321 E. Huron Street
Milford, MI 48381
(248) 685-3939
Fax: (248) 684-5406

http://www.michsci.com
mscinfo@michsci.com

MICHIGAN SCIENTIFIC corporation

8500 Ance Road
Charlevoix, MI 49720
(231) 547-5511
Fax: (231) 547-7070

AMP-SG-M1 & AMP-SG-EH1.5
MODULAR STRAIN GAGE AMPLIFIER
OPERATOR'S MANUAL

Revision 4/06

OBSERVE
PRECAUTIONS FOR
HANDLING
ELECTROSTATIC
SENSITIVE DEVICES

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Introduction

The *Modular Strain Gage Amplifier* is designed to provide strain gage excitation and signal amplification. These amplifiers may be used in conjunction with Michigan Scientific slip rings. Although all Michigan Scientific slip ring assemblies are manufactured with instrumentation quality rings and brushes, superior data accuracy is achieved by locating the signal amplifier on the rotating side of the slip ring. This configuration greatly improves signal quality because the amplifier is located closer to the sensor, which reduces errors due to long lead wires, connector resistance variations, and electro-magnetic interference.

These *Modular Strain Gage Amplifiers* incorporate a precision low drift bridge excitation supply, a stable differential amplifier, and a remotely activated shunt calibration resistor for system span verification. Each amplifier module provides strain gage bridge excitation and amplification for one channel. For multiple channels, the amplifiers may be stacked or arrayed around an adapter plate.

Features

- 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 Ω 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 (±10 Volts full scale).
- Signal is greatly immune to external noise sources.
- Wide signal bandwidth (40kHz standard, up to 200kHz).
- Remote shunt calibration capabilities
- Externally adjustable shunt calibration resistance, range of 100kΩ to 1MΩ.

Operation

General Operation

AMP-SG-M1 must be powered with ± 15 Volts and a common. These supplies should be connected to the proper wires (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 kΩ to 1MΩ. Instructions for setting this can be found in the Shunt Calibration Resistance Formula section.

Operation with PS Series Power Supplies

Any Michigan Scientific power supplies will provide the ±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.

Specifications

PARAMETER		SPECIFICATION
BRIDGE EXCITATION		
Type		DC Constant Voltage (Bipolar excitation)
Magnitude		AMP-SG-M1-5 ±2.5 V (5 volts total) AMP-SG-M1-10 ±5.0 V (10 volts total)
Accuracy		0.40%
Temperature Coefficient		0.0005 % / °C (0.00028 % / °F) Max
Current Limit		AMP-SG-M1-5 42 mA AMP-SG-M1-10 84 mA
REMOTE CALIBRATION		Positive & negative shunt calibration
Shunt Resistance	internal value external value	100kΩ & 1MΩ 100kΩ through 1MΩ
Shunt Accuracy	at 100kΩ at 1MΩ	0.01% 0.01%
GAIN		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)
OUTPUT		
Range		±10 V Max
Capacitive Load		1000 pF Max
VOLTAGE OFFSET		Referred to input of amplifier
Initial	@ 25°C	±10 μV typ (±50 μV max)
Temperature Stability		±0.1 μV / °C typ (±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
DYNAMIC RESPONSE		
Frequency Response -3dB		
	@ Gain=1000	20 kHz
	@ Gain=100	40 kHz
Slew rate		4 V / μS
Settling Time	0.01% @ Gain=100	9 μS
POWER REQUIREMENTS		
Voltage	@ 25°C	±15 VDC
Current		±15 mA plus Bridge Load (+15 mA additional during shunt calibration)
ENVIRONMENT		
Specification		-25 to +85 °C (-13 to +185 °F)
Operation		-55 to +125 °C (-67 to +257 °F)
MECHANICAL		**AMP-SG-M1** **AMP-SG-EH1.5**
Weight		14.17 G (0.50 Oz) 35 G (1.25 Oz)
Overall Length		31.75 mm (1.250 in) 38.1 mm (1.500 in)
Overall Height		6.35 mm (0.250 in) 12.7mm (0.500 in)
Overall Width		20.32 mm (0.800 in) 25.4mm (1.000 in)

Installation

Electrostatic Sensitivity

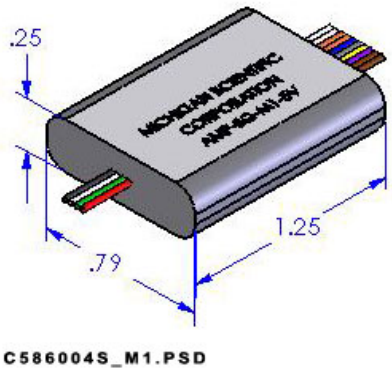
The AMP-SG-M1 is an electrostatic sensitive device. The wires should not be touched except during soldering. Soldering should be performed at electrostatic discharge protected workstations. Wires attached to the AMP-SG-M1 should not be touched either.

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-M1 in an anti-static bag or container when not in use.

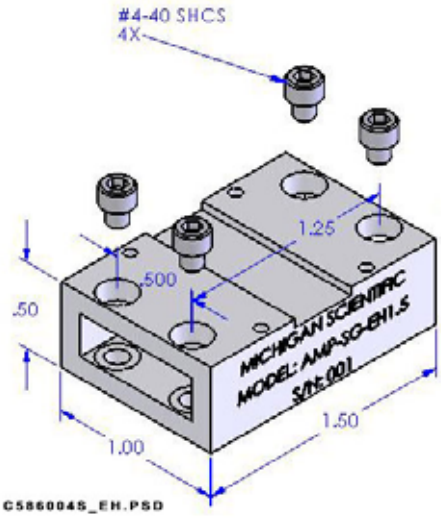
Mechanical Installation

The AMP-SG-M1 could be adhered to a clean surface with Dow Corning 3145 RTV adhesive/sealant. Manufacturer's directions for curing should be followed. Caution should be used to protect the hook-up wires from cutting or breakage.

The AMP-SG-EH1.5 package can be mounted using 4-40 screws as shown below or strapped with a hose clamp.



AMP-SG-M1: Molded Rubber



AMP-SG-EH1.5: Aluminum Housing

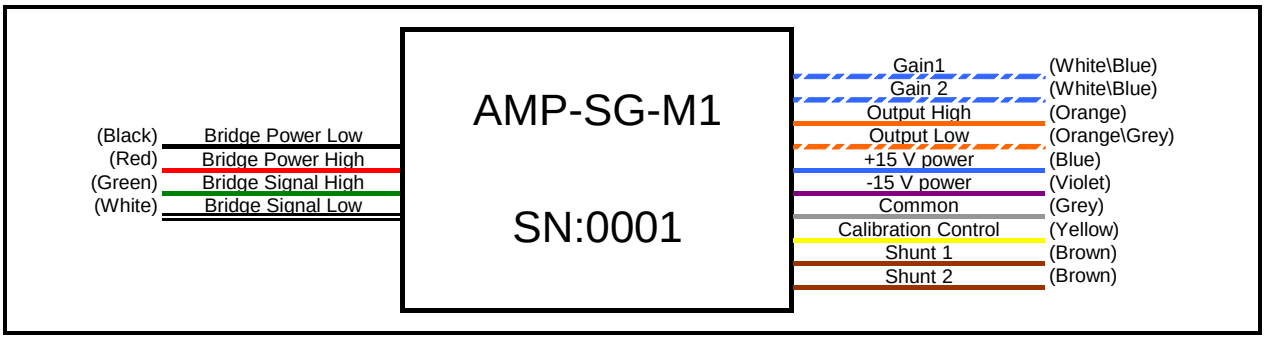
Electrical Installation

The hook-up wires on the AMP-SG-M1 are color coded to help determine which supply, control or signal goes to which wire.

SIGNAL	WIRES
BRIDGE CONNECTIONS:	
Positive Excitation	Red
Negative Excitation	Black
Bridge Signal High	Green
Bridge Signal Low	White
OUTPUT CONNECTIONS:	
Positive 15V	Blue
Negative 15V	Violet
Common	Gray
Calibration Control	Yellow
Output High	Orange
Output Low	Orange\Grey
ADJUSTMENT WIRES:	
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 strain gage bridge is needed to allow the AMP-SG-M1 to regulate the bridge excitation. Without the bridge, measurements of the excitation are not meaningful. Completion resistors can be added externally to the amplifier.



Gain and Shunt Settings

Gain Formula

The Gain of the AMP-SG-M1 can be set to 2000 V/V by shorting the White\Blue wires or to 100 V/V by leaving the wires open. For intermediate gains a resistor can be soldered across the wires. 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 wires are shorted the resistance is 100 kΩ. The resistance is 1 MΩ when the wires are open. Placing a resistor on these wires can make any resistance in-between. 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