



S SERIES SLIP RING WITH STRAIN GAGE AMPLIFIER



S6/Gx



SHORT S6/T/Gx

OPERATOR'S MANUAL



OBSERVE
PRECAUTIONS FOR
HANDLING
ELECTROSTATIC
SENSITIVE DEVICES

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Introduction

The *S6/Gx or Short S6/T/Gx* is a combination of Michigan Scientifics' S6 or Short S6 slip ring and a precision strain gage amplifier. The amplifier is built into the rotor of the slip ring. 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.

The built-in amplifier provides strain gage excitation and signal amplification. These 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 *S6/Gx or Short S6/T/Gx* provides strain gage bridge excitation and amplification for one channel. For multiple channels, consult Michigan Scientific for other amplifier options.

Features

- Compact design
- Rugged Stainless steel construction
- Permanently lubricated bearings
- Sealed against dust
- 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 at Gain=100).
- Remote shunt calibration capabilities
- Externally adjustable shunt calibration resistance, range of 100k Ω to 1M Ω .

Operation

General Operation

The *S6/Gx* or *Short S6/T/Gx* must be powered with ± 15 Volts and a common. These supplies should be connected to the proper wires (see Electrical 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 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 Ω to 1M Ω . Instructions for setting this can be found in the Shunt Calibration Resistance Formula section.

Operation with PS Series Power Supplies

Any Michigan Scientific PS series 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		SHORT S6/T/G5 ±2.5 V Standard (5 volts total) SHORT S6/T/G10 ±5.0 V Available (10 volts total)
Accuracy		0.40%
Temperature Coefficient		0.0005 % / °C (0.00028 % / °F) Max
Current Limit		SHORT S6/T/G5 42 mA SHORT S6/T/G10 84 mA
REMOTE CALIBRATION		
Shunt Resistance	internal value	100kΩ & 1MΩ
	external value	100kΩ through 1MΩ
Shunt Accuracy	at 100kΩ	0.01%
	at 1MΩ	0.01%
GAIN		
Range	with jumper	Externally adjustable
	with external resistor	100 & 2000 V / V
Accuracy	at 25°C, Gain=100	±0.05 % typ (±0.50 % max)
	at 25°C, Gain=1000	±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		
Initial	at 25°C	Referred to input of amplifier
Temperature Stability		±10 μV typ (±50 μV max)
Time Stability		±0.1 μV / °C typ (±0.25 μV / °C max)
DC CMRR		±1.0 μV / Month
Noise	rti 0.01 to 10 Hz	160 dB
		0.7 μV p-p
DYNAMIC RESPONSE		
Frequency Response -3dB		
	at Gain=1000	20 kHz
	at Gain=100	40 kHz
Slew rate		4 V / μS
Settling Time	0.01% at Gain=100	9 μS
POWER REQUIREMENTS		
Voltage	at 25°C	±15 VDC
Current		±15 mA plus Bridge Load (+15 mA additional during shunt calibration)
ENVIRONMENT		
Specification		-40 to +85 °C (-40 to +185 °F)
Operation		-55 to +125 °C (-67 to +257 °F)
RPM Rating		12,000 rpm
MECHANICAL		
Weight		63.79 G (2.25 Oz)
Overall Height		28.2 mm (1.11 in)
Overall Width		41.275 mm (1.625 in)

Installation

Electrostatic Sensitivity



The *S6/Gx* or *Short S6/T/Gx* 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 *S6/Gx* or *Short S6/T/Gx* 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 *S6/Gx* or *Short S6/T/Gx* in an anti-static bag or container when not in use.

Electrical Installation

The hook-up terminals on the *S6/Gx* and *SHORT S6/T/Gx* are color coded to help determine which supply, control or signal goes to which terminal.

<u>SIGNAL</u>	<u>TERMINAL</u>
BRIDGE CONNECTIONS (ROTOR):	
Positive Excitation	Red 
Negative Excitation	Black 
Bridge Signal High	Green 
Bridge Signal Low	White 
OUTPUT CONNECTIONS (STATOR):	
Positive 15V	Blue 
Negative 15V	Violet 
Common	Gray 
Calibration Control	Yellow 
Output High	Orange 
Output Low	Brown 
ADJUSTMENTS (ROTOR):	
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 amplifier to regulate the bridge excitation. Without the bridge, measurements of the excitation are not meaningful. Completion resistors can be added externally to the amplifier for use with quarter or half bridges.

Gain and Shunt Settings

Gain Formula

The Gain of the **S6/Gx or Short S6/T/Gx** can be set to 2000 V/V by shorting the White terminals on the rotor 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 external resistance (R_{ext}) needed for a selected gain ($Gain$).

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

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 on the rotor 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 in-between. The following equation is used to determine the external resistance (R_{ext}) required to achieve the desired Shunt Resistance (R_{cal}).

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

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

