Model 8120-410A

Strain Gage Sensor Signal Conditioner

Installation and Operating Manual

For assistance with the operation of this product,
contact PCB Piezotronics, Inc.

Toll-free: 800-828-8840
24-hour SensorLine: 716-684-0001
Fax: 716-684-0987
E-mail: info@pcb.com
Web: www.pcb.com

Repair and Maintenance

PCB guarantees Total Customer Satisfaction through its "Lifetime Warranty Plus" on all Platinum Stock Products sold by PCB and through its limited warranties on all other PCB Stock, Standard and Special products. Due to the sophisticated nature of our sensors and associated instrumentation, **field servicing and repair is not recommended and, if attempted, will void the factory warranty**.

Beyond routine calibration and battery replacements where applicable, our products require no user maintenance. Clean electrical connectors, housings, and mounting surfaces with solutions and techniques that will not harm the material of construction. Observe caution when using liquids near devices that are not hermetically sealed. Such devices should only be wiped with a dampened cloth—never saturated or submerged.

In the event that equipment becomes damaged or ceases to operate, our Application Engineers are here to support your troubleshooting efforts 24 hours a day, 7 days a week. Call or email with model and serial number as well as a brief description of the problem.

Calibration

Routine calibration of sensors and associated instrumentation is necessary to maintain measurement accuracy. We recommend calibrating on an annual basis, after exposure to any extreme environmental influence, or prior to any critical test.

PCB Piezotronics is an ISO-9001 certified company whose calibration services are accredited by A2LA to ISO/IEC 17025, with full traceability to SI through N.I.S.T. In addition to our standard calibration services, we also offer specialized tests, including: sensitivity at elevated or cryogenic temperatures, phase response, extended high or low frequency response, extended range, leak testing, hydrostatic pressure testing, and others. For more information, contact your local PCB Piezotronics distributor, sales representative, or factory customer service representative.

Returning Equipment

If factory repair is required, our representatives will provide you with a Return Material Authorization (RMA) number, which we use to reference any information you have already provided and expedite the repair process. This number should be clearly marked on the outside of all returned package(s) and on any packing list(s) accompanying the shipment.

Contact Information

PCB Piezotronics, Inc.
3425 Walden Ave.
Depew, NY14043 USA
Toll-free: (800) 828-8840
24-hour SensorLine: (716) 684-0001
General inquiries: info@pcb.com
Repair inquiries: rma@pcb.com

For a complete list of distributors, global offices and sales representatives, visit our website, www.pcb.com.

Safety Considerations

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the precautions required to avoid injury. While our equipment is designed with user safety in mind, the protection provided by the equipment may be impaired if equipment is used in a manner not specified by this manual.

Discontinue use and contact our 24-Hour Sensorline if:

- Assistance is needed to safely operate equipment
- Damage is visible or suspected
- Equipment fails or malfunctions

For complete equipment ratings, refer to the enclosed specification sheet for your product.

Definition of Terms and Symbols

The following symbols may be used in this manual:

DANGER
Indicates an immediate hazardous situation, which, if not avoided, may result in death or serious injury.

Manual 21354 Rev E
ECN 50523

CAUTION
Refers to hazards that could damage the instrument.

NOTE
Indicates tips, recommendations and important information. The notes simplify processes and contain additional information on particular operating steps.

The following symbols may be found on the equipment described in this manual:

This symbol on the unit indicates that high voltage may be present. Use standard safety precautions to avoid personal contact with this voltage.

This symbol on the unit indicates that the user should refer to the operating instructions located in the manual.

This symbol indicates safety, earth ground.

PCB工业监视和测量设备 - 中国RoHS2公布表

PCB Industrial Monitoring and Measuring Equipment - China RoHS 2 Disclosure Table

部件名称	有害物质					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
住房	O	O	O	O	O	O
PCB板	X	O	O	O	O	O
电气连接器	O	O	O	O	O	O
压电晶体	X	O	O	O	O	O
环氧	O	O	O	O	O	O
铁氟龙	O	O	O	O	O	O
电子	O	O	O	O	O	O
厚膜基板	O	O	X	O	O	O
电线	O	O	O	O	O	O
电缆	X	O	O	O	O	O
塑料	O	O	O	O	O	O
焊接	X	O	O	O	O	O
铜合金/黄铜	X	O	O	O	O	O

本表格依据 SJ/T 11364 的规定编制。

O： 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。

X： 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求 。

铅是欧洲RoHS指令2011/65/ EU附件三和附件四目前由于允许的豁免。

CHINA RoHS COMPLIANCE

Component Name	Hazardous Substances					
	Lead (Pb)	**Mercury (Hg)**	**Cadmium (Cd)**	**Chromium VI Compounds (Cr(VI))**	**Polybrominated Biphenyls (PBB)**	**Polybrominated Diphenyl Ethers (PBDE)**
Housing	O	O	O	O	O	O
PCB Board	X	O	O	O	O	O
Electrical Connectors	O	O	O	O	O	O
Piezoelectric Crystals	X	O	O	O	O	O
Epoxy	O	O	O	O	O	O
Teflon	O	O	O	O	O	O
Electronics	O	O	O	O	O	O
Thick Film Substrate	O	O	X	O	O	O
Wires	O	O	O	O	O	O
Cables	X	O	O	O	O	O
Plastic	O	O	O	O	O	O
Solder	X	O	O	O	O	O
Copper Alloy/Brass	X	O	O	O	O	O

This table is prepared in accordance with the provisions of SJ/T 11364.

O: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.

X: Indicates that said hazardous substance contained in at least one of the homogeneous materials for this part is above the limit requirement of GB/T 26572.
Lead is present due to allowed exemption in Annex III or Annex IV of the European RoHS Directive 2011/65/EU.

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If you need information regarding specific Model 8120 components and circuitry, please contact the Force/Torque Division of PCB toll-free at (888) 684-0004, or e-mail force@pcb.com.

MANUAL NUMBER: 27259
REVISION: NR
ECN:

1.0 DESCRIPTION

The 8120 Instrument Series is a family of premium signal conditioning instruments that includes models to accommodate virtually all types of transducers and signal sources commonly encountered in electro-mechanical testing and control operations. The 8120 Instruments are available in three forms: Signal Conditioner only; Signal Conditioner with Digital Indicator; and Signal Conditioner with Digital Indicator and Hi-Lo Limits. The Model numbering system used with the 8120 Series identifies the form and the type of signal source. This numbering system is further explained in Table 1. From Table 1, it can be seen that all models having a Digital Indicator are identified by a -_10A or -_30A suffix, with the first digit identifying the type of signal source.

Table 1 – 8120 Model Numbering System

8120-_ _0A

First digit after the dash identifies type of signal source:

1 = Strain Gages (DC excited)
4 = Strain Gages (AC excited)
7 = Pulse Pick-ups (Frequency)

Second digit after the dash identifies form:

0 = signal conditioner only
1 = signal conditioner with digital indicator
3 = signal conditioner with digital indicator and Hi-Lo Limits

The 8120 Series instruction manual system is designed to provide the user with the following documentation: (1) a separate instruction manual for each type of Signal Conditioner purchased; (2) an instruction manual covering only the Digital Indicator section of a 8120 Series instrument, but applicable to any -110A or –130A instrument; and (3) an instruction manual covering only the Hi-Lo Limit section 2 of a 8120 Series instrument, but applicable to any –130A instrument. It is the purpose of this manual to cover the Digital Indicator section of all -_10A or -_30A instruments.

The Digital Indicator section of any -_10A or -_30A instrument consists of a printed circuit board on which are mounted the required circuit components for digitizing the analog output of the Signal Conditioner and the light-emitting-diode (LED) display. This board is mounted above the circuit board that contains the components for the Signal Conditioner. The digits that comprise the display are mounted on a small board, which is affixed to the digitizer board with a right-angle printed-circuit board header. The -_30A instruments contain an additional printed-circuit board for the Hi-Lo Limit circuitry.

The LED display is comprised of six orange digits with polarity sign. The 0.4-inch height of the digits, combined with the inherent brilliance of an LED type of display, make the display easily discernible in normal room lighting. The display is viewed through the red plastic front panel of the instrument to provide filtering of external light and enhance the display brilliance. The front panel is opaque except for that portion through which the display is viewed. A typical 8120 Instrument with Digital Indicator is shown in Figure 1.

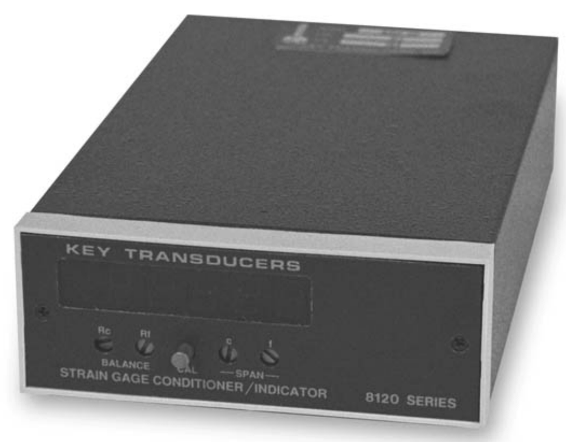


Figure 1 - Model 8120-110A

The Digital Indicator scaling is selected with rear-panel pushbutton switches. Full-scale values of ±5000 counted by 1 ' s , ± 10000 counted by 2's, or ±20000 counted by 5's can be selected. The most significant digit (MSD) of the display contains the polarity sign and is either unlit or lights as a 1 for displays of 10000 or greater. The least significant digit (LSD) is a dummy zero which can be turned ON or left unlit as desired. In addition, decimal-point position can be selected to give display readings as follows: 1.XXXX, lX.XXX, 1XX.XX, 1XXX.X, or 1XXXX (no decimal point). Decimal-point location and dummy zero selection are also accomplished with rear-panel switches (miniature slide-switch bank). When the 20000 scale is selected, the display is digitally limited to read a maximum number of 19995 since the MSD is either unlit or reads a "1" for displays of 10000 or greater. The 5000 and 10000 scales are analog limited to an overrange of approximately 5600 and 11200, respectively. An overrange condition on any range is indicated by a flashing display. The sampling rate of the display is 3 samples per second. The Digital Indicator specifications are summarized in Table 2.

Table 2 - Specifications

Display: Orange LED’s, six digits with polarity sign, 0.4 inch height. MDS is either unlit or reads a 1 and contains the polarity sign. LSD is a dummy zero which can be programmed to be lit or unlit (rear-panel switch).

Scaling: Selectable at rear panel; full-scale values of ±5000 counted by *1's*, ± 10000 counted by *2's*, or ±20000 counted by *5's*.

Decimal Point: Decimal-point location can be selected with rear panel switches as follows: 1.XXXX, 1X.XXX, 1XX.XX, 1XXX.X, or 1XXXX (no decimal point).

Sampling Rate: 3 samples per second.

Legends: Each instrument supplied with an appropriate assortment of user-installable rub-on engineering unit legends.

2.0 INSTALLATION

The 8120 Series Instruments can be operated as bench-top instruments or they can be rack- or panel-mounted. Dimensions for all three types of mounting and corresponding mounting instructions are given in the accompanying Signal Conditioner Instruction Manual. The following paragraphs provide the instructions for legend installation, scale selection, decimal point/dummy zero selection, and ac power connection.

Legend Installation

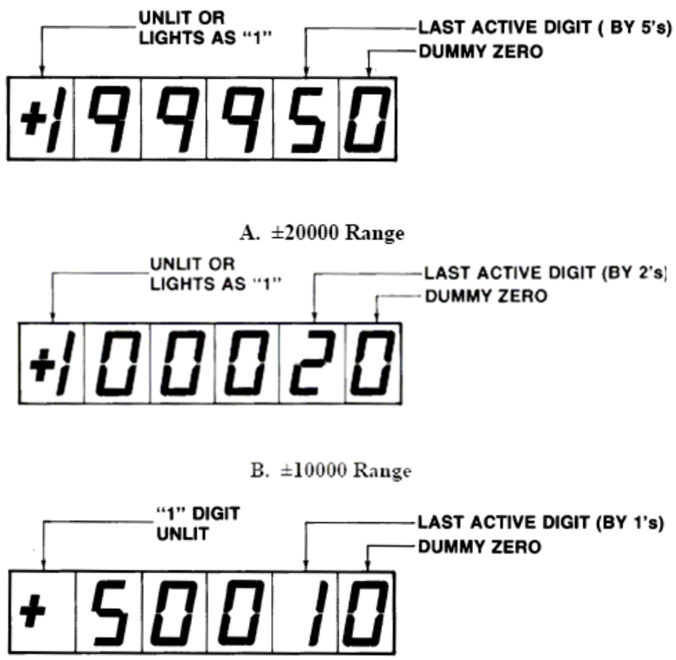
A sheet of dry-transfer lettering is supplied with each instrument to provide the user with a means of affixing an engineering-unit legend to the front panel. The sheet contains the common engineering units encountered in making electro-mechanical measurements and additional alphanumeric characters. Space is supplied on the front panel to affix the desired legend to the right of the display. To affix the legend to the front panel, press the dry-transfer sheet firmly against the panel with the desired legend or character situated in place. Rubbing the legend or character with a ballpoint pen will cause the legend to be transferred onto the panel. The legend can be protected from scratches, which may occur during calibration/operation of the instrument by lightly spraying it with Krylon #1306 Workable Fixative.

If it is desired to change a legend, remove the legend to be replaced by pressing masking tape against the legend, then pulling off the gummed tape.

Scale Selection.

Figure 2 shows the full-scale display for the three selectable scales: ±5000 counted by 1's, ±10000 counted by 2's, and ±20000 counted by 5's. The figure also indicates the last active digit and the dummy zero which can be lit for any scale selection. The first digit of the display contains the polarity sign and lights as 1 on the 10000 and 20000 scales for values equal to or greater than 10000. On the 20000 range, because the most significant digit is either unlit or a 1 and the count is by 5's, the greatest number which can be displayed is 19995. Of course, this would be displayed as 199950 if the dummy zero were lit.

Scale selection is accomplished with the two pushbutton switches located at the rear panel. The panel is marked to indicate which switches are pushed IN or left OUT for the corresponding scale selection. The switches have a push-push action and are illustrated, with the scale selection coding, in Figure 3. With both switches OUT, the ±5000 range is selected. With the left switch OUT and the right switch IN, the ±10000 range is selected. With the left switch IN and the right switch OUT, the ±20000 range is selected.



A. ±20000 Range

B. ±10000 Range

C. ±5000 Range

Figure 2 - Full-Scale Displays for 3 Ranges

Decimal Point/Dummy Zero Selection

Decimal-point location and dummy zero activation is selected with a rear-panel miniature slide switch bank. The switch bank is marked on the rear panel as shown in Figure 3. The decimal-point position can be fixed at any one of the display locations indicated on Figure 3. Place any one of slide switches 1 through 4 ON to light the decimal point at the desired location. Place slide switch 5 ON if no decimal point is to be lit. To activate the dummy zero (digit to the right of last active digit will continuously light as a zero), place slide switch 6 ON.

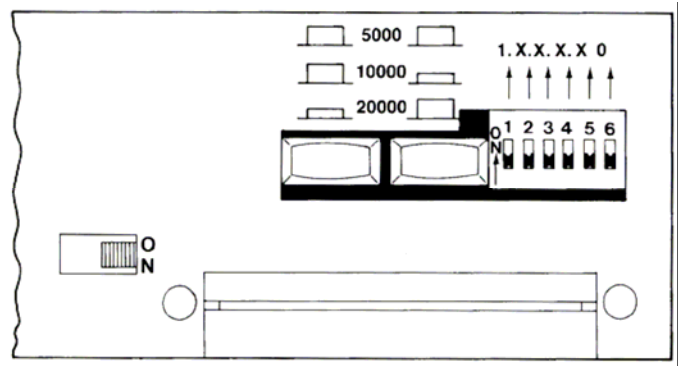


Figure 3 - Scale, Decimal Point, Dummy Zero Switches

AC Power Connection

To protect operating personnel, the 8120 Series Instruments are equipped with a three-conductor power cord. When the cord is plugged into the appropriate receptacle, the instrument is grounded. The offset pin on the power cord is ground. To maintain the safety ground when operating the instrument from a two-contact outlet, use a three-prong to two-prong adaptor and connect the green pigtail on the adaptor to ground.

To prepare the instrument for operation, connect the power cable to a 105-135 volt ac, 50-400 Hz power source. The instrument can use up to 5 watts of power.

3.0 OPERATION

The only operation required is turning ON/OFF ac power to the instrument. This is accomplished with the rear-panel slide switch (see Figure 3). The display lights immediately when ac power is ON.

NOTE: In all instances, a flashing display indicates that an overrange condition has occurred, and it is likely that the Signal Conditioner amplifiers are being overdriven. The 5000 and 10000 ranges are analog limited at approximately 5600 and 11200, and while a number may be displayed, if the display is flashing an overrange condition has occurred. Consequently, the displayed value may be invalid. The 20000 range is digitally limited to 19995. When an overrange occurs on this range, the display will flash all zeros.

4.0 BLOCK DIAGRAM DESCRIPTION

The purpose of this section is to explain how the Digital Indicator works by using a simplified block diagram. This section is not intended to provide a detailed explanation of electronic circuits for personnel untrained in electronic technology. However, it provides an adequate overview of operation for those familiar with basic electronic circuit operation. Throughout the following, refer to Figure 5.

Power Supplies

The integrated-circuit chips which comprise the A/D Converter and the Overrange Comparator are CMOS circuits which require ±9 volts regulated. These voltages are supplied from power supplies contained on the Signal Conditioner circuit board and are discussed in the Signal Conditioner Instruction Manual.

The digital part of the A/D Converter, the Bit Selector, and the various logic gates and inverters are operated from +5 volts regulated (TTL logic). The +5 volt supply consists of a three-terminal Regulator. The unregulated input to the Regulator is obtained from Signal Conditioner circuit board (unregulated side of +9 volt supply).

The BCD-to-7-Segment, Decoder, Display Drivers, and Display LED's operate from +6 volts unregulated. Five volts ac is supplied from the Signal Conditioner circuit board (secondary of power transformer located on board). Plus 6 volts unregulated is developed with a Diode Bridge and Filter located on the Digital Indicator board.

A +2.5 volts precision reference is supplied from a precision power supply located on the Signal Conditioner circuit board. This reference is used in the A/D Converter for digitizing the analog input signal.

A/D Converter

The A/D Converter is a dual-slope converter which digitizes the analog input signal using a ratiometric integrating technique. The analog signal input, a reference input, and a clock input are applied to the converter. The measurement cycle is divided into an Auto-Zero cycle, a Signal Integrate cycle, and a Reference Integrate cycle. Each cycle has a time base in which a certain amount of clock pulses occur. The clock used is a 100-kHz crystal oscillator. The Auto-Zero cycle is used to bring the output of the integrator to zero and lasts 10,000 counts. The next cycle is the Signal Integrate cycle which also lasts 10,000 counts. If the analog input is zero at the start of the Signal Integrate cycle, the integrator will see the same voltage that existed in the previous state. Thus, the integrator output will not change but will remain stationary during the entire Signal Integrate cycle. If the analog input is not equal to zero, an unbalanced condition exists compared to the Auto-Zero cycle and the integrator will generate a ramp whose slope is proportional to the analog input. At the end of this cycle, the sign of the ramp is determined. If the input signal was positive, a voltage which is VREF more negative than during Auto-Zero is applied to the integrator input. The A/D Converter chip generates the equivalent of a +Reference or –Reference from the single +Reference applied. The reference voltage returns the output of the integrator to zero. The time, or number of counts, required to do this is proportional to the input voltage. The Reference Integrate cycle can be a maximum of 20,000 counts. The full measurement cycle is then a maximum of 40,000 counts, with the answer to the measurement being achieved when the reference voltage returns the integrator output to zero. The full measurement cycle is shown in Figure 4.

The DIGIT DRIVES are positive-going signals that last for 200 clock pulses (see Figure 4). The scan sequence is D5 (MSD), D4, D3, D2, and D1 (last active digit). The scan is continuous unless an overrange occurs. Then all DIGIT DRIVES are blanked from the end of the first scan until the beginning of the Reference Integrate cycle when D5 will start the scan again. This gives a blinking or flashing display as a visual indication of overrange. Because the Digital Indicator has 5000 and 10000 ranges as well as a 20000 range, an analog Overrange Comparator is used as well as the inherent overrange capability of the A/D Converter.

The Overrange Comparator is described in a following paragraph.

The binary-coded-decimal (BCD) outputs of the A/D Converter are positive logic signals that go on simultaneously with the DIGIT DRIVE. Since the DIGIT DRIVES are blanked for an overrange on the 20000 scale, the display will flash all zeros when this condition occurs on this scale.

Input Attenuators/Range Switches

The 5-volt analog signal input (full scale) and the 2.5-volt reference from the Signal Conditioner are applied to attenuator networks where 2-volt and l-volt signal and reference inputs are developed for the A/D Converter. Since, on the 20000 range, the Reference Integrate cycle can be twice as long as the Signal Integrate cycle, the analog input voltage required to give a full-scale reading is exactly equal to 2 VREF. Consequently, on the 20000 range, the VREF is 1 volt and the VSIG is 2 volts for full scale. On the 10000 range, the two cycles can be equal; thus, VSIG = VREF = 2 volts. On the 5000 range, the analog voltage for a full-scale reading is then equal to 1/2 VREF; thus, VREF must be 2 volts and VSIG 1 volt. The appropriate levels are switched to the A/D Converter through the rear-panel Range switches.

Bit Selector/Decoding Logic

The Bit Selector transfers one of two sets of 4-line BCD data applied at input ports to output ports upon receiving a command at the A SELECT or B SELECT port. When the A SELECT port is high, the X input data is transferred to the Z output ports. Conversely, when the B SELECT input is high, the Y input data is transferred to the Z output ports. The Y data is obtained directly from the BCD output ports of the A/D Converter. The X data is comprised of specially coded bits used to count by 2' s or 5' s when the 10000 or 20000 ranges are selected, respectively. On the 5000 range, the A SELECT input is held low through the Range switches and the B SELECT input is high. The Y data is transferred to the output of the Bit Selector and the display count is by 1's. On the 10000 range, the A SELECT input is held low except when the Dl DIGIT DRIVE is high. When D1 is high, the A SELECT is high and the B SELECT is low, transferring the X data to the Z ports of the Bit Selector and allowing the display to count by 2's. Operation on the 20000 range is identical except that the bit coding is arranged to give a count by 5's with the X data.

Display Coding/Driving

The display is a 4.5-digit LED display with polarity and a dummy zero. DS2 through DS6 are 7-segment displays with common cathodes. The Bit Selector output ports are connected as inputs to a BCD-to-7-Segment Decoder. The 7 outputs of the decoder are connected as inputs to the segments (anodes) of DS2 through DS6. The DIGIT DRIVES of the A/D Converter are used to sequentially turn on DS2 through DS6 through Display Drivers which sink current. DS1 is either unlit or lights as a 1 for displays of 10000 or greater. Unlike DS2 through DS6, DS1 is a common anode device. The DS1 segments (cathodes) are sinked via a display driver from the 1 bit of the A/D Converter. The DS1 anode is then brought high by D5 through a driver comprised of an inverter and a transistor which applies +6 volts unregulated to the anode when D5 is high.

The last digit of the Display (DS6) is the dummy zero digit. When the Dummy Zero Select switch is ON, the DS6 cathode is sinked when D5 is high. The outputs of the BCD-to-7-Segment Decoder are tied to the DS6 segments. Also, when D5 is high, the B SELECT input to the Bit Selector is pulled low through the NOR gate connected to the port. The A SELECT input is also low since it is either held hard low through the Range switches on the 5000 range or it is connected to D1 through the Range switches on the 10000 and 20000 ranges (when D5 is high D1 must be low). With the A SELECT and B SELECT inputs both low, the Z ports of the Bit Selector assume the low state no matter what the X and Y input data reads. Consequently, each time D5 is high, DS6 displays a zero.

The polarity sign is also part of DS1. The minus (-) segment is always lit through 6 volts and an external resistor tied to circuit common. When the A/D Converter senses a positive polarity, the POLARITY port goes high. This action drives an inverter low to light the vertical portion of the polarity sign.

Decimal point position is selected with rear-panel slide switches (as is dummy zero selection). Only one of the Decimal slide switches is turned ON at any one time. The decimal point LED for DS1 is hard wired to +6 volts. Turning ON the associated Decimal switch connects an external resistor and circuit common to the other side of the decimal point LED. Since the remaining digits with decimal-point LED's (DS2 through DS4) are common cathodes devices, each LED is sinked when the corresponding DIGIT DRIVE is high and associated Decimal switch is ON, applying +6 volts to the other side of the LED through an external resistor.

Analog Overrange

Digital overrange for the 20000 range is inherent in the A/D Converter chip and has been previously described. However, for the 5000 and 10000 ranges, an analog overrange circuit is required. The Overrange Comparator is dc biased with equal resistors returned to the ±9 volt supplies so that its output is at approximately 4.5 volts. Both of the comparator inputs are connected through diodes to the analog input from the Signal Conditioner. When the analog input is one diode drop above or below the comparator biasing, an overrange condition exists since approximately 5.2 volts is present at the analog input (5 volts = full-scale value). The output of the Overrange Comparator goes low when either of the input diodes is forward biased. The comparator output and the BUSY output of the A/D Converter are gated through an OR gate. The BUSY signal is high during the Signal and Reference Integrate cycles of the A/D Converter, then it goes low. This causes the output of the OR gate to go low. The BLANK port of the BCD-to-7-Segment Decoder is normally held high through an external resistor. When the OR gate output goes low, the BLANK port is pulled low through a diode, causing DS2 through DS6 to flash. Since DS1 is not driven from the decoder, a second diode and resistor are used to pull the A/D Converter 1-bit output low when the overrange OR gate is low. This action causes DS1 to flash.

5.0 VERIFICATION OF NORMAL OPERATION

It is the purpose of this section to aid the user in rapidly determining whether the Digital Indicator is functioning normally or whether it is the source of the observed trouble. In the event a repair to the Digital Indicator is required, a complete parts list, schematic diagram, and component location drawing are included in this manual. The user may also contact the factory for assistance.

One of the two techniques can be used to rapidly determine whether the Digital Indicator is malfunctioning or whether the problem is in the Signal Conditioner, transducer, or transducer cabling. If the unit is a –_10A instrument (no Hi-Lo Limits), attempt to zero and calibrate the Signal Conditioner while observing the Signal Conditioner analog output (use the dc-to-2Hz output) on a dc-coupled oscilloscope. If the Digital Indicator is unstable or reads erratically, but the oscilloscope indicates a stable analog output from the Signal Conditioner, the problem is likely in the Digital Indicator. In the event the Signal Conditioner output is unstable or noisy, consult the Signal Conditioner Instruction Manual for the proper action to be taken.

If the instrument is a –_30A type, push one of the Limit pushbuttons and observe how the limit value is displayed on the Digital Indicator. If the display is stable with the Limit button pressed, but is unstable when the button is released, the problem is in the Signal Conditioner, transducer, or transducer cabling. If the display is unstable or erratic whether the button is pressed or released, the problem is in the Digital Indicator.

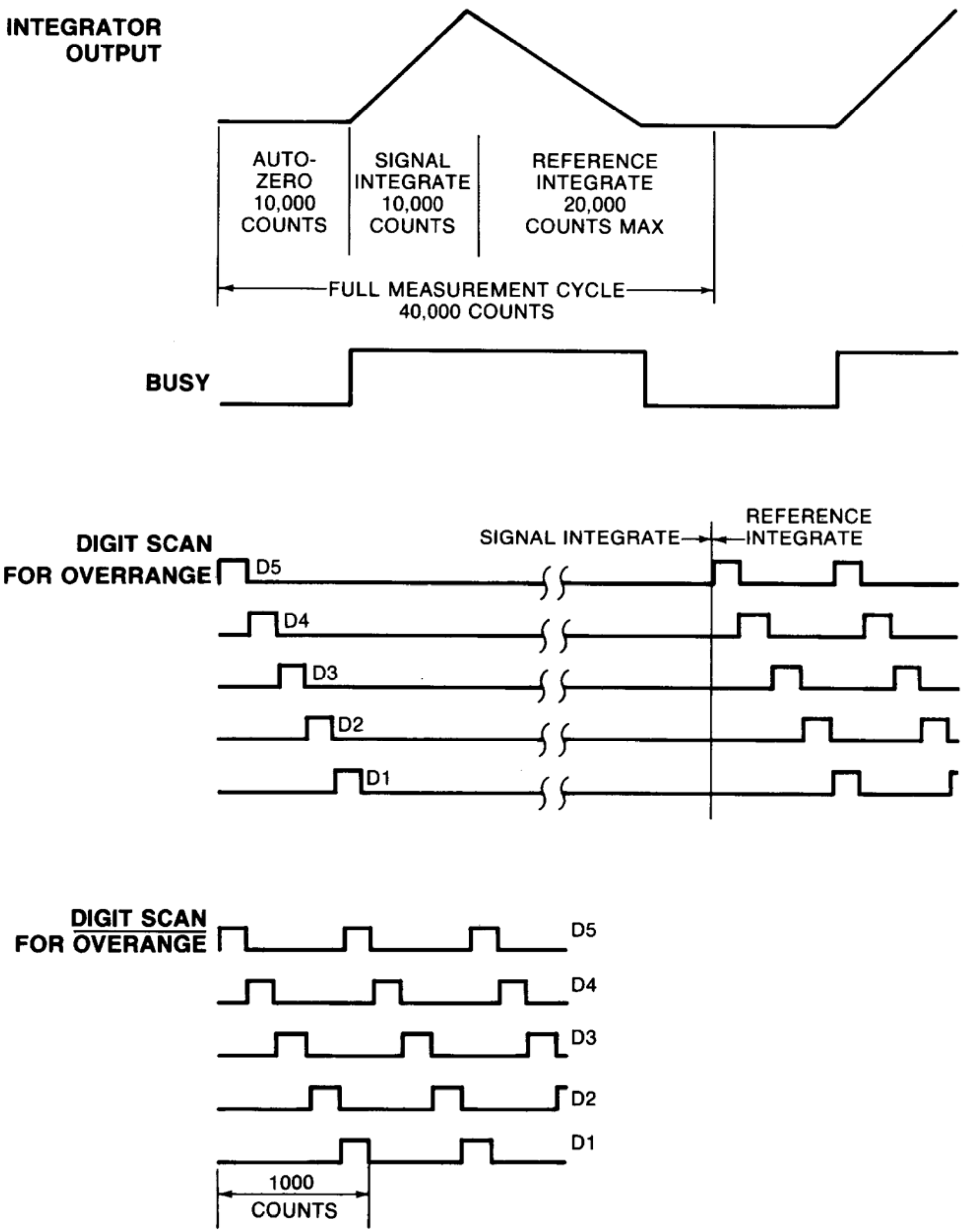


Figure 4 - A/D Converter Timing Diagram

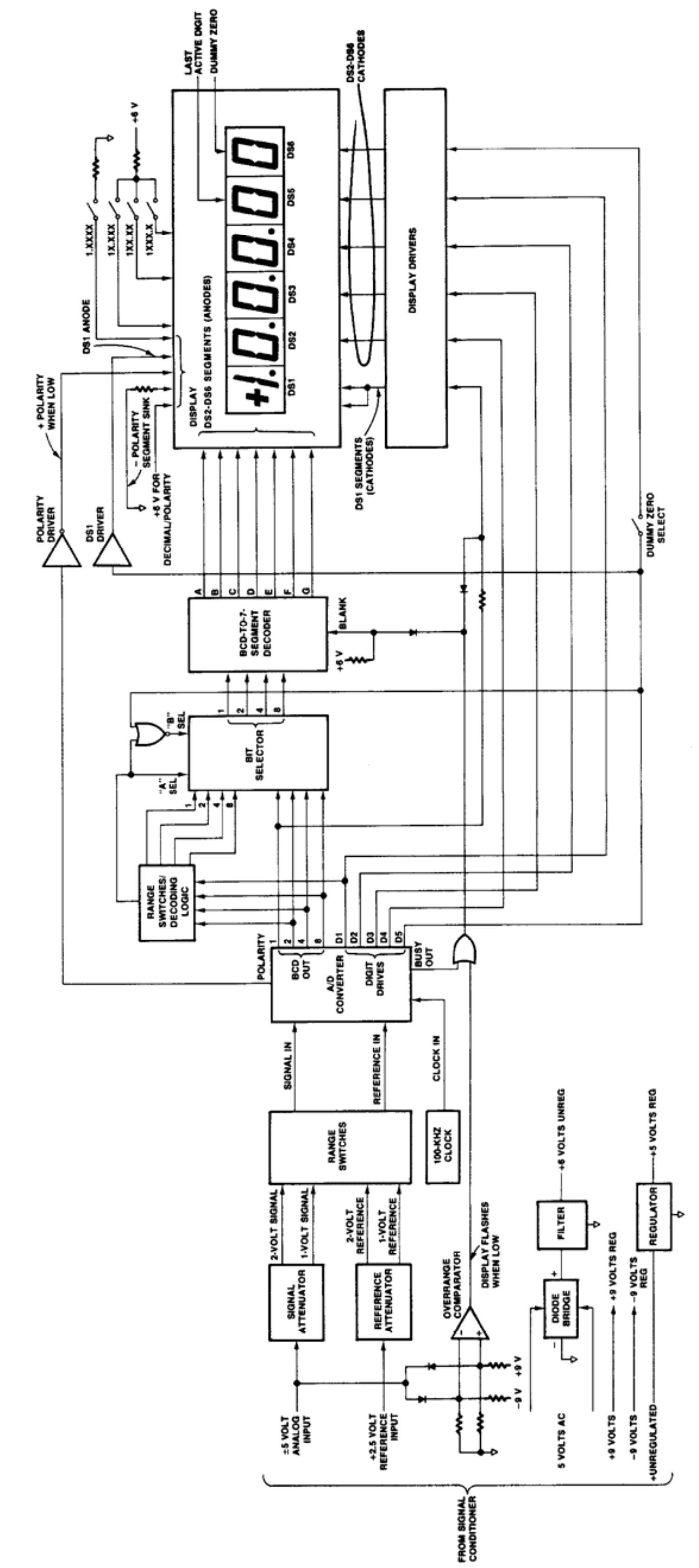


Figure 5 - Block Diagram

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Reference Figures

MANUAL NUMBER: 18222
REVISION: B
ECO NUMBER: 37012

1.0 DESCRIPTION

Model 8120-400A Transducer Signal Conditioner/Amplifier is designed for use with resistance strain gage transducers that require an AC excitation-amplification source. It supplies a 3.28 kHz frequency, precision amplitude-regulated excitation, which is remotely sensed to the transducer. The instrument uses a phase-sensitive carrier amplifier-demodulator design so that both direction and magnitude of the applied force are determined. The 8120-400A contains all necessary balancing and calibration controls and condition/amplify the applied input to a standard ± 5 volt DC analog output level. Two analog outputs, both having low-pass cutoff frequencies, one of 2 Hz and the other of 400 Hz, are provided. The filtered outputs provide for averaging of signals containing noise or other unwanted dynamic components that are periodic in nature.

The 8120-400A is used in applications involving transformer coupling of the strain gage bridge (rotary transformer coupled torque sensors for example), and in applications that require a high sensitivity (amplification) with optimum "signal to noise" characteristics. Carrier amplifiers offer higher sensitivity than comparable DC-excited bridge amplifiers, and since they respond only to the modulated carrier frequency, they reject certain extraneous voltages that cause interference with DC-excited bridge instruments.

Note: If you have a PCB rotary transformer torque sensor, please refer to Section 3 of this manual, or to either the 4100 Series Rotary Transformer Torque Sensor Manual (PCB Manual #18227), or the 4200 Series Rotary Transformer Torque Sensor Manual (PCB Manual #18228), for calibration procedures.

Calibration of the instrument is made through conventional shunt technique, using an internally installed calibration resistor, or an external shunt calibration reference, such as our Model 8113A or 8113-105A Shunt Calibration References. Front panel calibration buttons provide for calibration in both the positive and negative directions. An internal symmetry control provides independent adjustment of the negative direction sensitivity for transducers that do not have symmetrical positive and negative slope characteristics. Positive direction calibration can be checked by means of REMOTE CAL terminals on the instrument I/O connector.

The 8120-400A Strain Gage Conditioner is also available in two additional forms. The 8120-410A is similar to the 8120-400A except it also contains a dedicated 4.5 digit LED display with a 3Hz update rate. The resolution of the digital display is 1:5000 (0.02% FS). The display also has a selectable decimal point, trick count multiplier, and a trailing inert zero. For more information on instruments with digital display, refer to PCB Manual #27259. The Model 8120-430A contains a Limit section (in addition to a Digital Indicator) that provides High/OK/Low indications and outputs. Refer to PCB Manual #19479 for more information. The Digital Indicator and Limit features are standard to all 8120 Series Instruments.

2.0 INSTALLATION AND CABLING

The following paragraphs provide the instructions for instrument installation and cabling.

Mounting

The 8120 Series Instruments can be operated as bench-top units or they can be rack or panel mounted. Clearance dimensions for a bench-mounted instrument are given in Figure 1 and cut-out dimensions for panel mounting are shown in Figure 2.

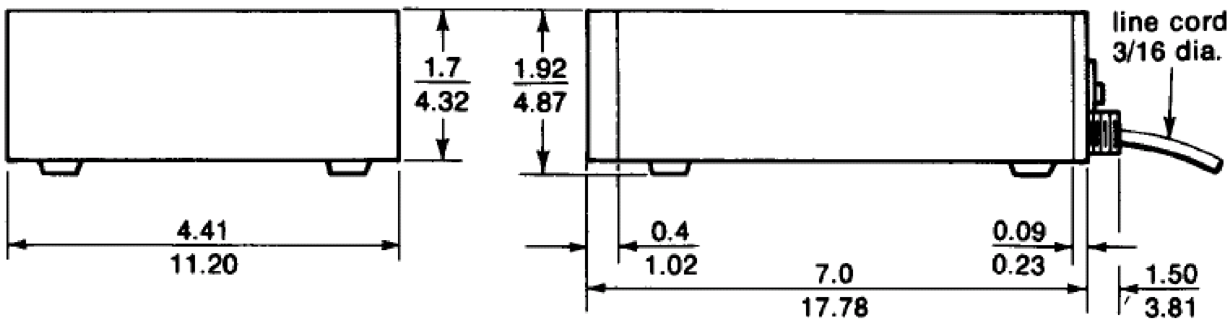


Figure 1 – Bench Mounting Clearance Dimensions

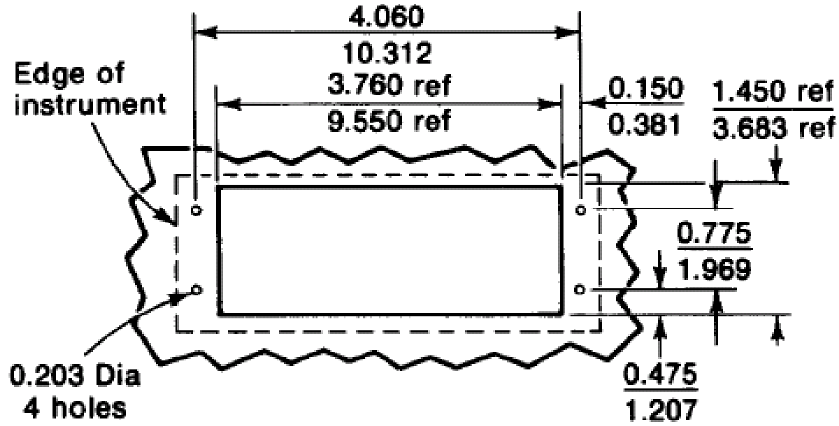


Figure 2 – Panel Mounting Cut-Out Dimensions

To panel mount an instrument, proceed as follows, referring to Figure 3.

Important: The unit is shipped with two spacer washers on the securing screws of the rear-panel I/O connector. When panel-mounting the unit, you *must* remove these washers so that the printed circuit board may move forward about 1/8" during Step (6).

1. Remove the front panel by removing the two #2-56 x 3/8" flat-head screws.

2. Remove the front bezel by removing the four #6-32 x 5/8" fillister-head screws.

3. Make the panel cut-out and drill the screw clearance holes indicated in Figure 2. The front bezel can be used as a template to define the rectangular cut-out and locate the clearance holes.

4. Hold the instrument enclosure behind the panel and re-attach the front bezel to the enclosure from the front of the panel with the four remaining screws.

5. Reinstall the front panel.

6. Tighten the two securing screws of the rear panel I/O connector to ensure that the connector is seated and that the conditioner printed-circuit board is pushed fully forward so that the front-panel screwdriver adjustments and buttons are accessible. These screws give approximately 1/8 inch adjustment; consequently, this is the maximum panel thickness that should be used.

Caution: Do not over tighten the connector securing screws or resultant damage may occur to the printed-circuit board.

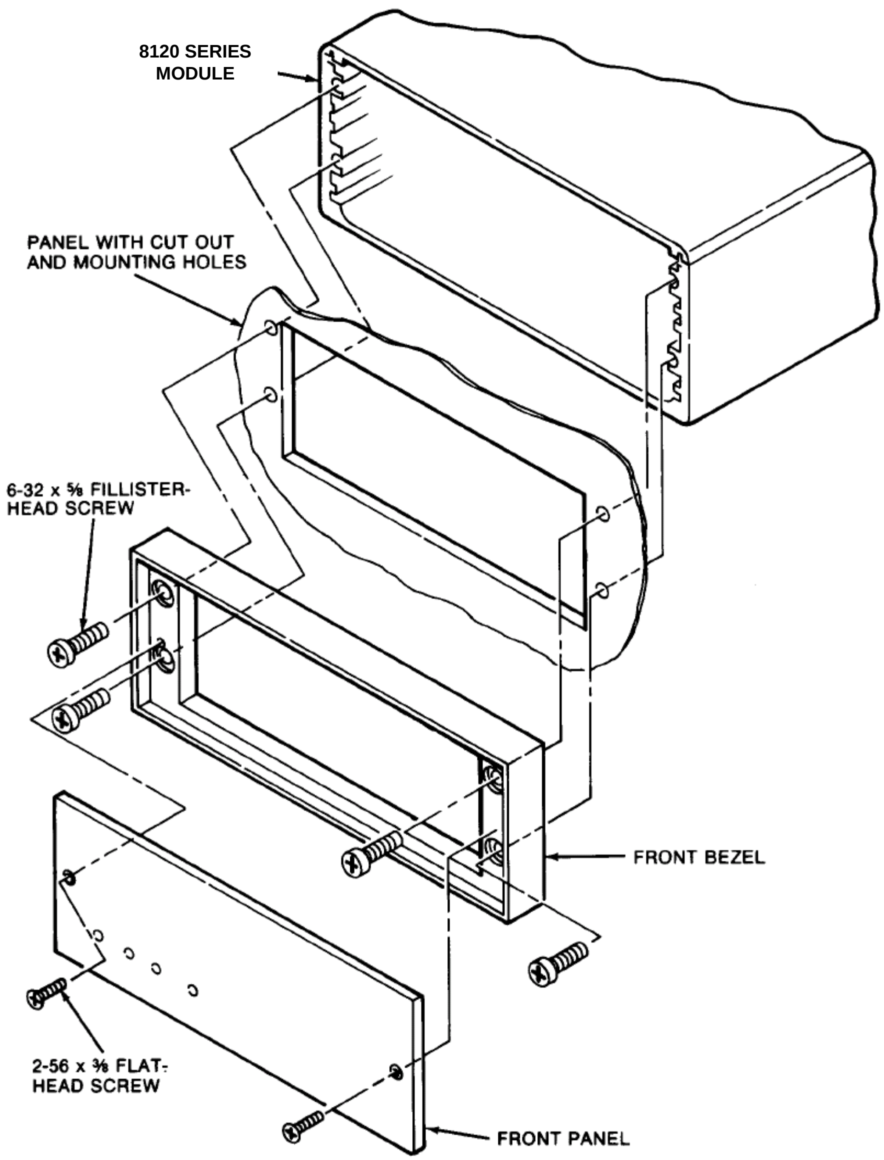


Figure 3 – Panel Mount Assembly

To rack mount an instrument, refer to Figure 4. Up to four 8120 Series Instruments can be mounted in a 19-inch rack using the 1.75-inch high Model 8171A Rack Adaptor.

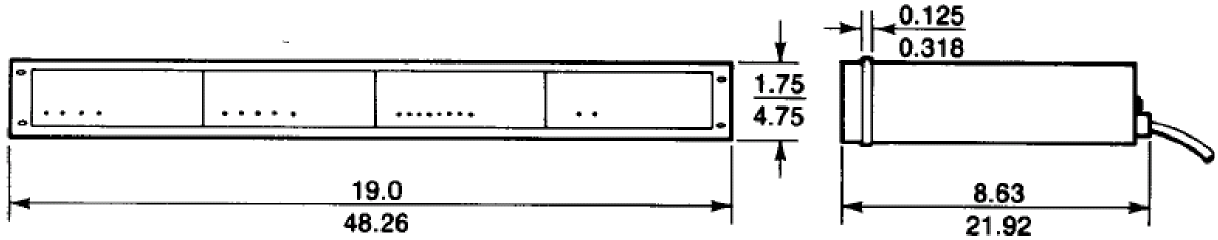


Figure 4 – Rack Mounting Dimensions

AC Power Connection

To protect operating personnel, the 8120 Series Instruments are equipped with a three-conductor power cord. When the cord is plugged into the appropriate receptacle, the instrument is grounded. The offset pin on the power cord is ground. To maintain the safety ground when operating the unit from a two-contact outlet, use a three-prong to two-prong adaptor and connect the green pigtail on the adaptor to ground.

To prepare the instrument for operation, connect the power cable to a 105-135 volt AC, 50-400 Hz power source. The instrument can use up to 5 watts of power.

Calibration Resistor

If a fixed resistor is shunted across one arm of a strain gage Wheatstone Bridge, it produces an unbalance equivalent to that of a particular value of mechanical input. If this Equivalent Input value is accurately known, it can be used as a reference point for shunt calibration of the system. Upon completion of installation of the transducer and its associated cabling, the user can:

1. Perform an overall dead weight calibration using a precisely known value of mechanical input. Shunt calibration data then can be collected by means of the installed calibration resistor for convenience in subsequent checking.

2. Replace the installed calibration resistor with one (or an equivalent resistance value) supplied by the transducer manufacturer to achieve a precisely known Equivalent Input allowing the instrument sensitivity to be adjusted correctly.

3. Determine the Equivalent Input value for the installed calibration resistor, knowing the transducer sensitivity, and adjust the instrument sensitivity accordingly.

4. A precision 59KΩ calibration resistor is installed in the 8120 at the factory. The installed resistor can usually be used even though the transducer calibration data mentions some other resistance value. In Section 3 of this manual, the techniques described above are demonstrated. If, however, the installed value of calibration resistor is not appropriate for the transducer and measurement range to be used, the 59KΩ resistor should be replaced at this time. The calibration resistor is mounted on solder terminals located at the front edge of the conditioner printed-circuit board in the instrument. It can be accessed by removing the front panel.

Note: PCB 4200 Series Rotary Transformer Torque Transducers are supplied with the appropriate calibration resistor integral to the transducer. When this type of transducer is used with the 8120-400A, it is not necessary to remove the 59KΩ resistor internal to the instrument. The calibration resistor can be appropriately connected to the 8120-400A calibration circuit via the transducer cabling. Refer to **Figure 5** and the following section.

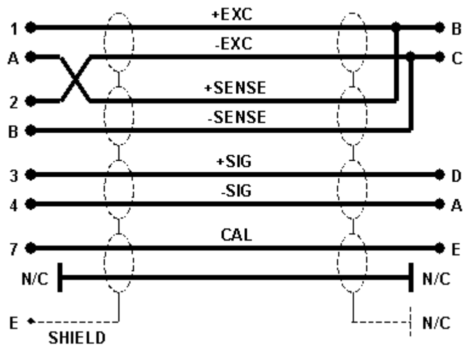
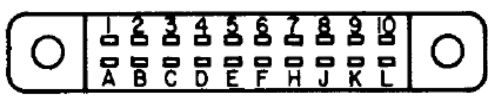


Figure 5 – PCB 4200 Series Cabling

Transducer Cabling

Cabling to the transducer is accomplished via the supplied instrument I/O connector (PCB Model 182-015A). The I/O connector pin numbers and functions are given in **Figure 6**.



Rear View

PIN		PIN	
1	+EXCITATION	A	+SENSE
2	-EXCITATION	B	-SENSE
3	+SIGNAL INPUT	C	CALIBRATION SENSE
4	- SIGNAL INPUT	D	OSC. DISABLE
5	SIGNAL COMMON	E	TRANSDUCER CABLE SHIELD
6	OSC. INPUT	F	OSC. OUTPUT
7	NC	H	ANALOG OUTPUT
8	REMOTE CALIBRATION	J	ANALOG OUTPUT
9	OUTPUT SHIELD	K	NC
10	OUTPUT SIGNAL COMMON	L	NC

Figure 6 – 182-015A Pin Out

Transducer cabling should take the form of a 4, 6, or 8-wire cable configuration. The 4-wire configuration, shown in Figure 7, should be used when overall deadweight calibration is the method used and the required cable length is less than 20 feet.

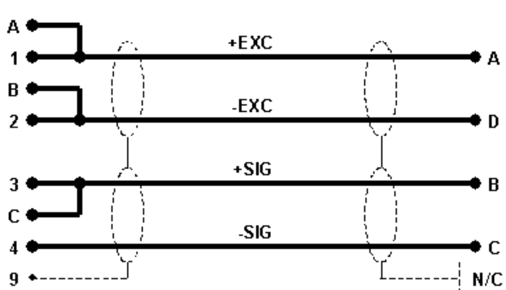


Figure 7 – 4 Conductor Cabling

The 6-wire configuration, shown in Figure 8, should be used when the instrument is to be calibrated by achieving a precisely known Equivalent Input value through the use of a shunt calibration resistor supplied by the transducer manufacturer and when the required cable length is less than 20 feet.

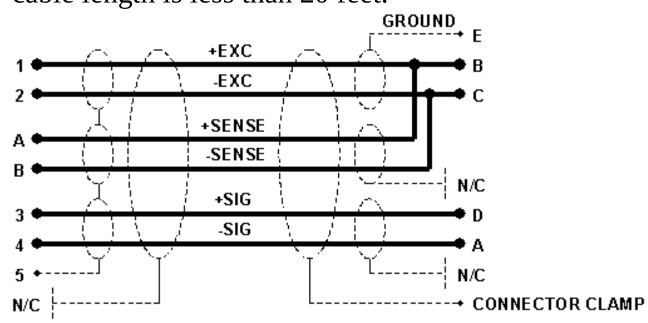


Figure 8 – PCB 4100 Series Cabling

The 8-wire configuration, shown in Figure 9, should be used with cable lengths longer than 20 feet since the excitation voltage is sensed and regulated at the transducer and optimum shunt calibration can be achieved.

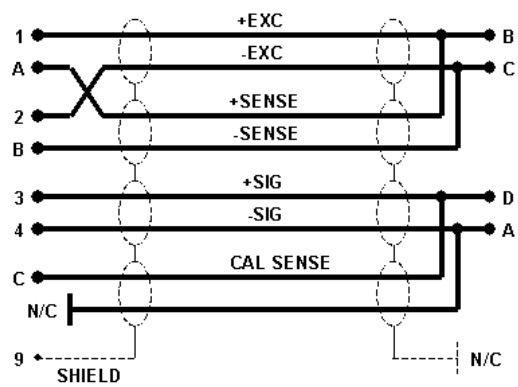


Figure 9 – 8 Conductor Cabling

Remote Calibration Check

The instrument can be placed in the calibration mode (positive realm only) by shorting pins 5 (Signal Common) and 8 (Remote Cal) of the rear-panel I/O connector. Figure 10 indicates three methods of remotely entering the calibration mode (external switch, transistor, or TTL source).

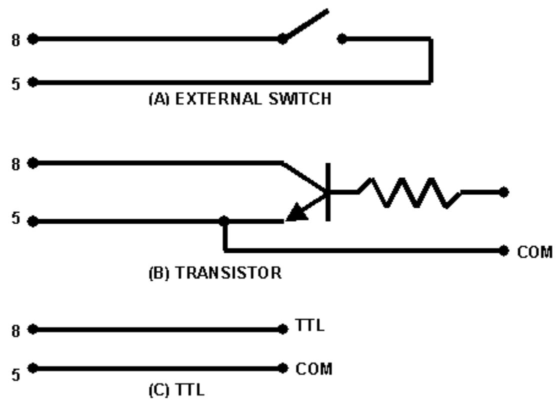


Figure 10 – Remote Calibration Methods

Master/Slave Connections

When more than one 8120-400A (or a combination of AC Carrier Conditioners) is being used in a measurement setup (instruments are continuously mounted or the transducer cabling is in a common conduit or raceway), beat frequencies may be produced from the 3-kHz oscillators used in the instruments to power the transducer(s) excitation. To prevent beat frequencies from occurring, one unit can be designated the Master, and the other units can be driven from the Master oscillator. The remaining units are designated as Slave instruments. To connect as Master/Slave units, refer to Figure 11.

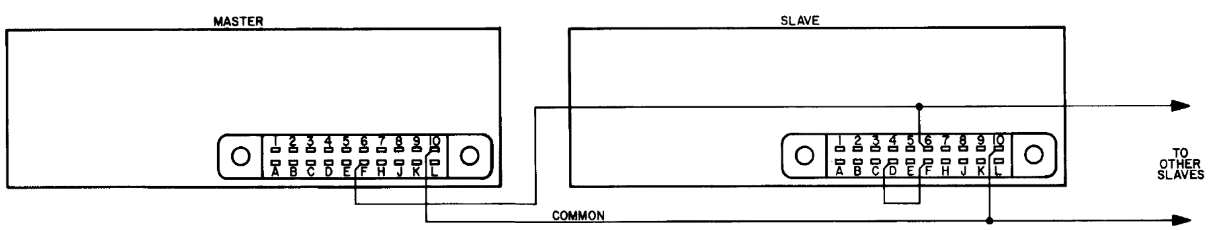


Figure 11 – Master/Slave Connections

Analog Outputs
Two analog outputs are simultaneously available at the instrument I/O connector, with each output having a different passband: DC to 2 Hz and DC to 400 Hz. The cutoff frequencies are achieved with active low-pass filters. When the DC to 2 Hz output is used, a trade off is made between noise elimination and increased time-to-answer, or slew time. Each output has a 60db rolloff a decade from the cutoff frequency.

The filter characteristics are given by the following equations:

$$A_{out} @ f_0 = 0.7\ A_{in}$$
$$A_{out} @ 10f_0 = 0.001\ A_{in}$$
$$T = 1.4/f_0$$

where A_{out} = output amplitude
A_{in} = input amplitude
f_0 = selected cutoff frequency
T = time-to-answer in seconds (output of filter within 0.1% of final value after step function is applied).

3.0 CALIBRATION

This section contains the instructions for calibrating the 8120-400A. Included is a functional description of the instrument front-panel (see Figure 12). To perform calibration, proceed as follows.

1. Turn power ON by placing the rear-panel slide switch in the ON position. The front-panel indicator should light to indicate the application of AC power. Allow 5 minutes of warm-up for stabilization of transducer characteristics.

2. Make sure the transducer is unloaded and is free from locked in torque or load by releasing one end. Zero the output reading with the Fine and Coarse R balance controls.

3. Press the NULL button and adjust the C BALANCE control to obtain the minimum (least positive, most negative) output reading. In some instances, an integral digital indicator will be used to display the conditioner output (Model 8120-410A or 8120-430A). When only the conditioner is supplied (8120-400A), an external indicator must be used to monitor the conditioner output. Release the NULL button. This step need only be performed one time for any transducer/cable combination.

Dead Weight Calibration

1. Load the transducer in the positive direction with a convenient dead weight value that is greater than one half of full scale. The following step is only for Rotary Transformer Transducers. If not using a Rotary Transformer Transducers, skip to step 2.
   1a. Remove the 8120's front panel (one small flat-head screw near each edge) to access the SYMMETRY and PHASE adjustments. Adjust the PHASE control (the one to the extreme right), until a maximum output value is obtained. Once set for your transducer, this PHASE adjustment step need not be repeated unless a great change in cable length or capacitance is required.

2. Adjust the Coarse and Fine SPAN controls until the output value equals the dead weight value. Remove the dead weight, and then press the +CAL button, noting the indicator reading obtained. In future calibrations, you need only press the +CAL button and adjust the SPAN controls until you obtain the previously recorded dead weight reading.

3. If the transducer is to be also used in the negative direction, load the transducer in the negative direction with the same dead weight value as used in step (1) and confirm that the dead weight reading obtained is the same as that of step (1). If not, see steps (4).

4. An internal SYMMETRY adjustment is provided to compensate for transducers that do not have symmetrical sensitivity characteristics. This adjustment is factory set assuming symmetrical characteristics. If

step (3) indicates that a field adjustment is necessary, proceed as follows:

- ✓ Remove the front panel by removing the two #2-56 flat head screws to obtain access to the SYMMETRY adjustment.
- ✓ With the transducer loaded as in step (3), adjust the SYMMETRY control (just to the right of the –CAL button) to obtain a dead weight reading equal to that obtained in step (3).

Shunt Resistor Calibration
If dead weight calibration is not practical and the transducer manufacturer has supplied a calibration resistor (or resistor value), install the recommended calibration resistor in place of the installed 59KΩ resistor as discussed in Section 2. If you purchased a complete system from PCB Piezotronics, this step may not be necessary. Please consult our factory.

1. Complete steps (2) and (3). Now press the +CAL button and adjust the PHASE control until a maximum output reading is obtained. Once set for your transducer, this PHASE adjustment step need not be repeated unless a great change in cable length or capacitance occurs.

2. Next adjust the SPAN controls until the instrument output is equal to the Equivalent Input value simulated by the installed resistor. Now release the +CAL button.

3. If a negative Equivalent Input value is also provided (as in the case of PCS's calibration sheet), press the –CAL pushbutton and confirm that the negative value can also be obtained with the same setting of the Coarse and Fine controls. If not, adjust the Symmetry control to obtain the negative Equivalent Input value.

4.0 CALIBRATION OF PCB ROTARY TRANSFORMER TORQUE SENSORS

Shunt calibration of the Model 4100 Torque Sensor Series is done utilizing the PCB Model 8113-105A or 8113A Calibration Reference Box.

Preparation
Do not follow the procedure, in Section 2 for replacement of the shunt calibration resistor since a calibration resistor is included with each PCB Rotary Transformer Torque Sensor. It should already be installed in the Calibration Reference Box Model 8113-105A or 8113A.

Calibration with 8113-105A Calibration Reference Box
A Model 8113-105A Calibration Reference Box is shipped with each PCB 4100 Series rotary torque sensor and contains a precision shunt calibration resistor for performing calibration of the 8120-400A/410A instrument. The box mounts directly on the edge connector at the rear panel. It is activated with a DC powered internal relay. A 5 VDC excitation must be provided in series with a remote ON-OFF switch in order to activate the relay to the ON position. The internal resistor of the 8120-400A/410A is bypassed when using a Model 8113-105A reference box.

Calibration Procedure
Both the transducer cable and 8113-105A reference box should always be connected to the 8120-400A/410A instrument.

1. With the relay OFF, zero the output reading with the Coarse and Fine R balance controls.

2. Turn the relay ON.

3. Zero the output again with the Coarse and Fine R balance controls.

4. Push the +CAL button and adjust the SPAN such that the reading matches the +CAL value on the transducer calibration sheet.

5. Release +CAL and check zero; adjust if necessary. Check +CAL and adjust if necessary. Repeat steps (4) and (5) until zero and span are correct.

6. Push the -CAL button and adjust the SYMMETRY pot located behind the front panel to the right of the –CAL button, until the reading matches the –CAL value on the transducer calibration sheet.

7. Turn the relay OFF.

8. Check and adjust zero per step (1). No further adjustment is required with the relay ON, even if the zero changed from step (1).

Calibration with 8113A Calibration Reference Box

The Model 8113A Calibration Reference Box may be used in some cases and contains a precision star bridge and two position rotary switch that allows the user to switch to either CAL mode or RUN mode.

Calibration Procedure

1. Switch the 8113A to the RUN position and zero the output reading with the Coarse and Fine R balance control.

2. Switch the 8113A to the CAL position.

3. Zero the output again with the Coarse and Fine R balance controls.

4. Push the +CAL button and adjust the SPAN such that the reading matches the +CAL value on the transducer calibration sheet.

5. Release +CAL and check zero; adjust if necessary. Check +CAL and adjust if necessary. Repeat steps (4) and (5) until zero and span are correct.

6. Push the -CAL button and adjust the SYMMETRY pot, located behind the front panel to the right of the –CAL button, until the reading matches the –CAL value on the transducer calibration sheet.

7. Switch the 8113A to the RUN position and check the instrument zero and adjust per step (1).

8. No further adjustment is required with the 8113A in the CAL position, even if the zero changed from step (1).

5.0 TROUBLESHOOTING

If the instrument is suspected of faulty operation, observe the following steps:

1. If the unit is totally inoperable (front panel power indicator does not light), check the primary power fuse (F1) located on the standup board that forms the power cord connection point. If the fuse is blown, replace it with a 0.50 ampere fuse of equivalent manufacture. Before reapplying power, visually inspect the power cord and the input power connections for anything that could have caused the overload.

2. The inability to balance correctly where the instrument output reads totally off-scale and the balance controls have no authority can very likely be the result of a damaged, or defective transducer or cable. This possibility can be confirmed, or eliminated, by substituting a transducer and or cable known to be in good condition or by simulating a balanced transducer. PCB supplies a simple Star Bridge consisting of four precision resistors mounted on a female circuit board edge connector that is supplied in the shipping box. Use the Star Bridge by plugging it into the back of the 8120 as if it were a transducer and interconnect cable and proceed with a calibration again. If the instrument works okay and a satisfactory calibration is achieved, then the transducer or cable is faulty. If a satisfactory calibration is not achieved, then the instrument is at fault.

3. Step (2) above is to be used only to verify instrument operation. Calibration instructions, found in Section 3 of this manual, must be completed before the Instrument and Transducer are used.

Note: The user can contact the factory for assistance. See the front page of this manual for phone and fax numbers for the factory.

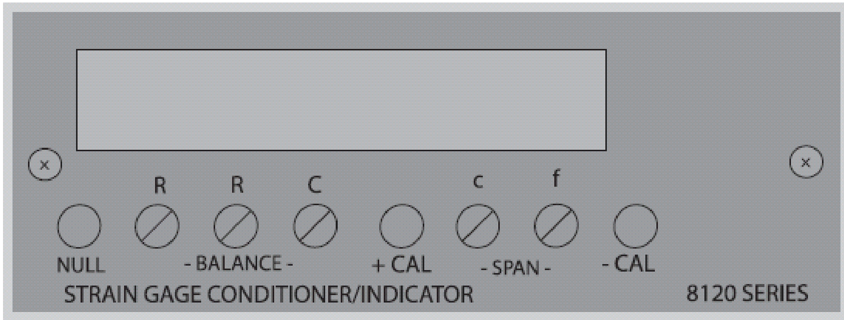


Figure 12 – Front Panel

R and C Balance Controls
These controls are used to set the output to zero when the transducer is unloaded.

NULL Pushbutton
This pushbutton is pressed when nulling the transducer bridge with the R and C Balance controls. It provides for non-synchronous demodulation of the carrier for balancing purposes. After a minimum reading is obtained on the display device by adjusting the C control, the push-button is released and the output is zeroed using the R controls.

SPAN Controls
The Coarse and Fine SPAN controls are used to set the output to the dead weight value when dead weight calibration is used. They can also be used to set the output to the Equivalent Input value when the CAL (+ or -) button is pressed.

CAL Pushbuttons
The +/–CAL pushbuttons provide for shunt calibration in the positive and negative directions, respectively. They are used in conjunction with the SPAN controls to calibrate the instrument. When both positive and negative direction calibration is required, the +CAL button is used in conjunction with the SPAN controls and the –CAL button is used with the internal SYMMETRY adjustment.

PHASE Control
The PHASE Control is used to give maximum output possible when a transducer and cable are connected to the instrument. The pot is accessed by removing the front panel. It is located to the extreme right.

SYMMETRY Control
The SYMMETRY Control is used to compensate for transducers that do not have symmetrical sensitivity characteristics in compression/tension for load cells, or CW/CCW rotation for torque sensors. The pot is accessed by removing the front panel. It is located to the right of the -CAL button.

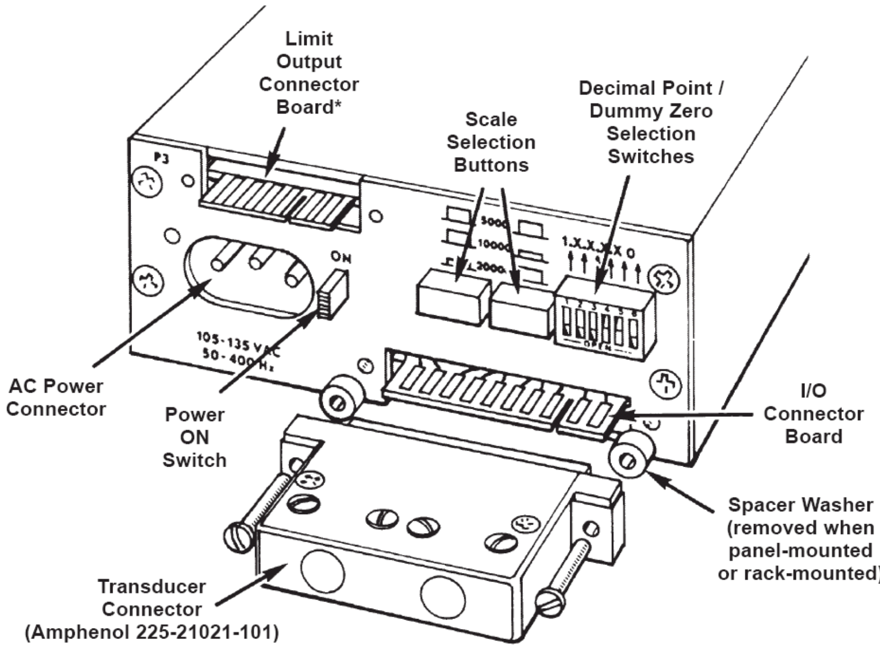


Figure 13 – Rear Panel

Decimal Point / Dummy Zero Switches
These switches, located in the upper right corner of the panel, place the decimal point in its proper place for the measurement range. Moving one of the switches places the decimal point at the selected position on the front panel display. Switching the rightmost switch "ON" causes an inert zero to be displayed.

Scale Selection Buttons
These pushbuttons control the range shown on the front panel display. For instance, if both pushbuttons are left fully extended rearwards, the full-scale display will read 5000. Pushing the left button in and leaving the right button extended out will cause the full scale display to be a maximum of 20000.

Input Power
The input power receptacle and the power ON/OFF switch are at the left side of the rear panel.

I/O Connector Board
The circuit board connector, marked P1, supplies the total interface to the transducer. See Section 2 for proper cable circuitry. Additional cable diagrams are shown in each PCB Transducer manual.

Model Number	STRAIN GAGE SENSOR SIGNAL CONDITIONER	Revision: A
8120-410A		ECN #: 24069

Bridge Resistance (4-arm)	ohm	90 to 1000	
Bridge Excitation	kHz	3.28 (regulated)	
	VAC (RMS)	2	[1]
Accuracy	%	+/-0.05	[4]
Balance Range	Mv/V	+/-1.5	[2]
Span Range	Mv/V	0.5 to 5	[2] [4]
Active Filter	Hz	2, 400	[3]
Analog Output (dc to 2 Hz)	volts	0 to +/-5	
Analog Output (dc to 400 Hz)	volts	0 to +/-5	
Output Ripple and Noise	% (RMS)	0.02 (2 Hz filter)	[4]
	% (RMS)	0.15 (400 Hz filter)	[4]
Display Type		0.4 in (10.2 mm) LED	
Display Range		+/-99,999 (5 digits)	
Decimal Point		Adjustable via rear switches	
Scaling		+/-5000 by 1's +/-10000 by 2's +/-20000 by 5's	
Sampling Rate		3 samples per second	
Shunt Calibration		Actuated via front panel	
Shunt Calibration Resistor		Accessible through rear panel	
ELECTRICAL			
Power Supply Requirement	VAC	105 to 135	
	Hz	50 to 400 at 5 watts max.	
ENVIRONMENTAL			
Operating Temperature Range	°F [°C]	0 to +130 [-18 to +54.4]	
PHYSICAL			
Connectors: Input/Output	type	20-pin card edge	
AC (power) Input	type	IEC 320	
Size (H x W x D):	in	1.7 x 4.41 x 8.5	
	[mm]	[43.2 x 112.0 x 215.9]	
Weight	lb [kg]	2 [0.9]	

All specifications are at room temperature unless otherwise specified.

OPTIONAL VERSIONS

Optional versions have identical specifications and accessories as listed for the standard model except where noted by the letter prefixes below. More than one option may be used.

- ❑ B- 12 VDC Battery-powered operation
- ❑ C- 4-20 mA Current Output
- ❑ F- Nominal 230 VAC operation
- ❑ G- Galvanic isolated outputs
- ❑ P- Analog peak capture

NOTES:

[1] Nominal
[2] 10-turn coarse and fine adjust
[3] Selectable
[4] Full Scale

SUPPLIED ACCESSORIES:
AC Line Cord (1)
Star Bridge Sensor Simulator (1)
Model 182-015A Mating Connector (1)

Drawn: BLS	Engineer: DMB	Sales: MFG	Approved: MJK	Spec Number:
Date: 4-12-06	Date: 4/13/06	Date: 4/14/06	Date: 4-10-06	32389

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