

## Precision Low-Noise DC Amplifier Model 121



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## Warranty

Measurement Specialties, Inc. accelerometers are warranted during a period of one year from date of shipment to original purchaser to be free from defects in material and workmanship. The liability of Seller under this warranty is limited to replacing or repairing any instrument or component thereof which is returned by Buyer, at his expense, during such period and which has not been subjected to misuse, neglect, improper installation, repair, alteration, or accident. Seller shall have the right to final determination as to the existence and cause of a defect. In no event shall Seller be liable for collateral or consequential damages. This warrant is in lieu of any other warranty, expressed, implied, or statutory; and no agreement extending or modifying it will be binding upon Seller unless in writing and signed by a duly authorized officer.

## Receiving Inspection

Every Measurement Specialties, Inc. accelerometer is carefully inspected and is in perfect working condition at the time of shipment. Each accelerometer should be checked as soon as it is received. If the unit is damaged in any way, or fails to operate, a claim should immediately be filed with the transportation company.

## Service Concerns

If a Measurement Specialties, Inc. instrument requires service, first contact the nearest Measurement Specialties, Inc. representative. They may be able to solve the problem without returning the unit to the factory. If it is determined that factory service is required, call Customer Service at the regional headquarters for an RMA number before return.

## Returns

All units being returned to the factory require an RMA (Return Material Authorization) number before they will be accepted. This number may

be obtained by calling Customer Service at the regional headquarters with the following information; model number(s), quantity, serial number(s), and symptoms of the problem, if being returned for service. You must include the original purchase order number if under warranty.

## Recalibration Services

The Vibration Sensors Design Center and its two manufacturing facilities in China and France offer factory re-calibration services for Variable Capacitance, Piezoresistive, Piezoelectric (including IEPE, ICP etc.) accelerometers and Electronics. NIST (US), DKD (Germany), COFRAC (France) traceable calibration services on sensitivity at 100 Hz (102 or 120 Hz in Europe) and full frequency sweeps are offered. Contact the regional headquarters for pricing information.

## Inquiries

Address all inquiries on operation or applications to your nearest Sales Representative, or to the Vibration Applications Support as follows:

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## Table of Contents

<b>1.0</b>	<b>Description</b>
1.1	Key Features
1.2	Safety
<b>2.0</b>	<b>Functional Characteristics</b>
2.1	Excitation Voltage
2.2	Sensor Sensitivity
2.3	Output Scaling
2.4	Gain
2.5	LP Filter
2.6	Auto-Zero
2.7	Shunt Calibration
2.8	Monitoring State
2.9	Fault Indication
<b>3.0</b>	<b>Operation</b>
3.1	Channel Selection
3.2	Function Selection
3.3	Edit and Display
<b>4.0</b>	<b>Wiring Connection</b>
4.1	Simple Hookup for Bridge Type Sensors
4.2	Full Hookup for Bridge Type Sensors
4.3	Hookup for Transducers Requiring Dual Excitation
4.4	CH1, CH2 and CH3 Transducer Connector
<b>5.0</b>	<b>Front Panel</b>
<b>6.0</b>	<b>Rear Panel</b>
6.1	Input and Output Impedances
6.2	Excitation Output Limit
6.3	Power Requirement
<b>7.0</b>	<b>Location of Filter Modules</b>
<b>8.0</b>	<b>Specification</b>
<b>9.0</b>	<b>Dimensions</b>
<b>10.0</b>	<b>Calibration and Repair</b>
<b>11.0</b>	<b>Ordering Information</b>

## 1.0 Description

The Model 121 is a 3-Channel DC Differential Amplifier designed to be used with bridge type or differential output accelerometers, pressure transducers, and load cells. The amplifier offers an exceptionally low input noise floor of  $<20\mu\text{Vrms}$  and wide bandwidth, out to 200 kHz, ideal for transient measurements.

With the Model 121, the user can instantly program gain or output scaling, and activate Auto-Zero controls for each channel using the front panel push-buttons. Its microprocessor employs a sleep mode in order to eliminate clock frequencies after setup is complete. Useful features are shunt calibration, 0 to 25Vdc programmable sensor voltage supply, and a selection of user-installed 4-pole Butterworth LP filter modules.

## 1.1 Key Features

- Three-Channel DC Differential Voltage Amplifier
- Programmable Excitation Voltage
- 200 kHz Bandwidth (-3dB corner)
- Gain Range from 0 to 9999
- Alternative 4-pole Butterworth LP filter Module
- Auto-Zero
- Shunt Calibration
- AC & DC Monitoring

## 1.2 Safety

Read this manual in its entirety before operating the Model 121 DC Amplifier. Read all wiring and power hookup instructions and understand the requirements prior to using another manufacturer's products with the Model 121. Insure that any product being interfaced with the Model 121 is wired according to prevailing local safety and operational standards before operating.

The following symbols and terms may be found on the Model 121 and its manuals and indicate important information.



When found on the device, this symbol indicates that the operator should refer to the manual for important instructions on the proper use of this device. When found in the manual, this symbol indicates that the reader should understand the implications contained in the text before operating the device.



This symbol indicates that a shock hazard may be present. Read the instruction manual carefully and insure that the device is wired properly and that all settings have been checked prior to applying power to the device.

The **WARNING** label indicates important information that should be heeded for safe and proper performance of the device.

The **CAUTION** label is used to indicate that damage to the power supply or equipment connected to it could occur if directions are not followed. Warranty could be invalidated if the instructions in this manual are not followed.

## Disassembling the Instrument



### **WARNING**

Turn Input Power Switch OFF before removing power cable from the instrument. Remove power cable from instrument before disassembling any part of the instrument.

## Grounding



### **WARNING**

To avoid electrical shock, the power cord protective grounding conductor must be connected to power ground.

## Fuse Replacement



### **CAUTION**

For continued fire protection, replace fuse only with the specific type and rating by qualified personnel (Reference Manual "Rear Panel" section). Disconnect the power cord before replacing fuse.

## 2.0 Functional Characteristics

The Model 121 can be manually programmed from the front panel by the following means:

- “Channel Select” push-button
- Three “channel LEDs”
- One “Select Function” push-button
- Eight “Function LEDs” indicating which function has been selected by the “Select Function” push-button
- Five character LED display to show the state of each function
- Five “EDIT” push-buttons to change the display of the Five character LED
- Three LEDs indicating if there is any fault in any of the channels.

The unit stores the settings for all of the functions in its internal memory. At power-up it will automatically restore the settings from the last session.

## 2.1 Excitation Voltage

This function is used to set the amplitude of the excitation voltage output.

The user can enter four (4) significant digits ranging from 0.000 to 25.00VDC with 30mA maximum current supply.

The excitation voltage for the sensor also can be set to dual  $\pm 12.5$ VDC with a different connection to the 9-pin Female D-connector.

The excitation will be set to the desired voltage level after the ENTER key (in the middle of the five EDIT keys) is pressed.

If the unit is short circuited, or overloaded on a single channel, the excitation voltage of the channel will indicate 0.000. The Fault LED corresponding to the channel will not extinguish until the fault is resolved and the power on the Model 121 recycled.

## 2.2 Sensor Sensitivity

This function selection provides for programming the sensitivity of the transducer (in mV/EU).

EU = Engineering Unit, such as g or m/sec<sup>2</sup>

The Model 121 uses this information to determine the gain needed to achieve the required output scaling.

The user can enter four (4) significant digits ranging from 0.001 to 1000.

(Note: Do not set the sensitivity to 0; otherwise the gain value will be infinity.)

## 2.3 Output Scaling

This function selection provides for programming the desired scaling of the output (in mV/EU) of the amplifier.

The user can enter four significant digits ranging from 0.000 to 1000.

The output scaling will be set to the desired value after the ENTER key (in the middle of the five EDIT keys) is pressed, and the gain will be set to the value determined by the following equation:

$$\text{Amplifier Gain} = \frac{\text{Output Scaling}}{\text{Sensitivity}}$$

## 2.4 Gain

This function selection provides for programming the desired gain of the amplifier.

The user can enter four significant digits ranging from 0.000 to 9999.

The gain will be set to the desired value after the ENTER key (in the middle of the five EDIT keys) is pressed, and the output scaling will be set to the value determined by the following equation:

$$\text{Output Scaling} = \text{Amplifier Gain} * \text{Sensitivity}$$

## 2.5 LP Filter

This function selection provides for enabling or disabling the built-in 4-pole Butterworth LP filter.

The LP filter will be turned ON or OFF after the ENTER key (in the middle of the five EDIT keys) is pressed,

The -3dB corner frequency of the LP filter is defined by the Filter Module installed by the User.

## 2.6 Auto-Zero

This function selection provides for auto zeroing the DC output voltage.

Auto-Zero Adjustment Range functions when the output of the amplifier is about  $\pm 0.1\text{VDC}$  or  $\pm 10\text{VDC}/\text{gain}$ , whichever one is greater.

## 2.7 Shunt Calibration

This function allows for the connection of either an external or internal shunt calibration resistor. The location of the shunt calibration resistor can be selected by the User with respect to any of the legs of the transducer under test.

When the left-right EDIT keys are pressed, the following messages will be shown alternately on the LED display each time the up-down EDIT keys are pressed:

1. "OFF": The shunt calibration resistor is disconnected from the sensor.
2. "EL P+": The external shunt calibration resistor is connected to the Vexc(+).
3. "EL P-": The external shunt calibration resistor is connected to the Vexc(-).
4. "S+ P+": The internal shunt calibration resistor (150Kohm) connected in parallel between the Vexc(+) and Sig(+) leg of the transducer
5. "S+ P-": The internal shunt calibration resistor (150Kohm) is connected in parallel between the Vexc(+) and Sig(-) leg of the transducer
6. "S- P+": The internal shunt calibration resistor (150Kohm) is connected in parallel between the Vexc(-) and Sig(+) leg of the transducer
7. "S- P-": The internal shunt calibration resistor (150Kohm) is connected in parallel between the Vexc(-) and Sig(-) leg of the transducer

## 2.8 Monitoring State

This function selection provides for programming the desired state of the Model 121.

The following messages will be shown alternately on the LED display each time the up-down EDIT keys are pressed: (1) "OFF", (2) "AC", and (3) "DC".

1. "AC": RMS voltage at Vout is monitored and shown on the LED display at the rate of approximately two (2) times per second. The values displayed on the LED display range from 0.000 to 10.00VAC.
2. "DC": DC voltage at Vout is monitored and shown on the LED display at the rate of approximately two (2) times per second. The values displayed on the LED display range from -10.00 to 10.00VDC.
3. "OFF": The LED display will be turned OFF. This setting provides the lowest noise performance.

## 2.9 Fault Indication

There are three (3) fault indicators (Red LEDs) for each channel located on the front panel. The Fault LED illuminates when the unit encounters a short circuit or an overload condition on a single channel. The excitation voltage of the channel will then set to 0.000.

Or, if the AC power input voltage is out of range (90~120VAC or 200~250VAC), then all of the Fault LEDs will not extinguish until the fault is corrected and the power recycled on the Model 121.

The excitation voltage of all three channels will then set to 0.000V.

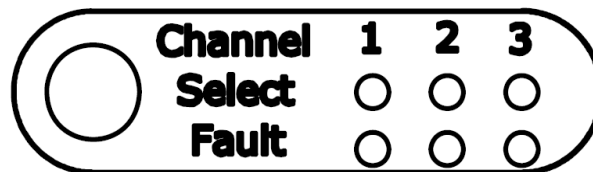


## 3.0 Operation

### 3.1 Channel Selection

Depress the “Channel Select” push-button to select the desired channel for programming.

Each press of the “Channel Select” push-button will alternately illuminate one of the 3 “Channel LEDs” located to the right of the “Channel Select” push-button indicating the channel number selected for programming.



### 3.2 Function Selection

The user selects which function is being programmed by pressing the “Select Function” push-button.

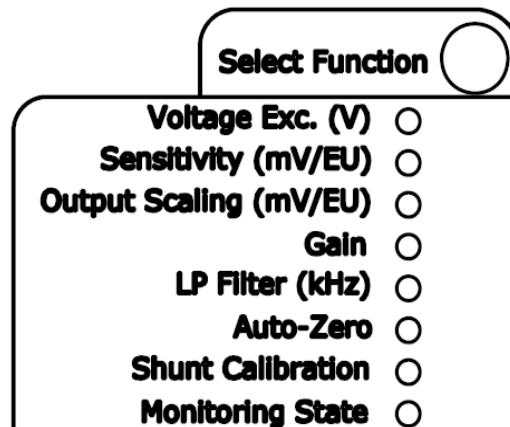
Each press of the “Select Function” push-button will alternately illuminate one of the “Function LEDs” indicating the function is selected for programming.

The selected Function LED will illuminate and the current setting will be displayed on the LED display. Each additional press of the “Select Function” push-button selects the next function and the corresponding setting is displayed on the LED display.

The following functions can be selected for programming:

- |                        |                        |
|------------------------|------------------------|
| (1) Excitation Voltage | (2) Sensor Sensitivity |
| (3) Output Scaling     | (4) Gain               |
| (5) LP Filter          | (6) Auto-Zero          |
| (7) Shunt Calibration  | (8) Monitoring State   |

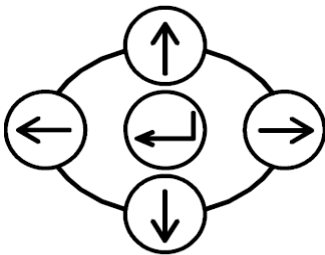
When the function is selected, the corresponding “Function LED” will illuminate and stay illuminated until the “Select Function” push-button is pressed again to select the next function.



## 3.3 Edit and Display

The five EDIT keys can be used to change the setting of each function, but make sure to press the ENTER key (in the middle of the five EDIT keys) after changed the setting. If you do not press the ENTER key (in the middle of the five keys) after changed the setting, these setting will not be active. The user can select a function, and then use the “Select Channel” push-button to view/edit the current setting for the selected function for each channel.

The new setting will be implemented into the unit hardware as soon as the ENTER key (in the middle of the five EDIT keys) has been pressed. The LED display will show the current setting for the selected function.



### ◆ Set Excitation Voltage Output for a Single Channel

Depressing the “Select Function” push-button will alternately illuminate one of the “Function LEDs” indicating the function is selected for programming.

The “Function LEDs” located to the under of the “Select Function” push-button will alternately illuminate each time the “Select Function” push-button is pressed.

The “Function LED”, located to the right of the “Voltage Exc. (V)”, stays illuminated. This indicates the “Voltage Exc. (V)” function is selected for programming.

The current setting for the “Voltage Exc. (V)” will be immediately shown on the LED display.

There are five characters in the LED display. The left hand character is reserved for displaying the sign of the value. The remaining four characters display the User setting.

Each of the four characters can be changed from 0 to 9 sequentially, and the decimal point also can be moved left or right.

Then the five EDIT keys can be used to change the value of the “Voltage Exc. (V)”.

The left-right EDIT keys select the number position in the LED display, and then the selected number position will be blinking to indicate the number selected for programming. The decimal point act to be the last one of the number position.

The up-down EDIT keys can modify the selected number. Each character can be change from 0 to 9 sequentially, and the decimal point also can be moved left or right accordingly.

The new setting will be implemented into the unit hardware as soon as the ENTER key (in the middle of the five EDIT keys) has been pressed.

## ◆ Set Sensitivity (mV/EU)

Depress the “Select Function” push-button to select the “Sensitivity (mV/EU)” for programming, and then the corresponding “Function LED” will illuminate and stay illuminated until the “Select Function” push-button is pressed again to select the next function.

Modifying the value of the “Sensitivity (mV/EU)” is the same as modifying the “Voltage Exc. (V)” using the five EDIT keys. Note not to set sensitivity to 0, otherwise the gain value will be infinite.

## ◆ Set Output Scaling (mV/EU)

The operating method is the same as above about the Voltage Exc. (V) and Sensitivity (mV/EU).

## ◆ Set Gain

The operating method is also the same as above.

## ◆ Set LP Filter (kHz)

Depress the “Select Function” push-button to select the “LP Filter (KHz)” for programming, and then the corresponding “Function LED” will illuminate and stay illuminated until the “Select Function” push-button is pressed again to select the next function.

The left-right EDIT keys select the number position in the LED display, and then the selected number position will be blinking to indicate the number selected for programming.

There will be display as “ON” or “OFF” alternately on the LED display with depress the up-down EDIT keys each time.

The LP Filter will be enabled or disabled after the ENTER key (in the middle of the five EDIT keys) is pressed.

The -3dB corner frequency of the LP Filter is defined by Filter Module installed by the User.

## ◆ Set Auto-Zero

Depress the “Select Function” push-button to select the “Auto-Zero” for programming, and then the corresponding “Function LED” will illuminate and stay illuminated until the “Select Function” push-button is pressed again to select the next function.

The left-right EDIT keys select the number position in the LED display, and then the selected number position will be blinking to indicate the number selected for programming. And the up-down EDIT keys can modify the selected number.

When the left-right EDIT keys pressed, the following messages will be shown alternately on the LED display each time the up-down EDIT keys are pressed: (1) “OFF”, and (2) “ON”.

1. "OFF": When the LED display "OFF", and then press the ENTER key (in the middle of the five EDIT keys), then the unit sets all of the internal DC offset adjustments to neutral.

2. "ON": When the LED display "ON", and then press the ENTER key (in the middle of the five EDIT keys), the unit sets the DC output voltage to zero to within  $\pm 20\text{mVDC}$ . This process will take several seconds, and then the LED will display "SUCC". If the unit is unable to set the DC output

voltage to zero within  $\pm 100\text{mVDC}$ , the LED will display "FAIL". And you can press the ENTER key (in the middle of the five EDIT keys) again to start the Auto-Zero process. And you can select function to monitoring state and change the setting to DC and then press the ENTER key (in the middle of the five EDIT keys) to view the DC output voltage on the LED display.

The output of the amplifier needs to be within a range of  $\pm 0.1\text{VDC}$  or  $\pm 10\text{VDC}/\text{gain}$ , whichever is greater, for the Auto-Zero to function. The resulting zero trim correction value is stored in non-volatile memory until overwritten in any subsequent Auto-Zero operation. Turning "OFF" Auto-Zero returns to an un-adjusted output state.

## ◆ Set Shunt Calibration

Depress the "Select Function" push-button to select the "Shunt Calibration" for programming, and then the corresponding "Function LED" will illuminate and stay illuminated until the "Select Function" push-button is pressed again to select the next function.

This function selection provides for connecting the external or internal shunt calibration resistors installed with several modes.

The left-right EDIT keys select the number position in the LED display, and then the selected number position will be blinking to indicate the number selected for programming. And the up-down EDIT keys can modify the selected number. The five characters about the LED display will be divided up to two parts, and the blinking position can be moved alternately in this two parts each time the left-right EDIT keys are pressed.

And the following messages will be shown alternately on the LED display each time the up-down EDIT keys are pressed:

On the left of the two parts, there will be shown alternately as "EL", "S+" or "S-". And on the other side of the two parts, there will be shown as "OFF", "P+" or "P-" alternately.

The setting will be active only after the ENTER key (in the middle of the five EDIT keys) is pressed.

## ◆ Set Monitoring State

Depress the "Select Function" push-button to select the "Monitoring State" for programming, and then the corresponding "Function LED" will illuminate and stay illuminated until the "Select Function" push-button is pressed again to select the next function.

The left-right EDIT keys select the number position in the LED display, and then the selected number position will be blinking to indicate the number selected for programming.

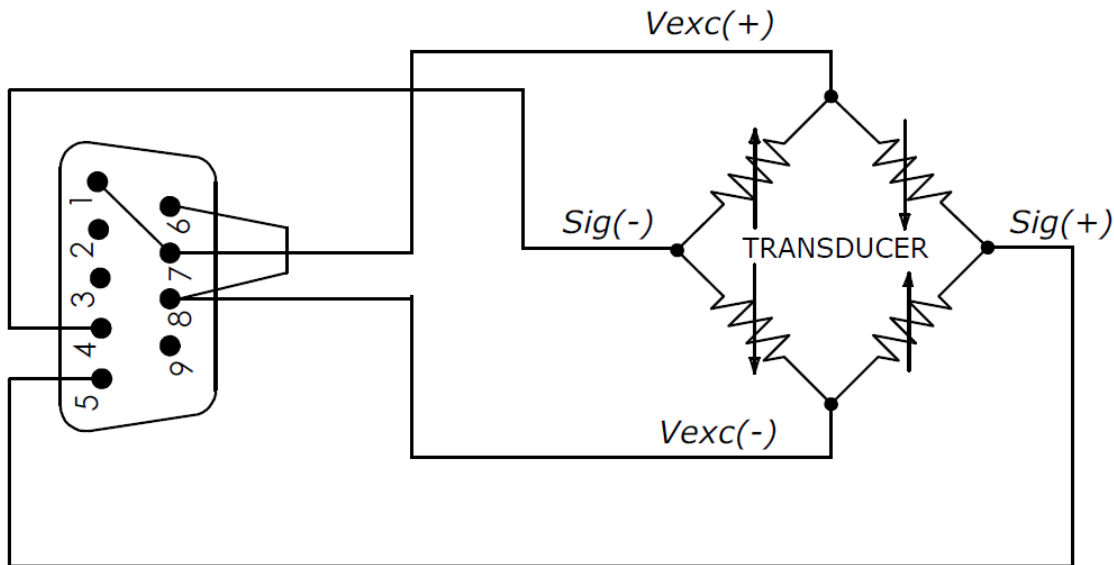
There will be display as "AC", "DC" or "OFF" alternately on the LED display with depress the up-down EDIT keys each time.

The setting will be active only after the ENTER key (in the middle of the five EDIT keys) is pressed, and then LED display will show the RMS AC voltage output, DC voltage output or disable the monitoring function accordingly.

## 4.0 Wiring Connection

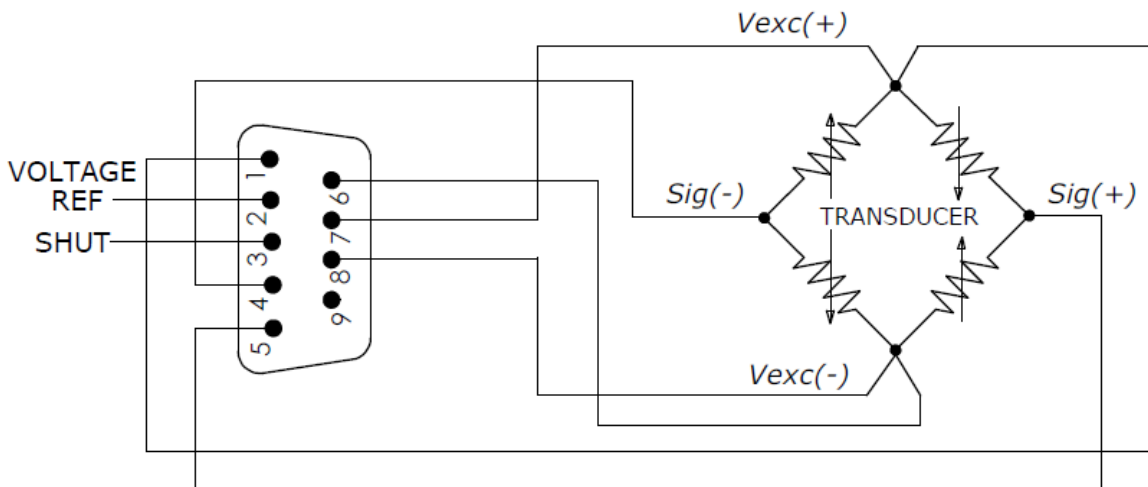
### 4.1 Simple Hookup for Bridge Type Sensors (Alternate Sense leads Wiring)

When the cable between transducer and the 9-pin Female D-connector of the Model 121 is not too long and the power consumption of the transducer is not too much, you may choose this simple wiring connection as following:



### 4.2 Full Hookup for Bridge Type Sensors (Sense leads Wired for optimum performance)

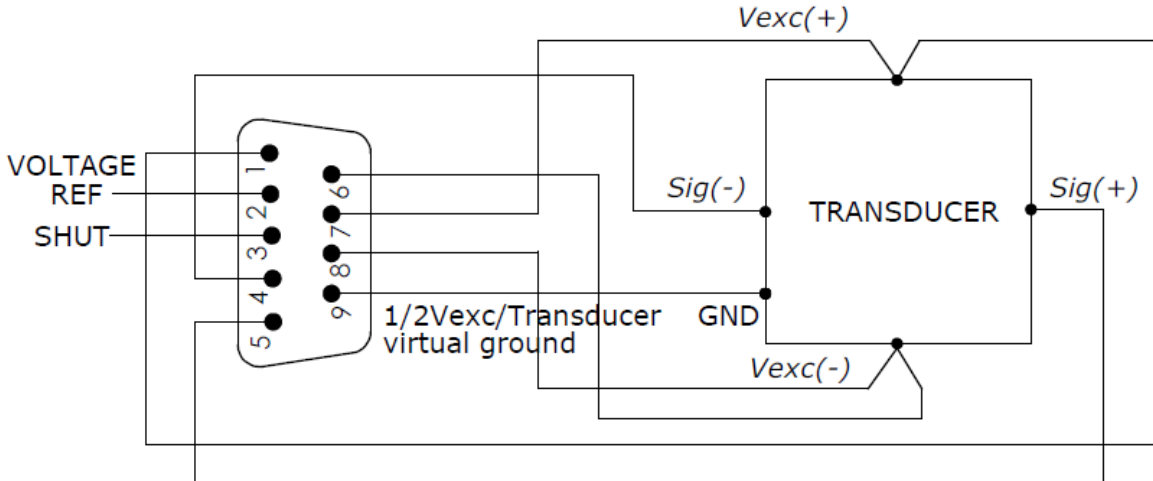
When the cable between transducer and the 9-pin Female D-connector of 121 is too long and the power consumption of the transducer is also too much, you may choose this wiring connection as following. With this wiring connection, the excitation voltage on the transducer will be compensated with voltage feedback control.



### 4.3 Hookup for Transducers Requiring Dual Excitation

A differential output transducer requiring  $\pm$  Dual Excitation and a common ground connection can be hooked up as follows.

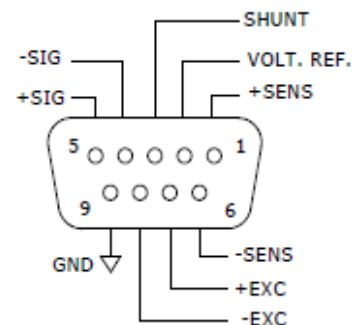
Note that  $V_{exc}(+)$  is half the voltage set by user with respect to pin 9 (virtual ground) and  $V_{exc}(-)$  is half the voltage below.



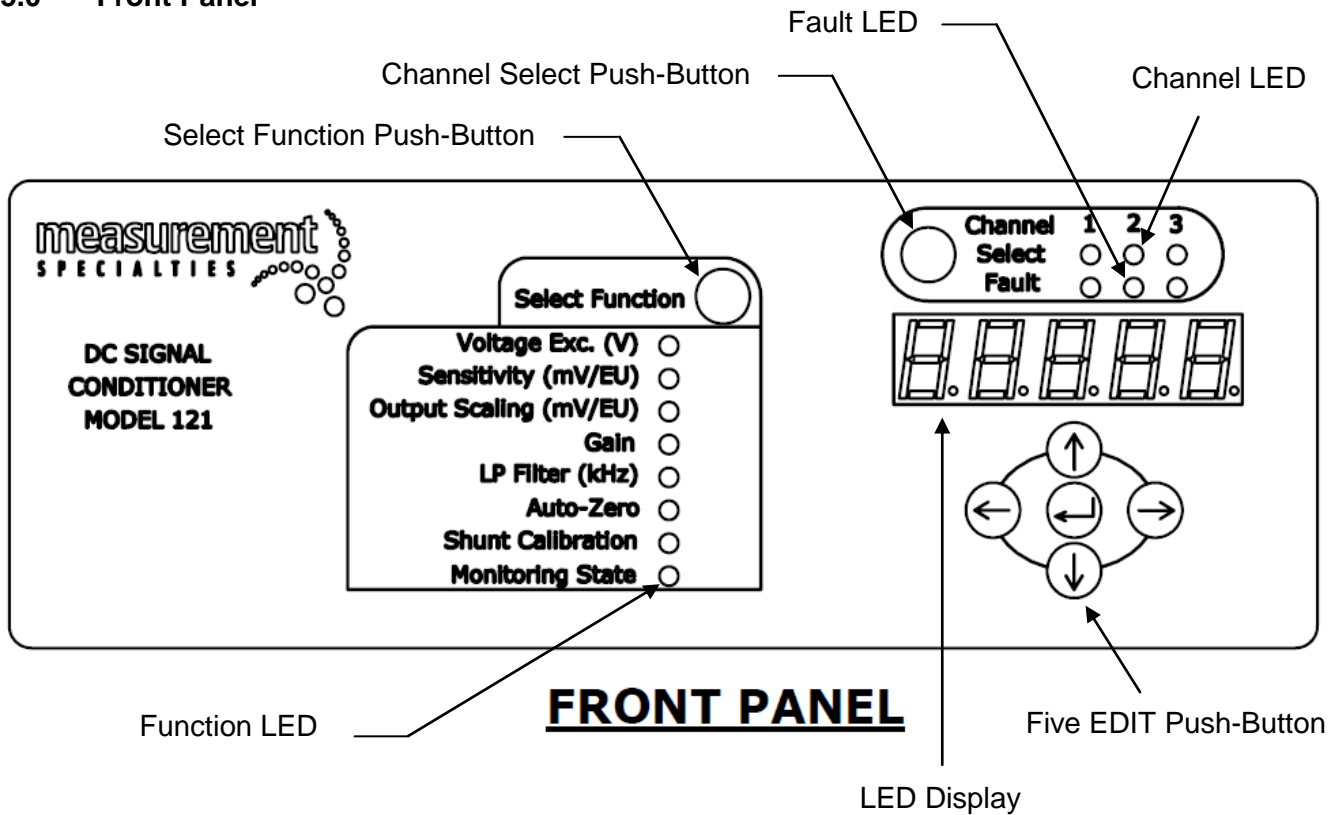
### 4.4 CH1, CH2 and CH3 Transducer Connector

Pin 1: +SENS	Positive Excitation Sense
Pin 2: VOLT.REF.	Reference Voltage Output
Pin 3: SHUNT	External Shunt Resistor
Pin 4: -SIG	Negative Transducer Output
Pin 5: +SIG	Positive Transducer Output
Pin 6: -SENS	Negative Excitation Sense
Pin 7: +EXC	Positive Excitation Voltage
Pin 8: -EXC	Negative Excitation Voltage
Pin 9: GND	Guard/Shield (1/2 Vexc)

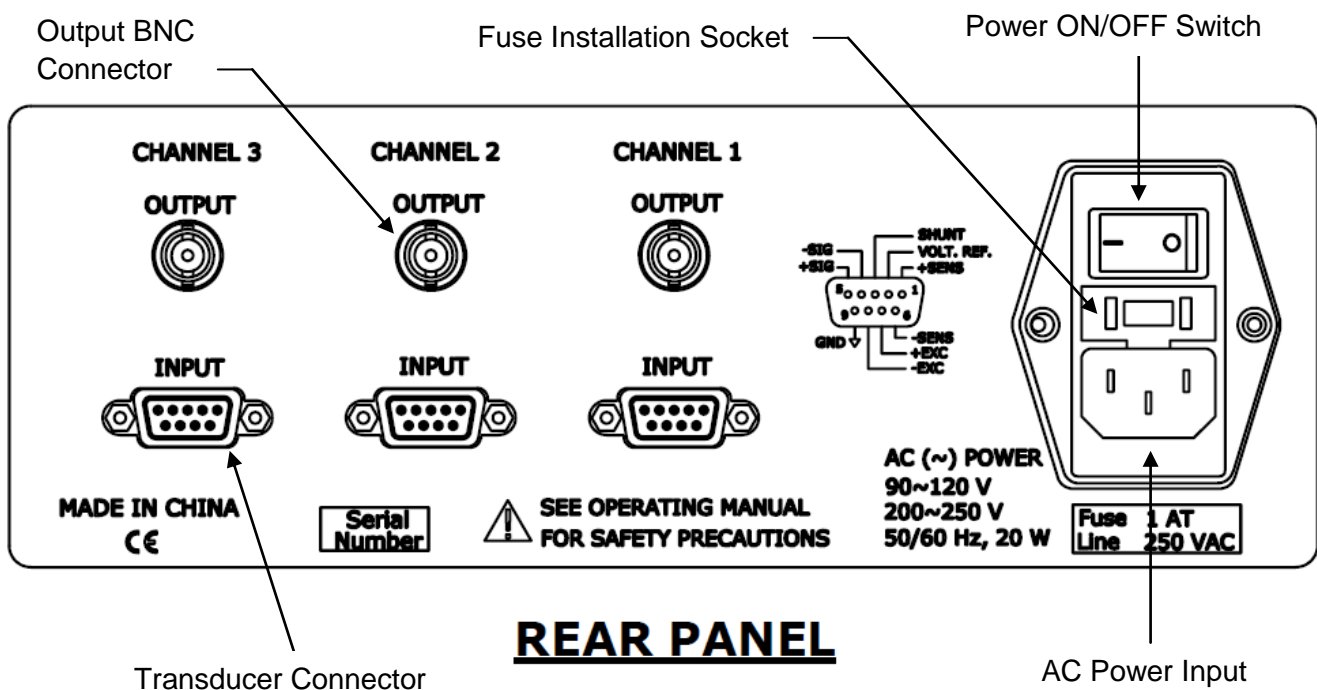
#### 9-pin Female D-connector



## 5.0 Front Panel



## 6.0 Rear Panel



## 6.1 Input and Output Impedances

Input : 1MegaOhm minimum

Output: 10 Ohm typical

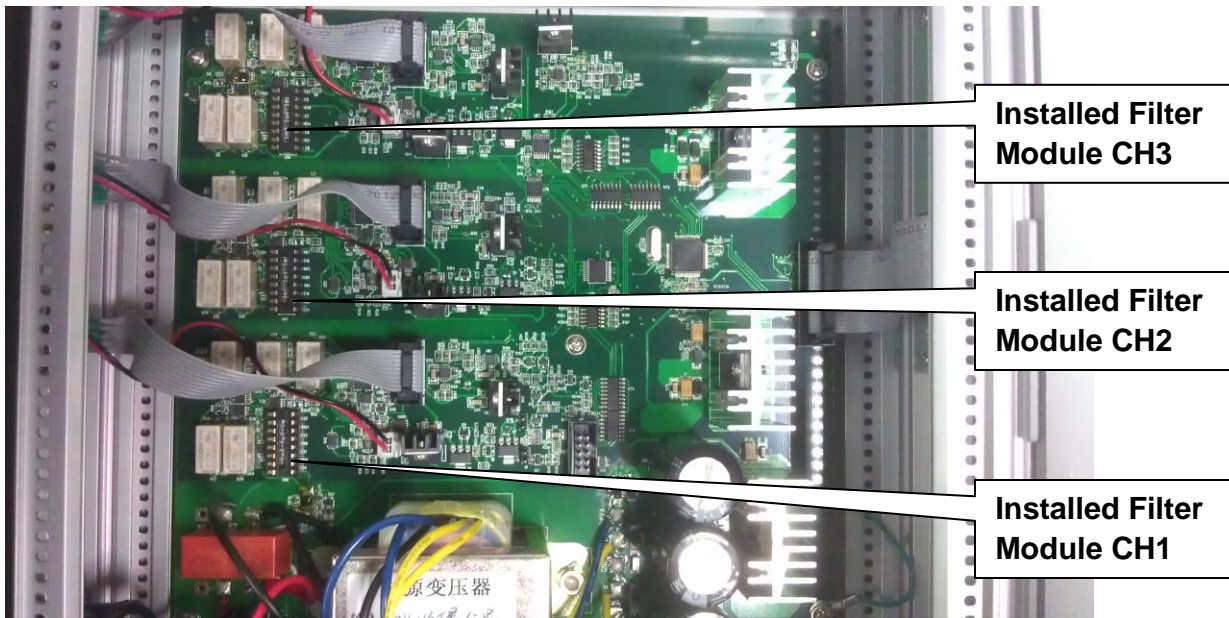
## 6.2 Excitation Output Limits

Current: 30 mA maximum, short circuit protected

## 6.3 Power Requirement

90~120 or 200~250 VAC 50/60 Hz, which adjusts automatically

## 7.0 Locations of Filter Modules



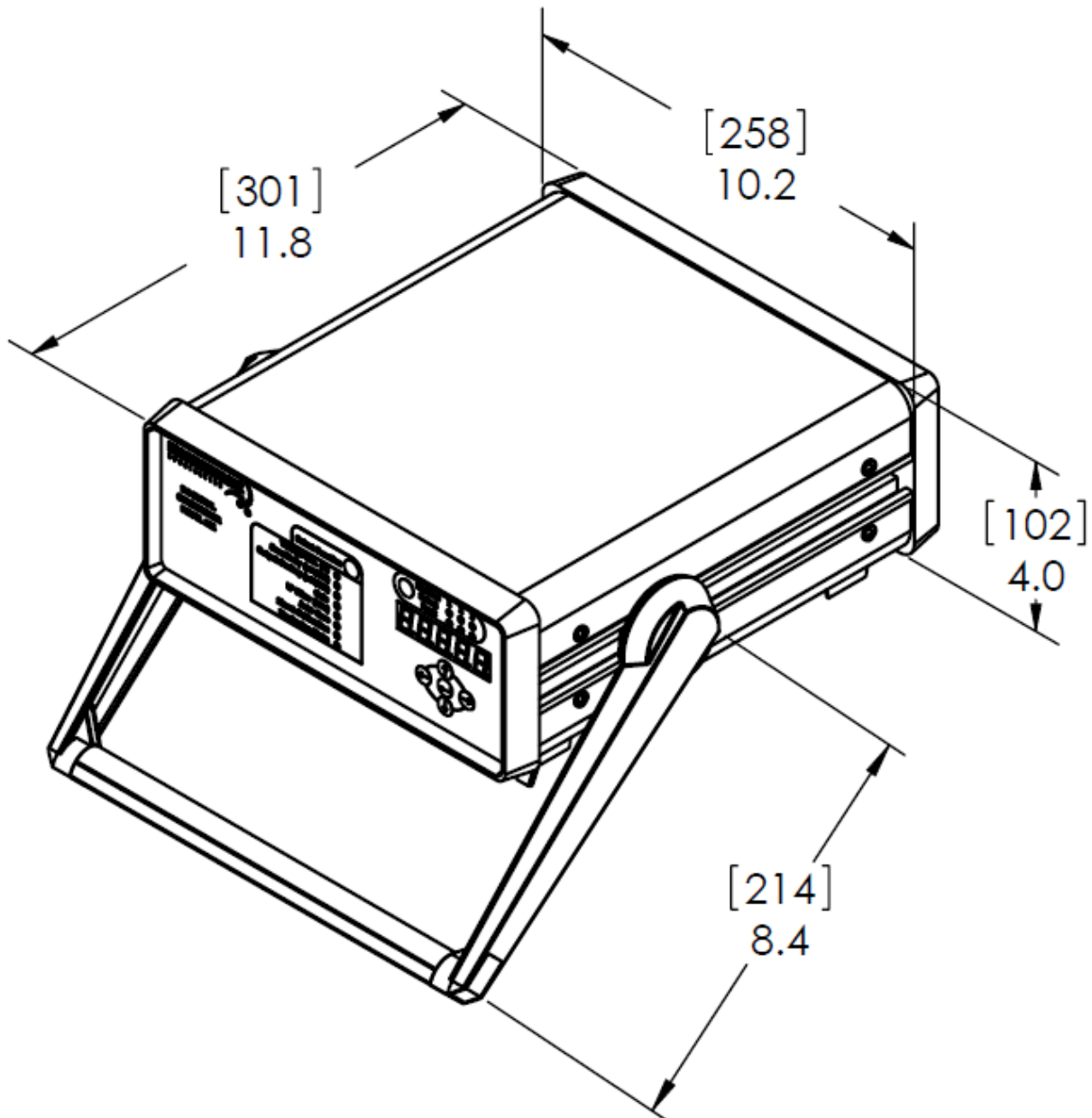




## 9.0 Dimensions

Dimensions shown in inches [millimeters].

INTERPRET GEOMETRIC TOLERANCING PER ANSI Y14.5M-1994.



## 10.0 Calibration and Repair

A calibration certificate is provided with each model 121 that certifies each instrument against the listed performance specifications. It is recommended to perform routine calibrations on the amplifier to ensure accurate operation. The recommended calibration cycle is one year.

Repair of the model 121 amplifier should not be attempted. Should the amplifier not be functioning correctly, then it should be returned to the factory for further evaluation.

## 11.0 Ordering Information

Model 121 must be specified in the following manner: 121-X

If X = U, the Model 121 is supplied with NEMA 5-15 USA 3 pin Plug (120V, 60Hz)

If X = E, the Model 121 is supplied with CEE 7/16 Europlug (220V, 50Hz)

If X = A, the Model 121 is supplied with AS-3112 China, Australasia (220V, 50HZ)