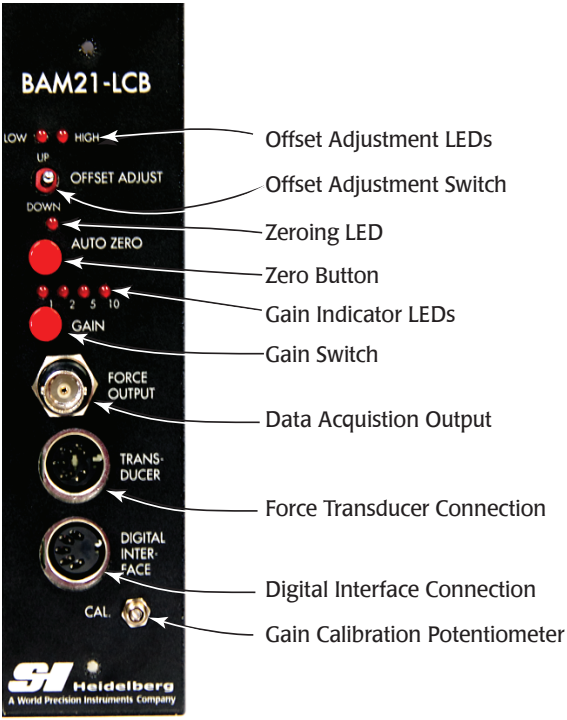

Fig. 4—SI-BAM21-LCB KG Optical Force Transducer Amplifier

Zero Button–When pressed, the **SI-BAM21-LCB** output comes close to zero and the **Zeroing LED** illuminates. Before any measurements are taken, the **SI-BAM21-LCB** should be zeroed to establish a baseline value for the force transducer.

Offset Adjustment Switch–This toggle switch permits the position of the baseline to be adjusted after the baseline is zeroed. Press and hold the toggle switch to the left if you want to raise the baseline. Or, press and hold the toggle switch to the right to lower the baseline. If the baseline is more that 0.3V above zero, the High LED illuminates, and if it is less than –0.3V, the Low LED illuminates. When the baseline is within 0.3V of zero, the LEDs are off.

Gain Switch–Under normal conditions, the **Gain** switch is set to X1. The output of the force transducer can be amplified by a factor of 2, 5 or 10. Press the **Gain** switch to toggle between the gain settings. A **Gain Indicator LED** illuminates to show which gain factor is applied. Larger gains are essential when working with extremely small forces.

Gain Calibration Potentiometer– This potentiometer can be used to maximize the output of the amplifier for the anticipated range of forces to be measured. Use the provided potentiometer adjustment tool (WPI#**13661**) to calibrate the output of the amplifier to the

range of forces that will be measured by the transducer. See "Calibrating the SI-BAM21-LCB" on page 7.

Data Acquisition Output–Connect a data acquisition system like WPI's **Lab-Trax** to this BNC connector to record the raw **SI-BAM21-LCB** voltage output. For test purposes, a multi-meter or oscilloscope may be connected using a standard BNC cable (WPI #**2851**).

Force Transducer Connection–A SI-KG series force transducer is plugged into this DIN connector. Align the pins, and insert the connector until it is fully seated.

Digital Interface–This connection is a legacy interface for classic SI-H equipment.

Setup

1. Connect the 5-pin connector on the force transducer cable to the **Force Transducer** connection port (labeled **Transducer**) on the front of the **SI-BAM21-LCB**. Align the pins and insert the connector.
2. Connect a BNC cable from the data acquisition system input to the **Force Output** port on the front panel of the **SI-BAM21-LCB** to capture the voltage output from the **SI-BAM21-LCB**.
3. Verify that the **Power** switches on the back panel and on the front panel of the **Signal Conditioning Amplifier System** are in the on (I) position.

Calibrating the SI-BAM21-LCB

Before taking measurements, the **SI-BAM21-LCB** must be calibrated. The SI-KG force transducers shown in the table below respond linearly within their respective measurement ranges. Consequently, the **SI-BAM21-LCB** can be calibrated using only two reference points.

Force Transducer	Force Range	Range (g)	Noise (µN)	Compliance (nm/mN)	Resonance Frequency
SI-KG2	0-2 N	0-200	250	150	1.3 kHz
SI-KG2B	0-0.2 N	0-20	80	2	590 Hz
SI-KG4	0-50 mN	0-5	15	0.5	1.2 kHz
SI-KG4A	0-20 mN	0-2	4	1	1.2 kHz
SI-KG7	0-5 mN	0-0.5	0.2	10	250 Hz
SI-KG7A	0-5 mN	0-0.5	0.4	5	500 Hz
SI-KG7B	0-10 mN	0-1.0	1	1.5	550 Hz
SI-KG20	0-0.2 N	0-20	80		590 Hz

Methodology

The basic procedure for calibrating the **SI-BAM21-LCB** is outlined here:

1. Power up the system and allow the amplifier and the force transducer to warm up for 30 minutes to stabilize the system.
2. Set a zero reference point with the force transducer unloaded.
3. Apply a load to the transducer with a known mass.
4. Use the **Gain Calibration Potentiometer** to adjust the amplifier's output range. Choose a value that EITHER (choose one):
   - Maximizes the resolution for the intended measurement range.
   - Numerically correlates the force with a voltage output.

This allows you to choose the calibration method that best serves your application.

- For the greatest precision, maximize the resolution of the **SI-BAM21-LCB** by calibrating so that the 10.0V output is set a little above the maximum expected force (~5%). For example, if your maximum expected value is 4.75g, set the **SI-BAM21-LCB** so that a 5g mass yields a 10.0V output. The maximum expected output would then be 9.5V, with a 4.75g applied load.
- On the other hand, for quick visualization, you might choose to establish a numerical correlation by calibrating the **SI-BAM21-LCB** so that a force like 1.0g generates a 1.0V output.

Although each of the SI-KG force transducers has a fixed load range, the design of the **SI-BAM21-LCB** offers four levels of amplification using the **Gain** switch (X1, X2, X5 and X10). You can choose to use the full-load range of the transducer (X1) or, if higher resolution is desired, one of the other multipliers (X2, X5, X10). For example, using X10 uses 1/10th of the full-load range of the transducer. Under ideal conditions, the **Gain** switch is set to an amplification factor of X1 using an SI-KG force transducer with a force range that is no more than 120% of the maximum force anticipated. In general, it is best to choose a gain factor that will not need to be changed during an experiment. This is because each gain factor can have slight variances in offset. However, if it is necessary to switch between gain ranges during an experiment, check the offsets in each of the ranges to be used. Then, use the **Offset Adjustment** switch to set the minimum average offset between the ranges.

Fig. 5—SI-KG force transducer with a pointed hook for mounting the tissue.

Force Transducer mount pictured on the left;
Motor/micrometer mount pictured on the right.

Fig. 6—Mounting hooks can be used in a variety of combinations, depending on the type of tissue to be examined.

Procedure

The following calibration procedure may be used with any SI-KG force transducer. For illustration purposes a **SI-KG4** force transducer is used in the example. Note that a 0.5g mass is about 10% of the total range of the **SI-KG4** force transducer, and a 5g mass is a the maximum force the **SI-KG4** can measure. If we intend to use the X10 mode, 0.5g is the largest mass we can use with this force transducer.

1. Attach the desired force transducer to the **Transducer** port on the front panel of the **SI-BAM21-LCB**. For this example, use a **SI-KG4** force transducer.

2. Connect a data acquisition system or a digital multi-meter to the **Output** (BNC connection) on the front panel of the **SI-BAM21-LCB**. The analog BNC output on the front panel can be connected to a multi-meter for DC voltage measurements between –10.0 and +10V DC. Alternatively, a data acquisition system with analog data tracking, recording and analysis can be connected to a PC to provide a record of the analog output (WPI #**LAB-TRAX-4**).

3. Mount the force transducer on the calibration stand on the base of the **SI-MT**, **SI-MKB** or **SI-HTB** system.
   NOTE: The calibration stand holds the force transducer and its tissue mount in the proper orientation for an accurate calibration. This angle is critical in establishing a proper calibration ratio. When gravity pulls the mass hung on end of the tissue mount down, the actuator rod of the transducer is pulled in the same direction as the force created by the tissue used in the experiment. If the force is not pulling on the tissue mount in this direction, the output signal has to be adjusted correspondingly.

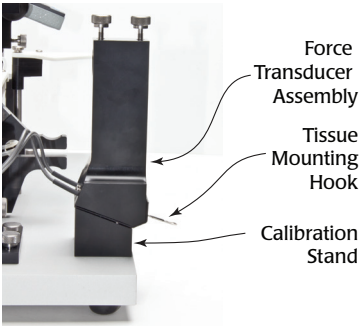

Fig. 7—When the force transducer is properly mounted in the calibration stand on the muscle tester, the force transducer is held at the same angle used when making measurements.

4. Gently slide the tissue mounting hooks up on the pin that extends from the arm of the micrometer. Some mounting hooks require an adapter (**Fig. 8**).

   If you are using one of the mounting hooks (type 1-8), which is designed for use with the **SI-KG4A**, **SI-KG4B** and **SI-KG7B** force transducers, you must first slide the mounting hook into the adapter (**Fig. 8**) before sliding the adapter into the pin of the micrometer arm. When the **SI-KG2** force transducer is used with the large mounting hooks (types 9-11), no adapter is needed.

Fig. 8—The mounting hook slides into the adapter before it is installed in the micrometer assembly.

5. Set the **Gain** switch to the amplification factor you intend to use.

6. With no weight suspended from the transducer, press and release the **Zero** button and monitor the output. You should see a reading of 0.0V DC ±50mV. Keep in mind that for higher gain settings the zeroing error is larger and requires the use of the Offset Adjustment switch if a smaller error is desired.

   NOTE: When the **Zero** button is pressed, the zeroing LED illuminates to indicate that the zeroing function is processing.

7. Use the **Offset Adjustment** switch to adjust the baseline to zero. Press and hold the toggle switch to the left if you want to raise the baseline. Or, press and hold the toggle switch to the right to lower the baseline. If the baseline is more that 0.3V above zero, the **High** LED illuminates, and if it is less than –0.3V, the **Low** LED illuminates. When the baseline is within 0.3V of zero, the LEDs are off.

   NOTE: Once the baseline is zeroed to the desired position, do not touch the **Offset Adjustment** switch until the calibration procedure is completed.

8. From the transducer, suspend a known mass that is close to the maximum range for the amplification factor and force transducer. For the SI-KG4 force transducer, use a less than 5.0g for X1 or less than 0.5g for X10.

   NOTE: Mass in grams in not equal to force in newtons. Since force equals mass times acceleration (F = ma), a 0.5g weight is equal to 4.9mN.
   (0.0005kg * 9.8m/s^2 = 0.0049N) The mass you choose must exert a force that falls within the operating range of the force transducer and amplification factor you select.

9. After the suspended mass becomes motionless, monitor the output while adjusting the **Gain Calibration Potentiometer**. The output voltage may be set to almost any arbitrary value up to 10.0V. Use a potentiometer adjustment tool (WPI #**13661**) to adjust the **Gain Calibration Potentiometer** for the desired output voltage.

10. If you intend to use multiple amplification factors, cross-check your calibration. Set the **Gain** switch to X1 and verify that the output is one tenth of the value recorded in the X10 gain setting. If a 0.5g mass is used and the **SI-BAM21-LCB** is calibrated as close as possible 10.0V in X10, then in X1, the monitor should display very close to 1.0V.

Making Measurements

After the **SI-BAM21-LCB** has been calibrated, measurements may be taken.

1. Turn the **SI-BAM21-LCB Power** switch on (I). The system needs to be powered on for 30 minutes before calibration. Leave it on while your prepare to take measurements.
2. Turn on the data acquisition system.
3. Press the **Zero** button to set the baseline value for the measurements.

   NOTE: When the **Zero** button is pressed, the zeroing LED illuminates to indicate that it is functioning properly.

4. Measurements may be taken.

Setting System Gain Factor

The **SI-BAM21-LCB** gain multiplier setting is selected with an internal jumper that is configured at the factory for use with either an **SI-MT** muscle tester system or an **SI-MB** tissue bath system. The **SI-MT** setting allows for 1X, 2X, 5X and 10X gains. The **SI-MB** setting allows for 10X, 20X, 50X and 100X gains.

1. Turn off the Signal Conditioning Amplifier System and unplug it from the power outlet.
2. Remove the two screws on the face of the **SI-BAM21-LCB** module.
3. Gently slide the module out of the **SI-BMFA** frame.
4. Locate the 3-pin jumper J16.
5. Jumper pins 1 and 2 to use the **SI-BAM21-LCB** with the **SI-MT** system, or jumper pins 2 and 3 for use with the **SI-MB** systems.
6. Reinstall the module into the frame and secure it with the screws.

SI-AOSUB

Every force transducer has a resonance frequency at which it vibrates. The **SI-AOSUB** allows you to locate that frequency and filter the signal to mitigate the noise of the resonance frequency. Since each force transducer is unique, the anti-oscillation unit must be calibrated for each force transducer. Likewise, the tissue mounting hardware affects the resonance frequency. Therefore, the system must be calibrated with the mounting hardware attached to the force transducer.

Front Panel

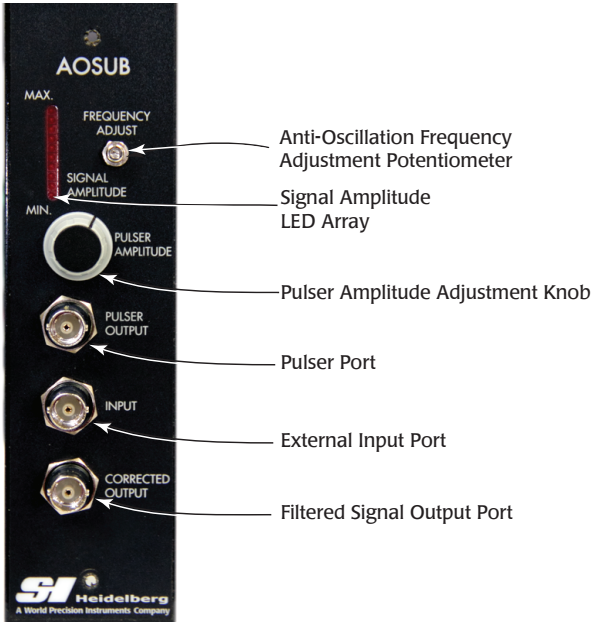

Fig. 9—SI-AOSUB Anti-Oscillation Module

Pulser Port–Connect the Pulser cable to this port when you need to calibrate the system for a force transducer. The force transducer fits inside the Pulser, and the Pulser uses a strong electro-magnet to exert small square-wave forces on the force transducer.

Pulser Amplitude Adjustment Knob–When calibrating a force transducer, this knob adjusts the amplitude of the pulser waveform so the display registers on the **Signal Amplitude Array**.

Signal Amplitude Array–The 10-position LED array indicates the amplitude of the transducer's response to the pulser's excitations. The LED array indicates when the frequency of the square wave is equal to the resonance frequency of the force transducer.

Anti-oscillation Frequency Adjustment potentiometer– Use the included potentiometer adjustment tool (WPI #**13661**) to rotate the potentiometer until the force transducer resonates. During this procedure, the number of segments in the **Signal Amplitude LED** array that light up increases as the resonance frequency approaches that of the force transducer.

External Input Port–The output signal from the transducer amplifier comes into the **SI-AOSUB** through this port. If the signal is not routed along the backplane, connect the **SI-BAM21-LCB Force Output** to this port.

Adjusting the Anti-Oscillation Filter

The anti-oscillation filter is adjusted at the factory using the transducer that is supplied with the **SI-MT**, **SI-MKB**, **SI-HTB**, or **SI-CTS** system. Normally, the filter does not need to be reset, unless a different force transducer is connected to the unit. To adjust the anti-oscillation filter properly, the transducer is excited at its resonance frequency using a magnetic driver or pulser (WPI #**97204**).

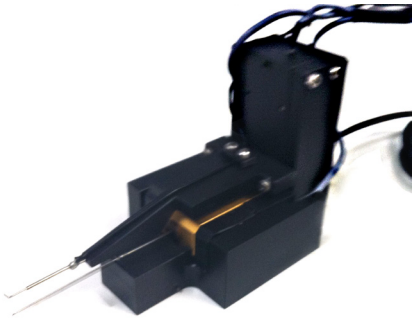

Fig. 10—(Left) This pulser assembly has no force transducer mounted in it.
Fig. 11—(Right) A force transducer is mounted in the **SI-AOSUB** *pulser assembly.*

Keep in mind that:

- The closer the anti-oscillation frequency matches the resonance frequency of the force transducer, the more the ringing phenomenon is removed from the force

signal.

- The resonance frequency can be evoked at anti-oscillation frequencies that are multiples of the resonance frequency. For example, if the resonance frequency of the transducer is 200Hz, it can also be evoked when the anti-oscillation frequency is set to 400 or 600Hz. The anti-oscillation filter works best when the anti-oscillation frequency is set at the actual resonance frequency of the transducer.

1. Slide the force transducer, with its tissue mount in position, forward into the pulser (magnetic driver assembly) until it rests against the stop at the front of the pulser. See Fig. 10.
2. Attach the cable of the pulser to BNC connector of the **Pulser Output** on the front of the Anti-Oscillation module (**SI-AOSUB**).
3. Using the potentiometer adjustment tool provided with the signal conditioning amplifier system, rotate the calibration screw of the **Anti-oscillation Frequency Adjustment** potentiometer completely to the left (counter-clockwise). The anti-oscillation frequency is now set to the lowest possible level.
4. Turn the **Pulser Amplitude Adjustment** knob completely to the left (counter-clockwise). The amplitude of the anti-oscillation frequency is now set to the lowest possible level. Then, slowly turn the **Pulse Amplitude Adjustment** knob to the right until a couple of bars on the **Signal Amplitude LED** array are illuminated.
5. Using the potentiometer adjustment tool, slowly turn the calibration screw of the **Anti-oscillation Frequency Adjustment** potentiometer to the right (clockwise) while observing the **Signal Amplitude LED** array. As the calibration screw is turned to the right, the anti-oscillation frequency gets closer to the resonance frequency of the transducer, and the transducer begins to oscillate at higher amplitude as indicated by the increased number of lights in the LED array that illuminate.
6. Continue to rotate the calibration screw of the **Anti-oscillation Frequency Adjustment** potentiometer to the right (clockwise) until the greatest number of bars on the **Signal Amplitude LED** array are illuminated.

   If the **Signal Amplitude LED** array becomes fully illuminated as the anti-oscillation frequency is increased, decrease the pulse amplitude by turning its control knob to the left (counterclockwise). Turn the knob to the left until some of the bars at the top of the **Signal Amplitude LED** array are no longer illuminated.
7. Repeat Step 6 until the greatest number of bars on the **Signal Amplitude LED** array is illuminated without the signal amplitude being saturated. When this occurs, the anti-oscillation frequency has been set equal to the resonance frequency of the transducer.

   NOTE: If the **Signal Amplitude LED** array is saturated at any time during the frequency calibration, reduce the pulse amplitude by rotating **Pulser Amplitude Adjustment** knob to the left until some of the bars at the top of the array are no longer illuminated.

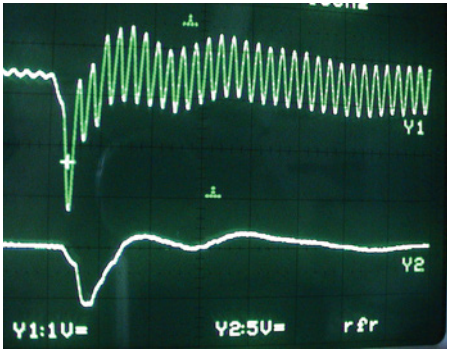

Fig. 12—The upper trace is a force transient obtained directly from the bridge amplifier output, and the lower trace shows the signal after it passes through the "anti oscillation" unit.

SI-PF100

This low pass filter may be used to program the cutoff equivalence. It is a low pass filter set to pass signals of interest below the specified frequency. It can be calibrated from 5 to 1,000 Hz. You may select a Bessel or a Butterworth filter and set the cutoff frequency.

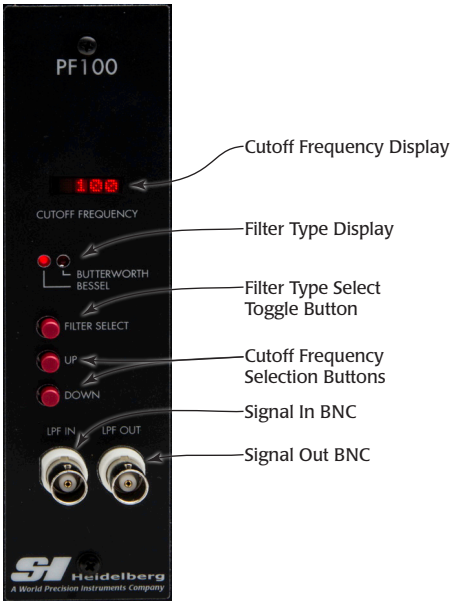

Fig. 13—SI-PF100 Programmable Filter Module

Cutoff Frequency Display–This display shows the current cutoff frequency being applied to the input signal.

Filter Type Display–One of the two LEDs illuminates to indicate the type of filter being applied to the input signal (Bessel or Butterworth).

Filter Type Select Toggle Button–Press this button to change the filter type. Choices include Bessel and Butterworth. The Filter Type Display LED illuminates to indicate which filter type is selected.

Cutoff Frequency Selection Buttons–Use the Up and Down buttons to change the frequency of the filter applied to the input signal.

Signal In BNC– The output signal from the transducer amplifier comes into the **SI-PF100** through this port (LPF IN). If the signal is not routed along the backplane, connect the **SI-BAM21-LCB Force Output** to this port.

Signal Out BNC– The Programmable Filter applies the selected cutoff frequency to the input signal (LPF IN) and makes the filtered signal available through this BNC port (LPF OUT).

MAINTENANCE

The **Signal Conditioning Amplifier System** chassis is maintenance free. However, to protect it, follow these guidelines:

- Place the system in a clean, dry location.
- Use only the power supply included.
- Keep liquids away from all the connections.

ACCESSORIES

Part Number	Description
13661	Potentiometer Adjustment Tool (Tweaker)
2851	BNC Cable
SI-KG2	0-2 N Force Transducer
SI-KG2B	0-0.2 N Force Transducer
SI-KG4	0-50 mN Force Transducer
SI-KG4A	0-20 mN Force Transducer
SI-KG7	0-5 mN Force Transducer
SI-KG7A	0-5 mN Force Transducer
SI-KG7B	0-10 mN Force Transducer
SI-KG20	0-0.2 N, 0-20 g Force Transducer
LAB-TRAX-4	4-Channel Data Acquisition System

TROUBLESHOOTING

Issue	Possible Cause	Solution
No power	One of the two power switches is off.	Verify that the power switch one the back of the chassis and the power switch on the front panel are both in the on (0) position.
	The power cord is loose or not connected properly to the AC wall outlet	Unplug the power cord from the wall and the chassis and re-install it.
No output Signal (0.0V DC)	Poor force transducer connection	Verify that the cables are securely connected.
	BNC cable is bad	Try substituting a different BNC cable to troubleshoot the cause.
	Transducer failed	Try substituting a different force transducer to troubleshoot the cause.
Excessive Noise	Lack of ground	Use the rear ground (banana) connection to connect to a quality ground.
Drift	Insufficient warm up time	Allow at least 30 minutes for the SI-BAM21-LC and the KG force transducer to warm up before running tests.
	Temperature variations	Try to keep the room or environmental temperature stable.

NOTE: If you have a problem/issue with that falls outside the definitions of this troubleshooting section, contact the WPI Technical Support team at 941.371.1003 or technicalsupport@wpiinc.com.

SPECIFICATIONS

Chassis

Maximum Power Consumption	1.3A at 115V 50/60Hz, 1.8A at 230V 50/60Hz
Fuse	2 A, 250 V slow, 5x20 mm (WPI# **802270**)

SI-BAM21-LCB

Input Configuration	Current to voltage converter
Gain	1X, 2X, 5X, 10X - Switch selectable
Output Impedance	470 Ω
Power Requirements	12V DC provided by the chassis
Output Range	±10V DC

WARRANTY

WPI (World Precision Instruments) warrants to the original purchaser that this equipment, including its components and parts, shall be free from defects in material and workmanship for a period of one year* from the date of receipt. WPI's obligation under this warranty shall be limited to repair or replacement, at WPI's option, of the equipment or defective components or parts upon receipt thereof f.o.b. WPI, Sarasota, Florida U.S.A. Return of a repaired instrument shall be f.o.b. Sarasota.

The above warranty is contingent upon normal usage and does not cover products which have been modified without WPI's approval or which have been subjected to unusual physical or electrical stress or on which the original identification marks have been removed or altered. The above warranty will not apply if adjustment, repair or parts replacement is required because of accident, neglect, misuse, failure of electric power, air conditioning, humidity control, or causes other than normal and ordinary usage.

To the extent that any of its equipment is furnished by a manufacturer other than WPI, the foregoing warranty shall be applicable only to the extent of the warranty furnished by such other manufacturer. This warranty will not apply to appearance terms, such as knobs, handles, dials or the like.

WPI makes no warranty of any kind, express or implied or statutory, including without limitation any warranties of merchantability and/or fitness for a particular purpose. WPI shall not be liable for any damages, whether direct, indirect, special or consequential arising from a failure of this product to operate in the manner desired by the user. WPI shall not be liable for any damage to data or property that may be caused directly or indirectly by use of this product.

Claims and Returns

Inspect all shipments upon receipt. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed loss or damage should be reported at once to the carrier and an inspection requested. All claims for shortage or damage must be made within ten (10) days after receipt of shipment. Claims for lost shipments must be made within thirty (30) days of receipt of invoice or other notification of shipment. Please save damaged or pilfered cartons until claim is settled. In some instances, photographic documentation may be required. Some items are time-sensitive; WPI assumes no extended warranty or any liability for use beyond the date specified on the container

Do not return any goods to us without obtaining prior approval and instructions from our Returns Department. Goods returned (unauthorized) by collect freight may be refused. Goods accepted for restocking will be exchanged or credited to your WPI account. Goods returned which were ordered by customers in error are subject to a 25% restocking charge. Equipment which was built as a special order cannot be returned.

Repairs

Contact our Customer Service Department for assistance in the repair of apparatus. Do not return goods until instructions have been received. Returned items must be securely packed to prevent further damage in transit. The Customer is responsible for paying shipping expenses, including adequate insurance on all items returned for repairs. Identification of the item(s) by model number, name, as well as complete description of the difficulties experienced should be written on the repair purchase order and on a tag attached to the item.

** Electrodes, batteries and other consumable parts are warranted for 30 days only from the date on which the customer receives these items.*

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