

# AMP-SG-MH

## User Manual



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Revision A1: 08/15/2019 8:00 a.m. twnachazel

# Contents

Introduction	1
Installation	3
Operations	5
Gain and Shunt Settings	6
Block Diagram	7

## AMP-SG-MH

### Miniature Strain Gage Amplifier...

- Precision low drift bridge excitation supply of 5 or 10 Volts
- Bridge excitation may be remotely turned on and off
- Powers resistive bridges of 350  $\Omega$  and greater
- Precision, low noise, differential amplifier
- Externally adjustable gain, range of 100 V/V to 2000 V/V
- Amplified signal is at high-level voltage ( $\pm 10$  Volts full scale)
- Signal is greatly immune to external noise source
- Wide signal bandwidth (20 kHz standard, up to 200 kHz)
- Remote shunt calibration capabilities
- Externally adjustable shunt calibration resistance, range of 100 k $\Omega$  to 1 M $\Omega$

## Specifications

<b>Bridge Excitation</b>	
Type	DC Constant Voltage (Bipolar excitation)
Magnitude	AMP-SG-MH-5    ±2.5 V (5 volts total) AMP-SG-MH-10   ±5.0 V (10 volts total)
Accuracy	0.40%
Temperature Coefficient	0.0005% / °C (0.00028% / °F) Max
Current Limit	AMP-SG-MH-5    42 mA AMP-SG-MH-10   84 mA
<b>Remote Calibration</b>	
Negative shunt calibration	
Shunt Resistance    internal value external value	100 kΩ & 1 MΩ 100 kΩ - 1 MΩ
Shunt Accuracy    @ 100 kΩ @ 1 MΩ	0.01% 0.01%
<b>Gain</b>	
Externally adjustable	
Range    with jumper with external resistor	100 & 2000 V / V 100 through 2000 V / V
Accuracy    @25 °C, Gain=100 @ 25 °C, Gain=1000	±0.05% typ (±0.50% max) ±0.50% typ (±1.00% max)
Temperature Coefficient	0.0025% / °C (0.0014% / °F)
<b>Output</b>	
Range	±10 V Max
Capacitive Load	1000 pF Max
<b>Voltage Offset</b>	
Referred to input of amplifier	
Initial    @25 °C	±10 μV typ (±50 μV max)
Temperature Stability	±0.1 μV / °C type (± 0.25 μV / °C max)
Time Stability	±1.0 μV / Month
DC CMRR	160 dB
Noise    rti 0.01 to 10 Hz	0.7 μV p-p
<b>Dynamic Response</b>	
Frequency Response -3dB	
@ Gain=1000	20 kHz
@ Gain=100	20 kHz
Slew Rate	4 V / μS
Settling Time    0.01% @ Gain=100	9 μS
<b>Power Requirements</b>	
Voltage    @25 °C	±15 VDC
Current	±15 mA plus Bridge Load (±15 mA additional during shunt calibration)
<b>Environment</b>	
Specification	-25 to +85 °C (-13 to +185 °F)
Operation	-55 to +125 °C (-67 to +257 °F)
<b>Mechanical</b>	
Weight	11 g (0.39 oz)
Overall Length	30.54 mm (1.596 in)
Overall Height	6.86 mm (0.270 in)
Overall Width	25.4 mm (1.00 in)

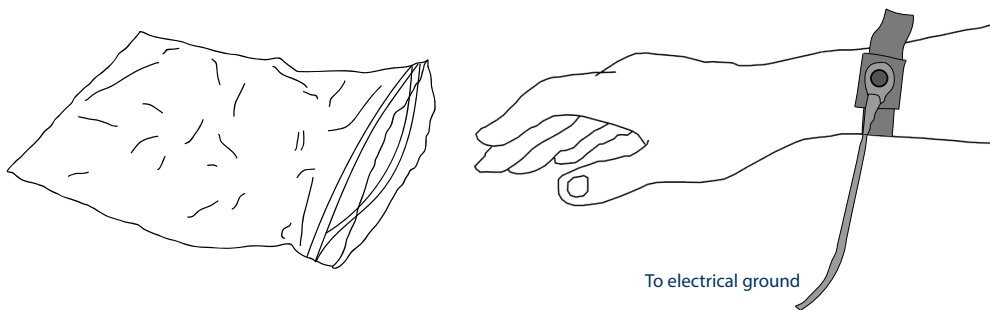
# Installation



## Electrostatic Sensitivity

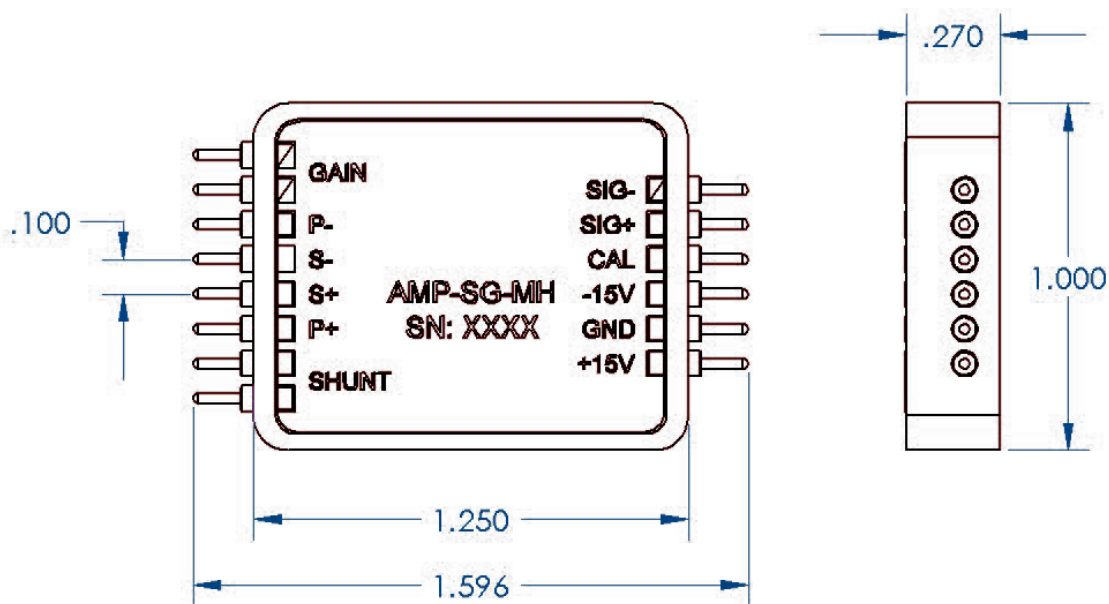
The AMP-SG-MH is an electrostatic sensitive device. The terminals should not be touched except during soldering. Soldering should be performed at electrostatic discharge protected workstations. Wires attached to the AMP-SG-MH should not be touched either.

If an electrostatic discharge protected workstation is not available, use a grounded wrist-strap and ground the strain gage amplifier. Do not handle the device in areas where static charges are obviously present. Always store the AMP-SG-MH in an anti-static bag or container when not in use.



## Mechanical Installation

The AMP-SG-MH could be adhered to a clean surface with DOW Corning 3145 RTV adhesive/sealant. Manufacturer's directions for curing should be followed.



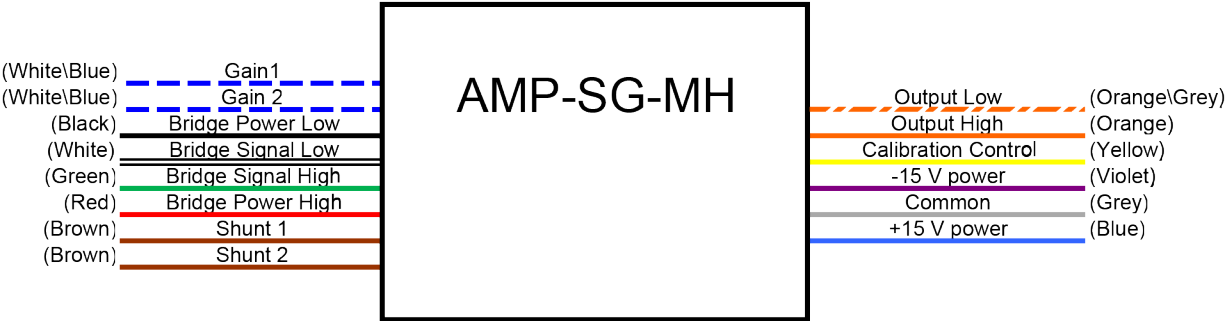
# Electrical Installation

The solder terminals on the AMP-SG-MH are color coded to help determine which supply, control, or signal goes to which wire.

<u>SIGNAL</u>	<u>TERMINAL</u>
<b>BRIDGE CONNECTIONS:</b>	
Positive Excitation	Red
Negative Excitation	Black
Bridge Signal High	Green
Bridge Signal Low	White
<b>OUTPUT CONNECTIONS:</b>	
Positive 15V	Blue
Negative 15V	Violet
Common	Gray
Calibration Control	Yellow
Output High	Orange
Output Low	Orange\Grey
<b>ADJUSTMENT CONNECTIONS:</b>	
Gain Adjust	White\Blue
Shunt Calibration Resistance Adjust	Brown

The Output High is measured relative to the Output Low. Michigan Scientific recommends the Output Low be used and not the Common to reduce errors from voltage drops along the power common wire.

A full Wheatstone bridge is needed to allow the AMP-SG-MH to regulate the bridge excitation. Without the bridge, measurements of the excitation are not meaningful. Completion resistors can be added externally to the amplifier.



# Operations

## General Operations

AMP-SG-MH must be powered with  $\pm 15$  Volts and a common. These supplies should be connected to the proper terminals (see [installation](#)) for normal operation. If the supplies are reversed, -15 Volts to the +15 Volt pin and +15 Volts to the -15 Volt pin, the amplifier still operates, but the bridge's excitation is killed. This allows measurement of the amplifier's contribution to the signal's offset, the noise floor and magnetic contributions to the signal.

The signal from the strain gage bridge is amplified by 100 V/V to 2000 V/V. Instruction can be found for setting the gain in the Gain Formula section.

Applying +15 Volts to the calibration control pin invokes a shunt calibration resistor from positive bridge excitation to positive bridge signal. -15 Volts to the calibration control pin invokes the resistor from the positive bridge excitation to the negative bridge signal. This induces an offset in the bridge that simulates a known load on the transducer allowing the user to calibrate a data acquisition system without applying the actual load.

The shunt calibration resistance can be set from 100 k $\Omega$  to 1 M $\Omega$ . Instructions for setting this can be found in the Shunt Calibration Resistance Formula section.

## Operation with PS Series Amplifier Control Units

Any Michigan Scientific power supplies will provide the  $\pm 15$  Volts and common. These power supplies reverse the polarity when the bridge excitation switch is off. Positive and negative shunt calibrations are also performed with a flip of the shunt calibration switch.

PS Series power supplies can power many spinning amplifiers depending on bridge excitation, bridge resistance, and power supply current capability.



# Gain and Shunt Settings

## Gain Formula

The Gain of the AMP-SG-MH can be set to 2000 V/V by shorting the White/Blue terminals or to 100 V/V by leaving the terminals open. For intermediate gains, a resistor can be soldered across the terminals. The following formula determines the resistor needed for a selected gain:

$$R_{ext} = \frac{24.014 \times 10^6 - 12007.24 \times Gain}{505.053 \times Gain - 50505.053}$$

Michigan Scientific can supply resistors, but if the user supplies their own Michigan Scientific suggests a 0.01% tolerance with a less than 25 ppm/°C temperature coefficient.

## Shunt Calibration Resistance Formula

The resistance that is placed across the arm of the bridge is adjustable. When the Brown terminals are shorted the resistance is 100 kΩ. The resistance is 1 MΩ when the terminals are open. Placing a resistor on these terminals can make any resistance between 100 kΩ and 1 MΩ. The following equation is used to determine the external resistance:

$$R_{ext} = \frac{9 \times 10^{10} - 9 \times 10^5 \times R_{cal}}{R_{cal} - 1 \times 10^6}$$

Michigan Scientific can supply resistors, but if the user supplies their own Michigan Scientific suggests a 0.01% tolerance with a less than 25 ppm/°C temperature coefficient.

# Block Diagram

