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

MICROTC

LINEAR THERMOCOUPLE AMPLIFIER
OPERATOR'S MANUAL

OBSERVE
PRECAUTIONS FOR
HANDLING
ELECTROSTATIC
SENSITIVE DEVICES

Table of Contents

Introduction

The *MicroTC Linear Thermocouple Amplifier* is designed to provide cold junction compensation, amplification and linearization of thermocouple sensors. 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 thermocouple 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 temperature gradients across dissimilar metals in the slip ring and magnetic interference.

MicroTC amplifiers are available for K-type thermocouples. For more channels, more than one amplifier may be used with a single control unit. The amplifiers can be mounted or strapped to many different types of parts.

Features

- Nonlinear thermocouple input signal is converted to linear output voltage
- Input signal is amplified to 5 mV per degree Celsius over a wide input range
- Cold junction compensation
- Units available in K-type
- Signal bandwidth, 2.35 kHz (other bandwidths available)
- Input signals can be grounded or isolated

Operation

General Operation

The MicroTC must be powered with ± 7 to ± 16 Volts and a common (+7 to +16 V and a common for single-supply configurations). See electrical installation for instructions on how to connect these supplies to the proper terminals. The MicroTC signals should be measured with respect to the common terminal.

Current flows in the ground line, so there will be a voltage drop along the length of the conductor. This will create an offset if the signals are measured with respect to the common at the Remote Amplifier Control Unit. Michigan Scientific recommends that the signals be measured with respect to the common wire at the amplifier. This can be accomplished by adding a second common line from the amplifier to the recording device.

The thermocouple sensor should be attached using the provided mating connector (Omega® HMPW-*-M). If a thermocouple input is left unused or if the thermocouple opens, the output of the amplifier will rise to +Vs. The amplifier will not be damaged if a thermocouple is left unattached.

Operation with PS Series Amplifier Control Units

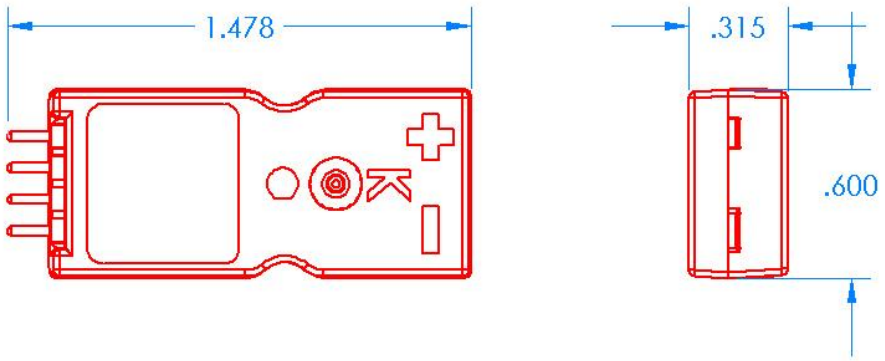
Any Michigan Scientific Remote Amplifier Control Unit will provide ±15 Volts and common. These control units have switches that control bridge excitation and shunt calibration. Both switches are used with Michigan Scientific's strain gage amplifiers.

The Remote Amplifier Control Units reverse the polarity of the ±15 V terminals when the bridge excitation switch is off. The MicroTC-D will continue to work under this condition. The MicroTC-S will power off.

Specifications

PARAMETER	SPECIFICATION	
	Dual Supply	Single Supply
INPUT		
Range (5mV/°C linear output)	-50 to +400°C	5 to 400°C
Range (w/ polynomial equation)	-200 to 1360°C	5 to 1360°C
OUTPUT		
Range	Min = -Vs + 0.025V; Max = +Vs - 0.1V	Min = 0.050V; Max = +Vs - 0.1V
TEMPERATURE ERROR		
0°C to +50°C Case Temperature	± 2°C Max	
-40°C to +100°C Case Temperature	± 3°C Max	
NOISE		
0.01 - 10 Hz	0.8 µV p-p	
DYNAMIC RESPONSE	Higher Bandwidths available	
Frequency Response -3dB	2.35 kHz	
Settling Time 0.1%	36 µs	
POWER REQUIREMENTS		
Voltage (Vs)	±7 to ± 16 VDC	+7 to +16 VDC
Quiescent Current	±2.55 mA max	3.25 mA max
ENVIRONMENT		
Specification	0 to +50°C (+32 to +122°F)	
Operation	-40 to +100°C (-40 to +212°F)	
MECHANICAL		
Weight	5g (0.18 oz)	
Overall Length	37.5 mm (1.478 in)	
Overall Height	8 mm (0.315 in)	
Overall Width	15.2 mm (0.6 in)	

Table 1



Installation

Electrostatic Sensitivity

The MicroTC is an electrostatic sensitive device. The signal terminals should not be touched except during soldering. Soldering should be performed at an electrostatic discharge protected workstation.

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

MicroTC-D vs. MicroTC-S

The MicroTC is available in configurations for dual-supply (MicroTC-D) or single-supply (MicroTC-S) power. Mechanically, these two options are identical except for the elimination of the V- terminal in the single-supply unit. Electrically, the single-supply unit cannot measure temperatures below 5 °C. The upper measurement limit is the same as the dual-supply unit.

(L) MicroTC-D, (R) MicroTC-S

Mechanical Installation

The MicroTC has a mounting hole with clearance for a #2 machine screw. Alternately, the mounting hole can be used to strap the amplifier to the mating connector.

Wires soldered to the signal terminals should be covered with heat shrink tubing. This will both protect the terminals from electrical shorting as well as provide strain relief for the wires.

Electrical Installation

The signal terminals on the MicroTC are color coded and labeled to help determine which supply or output signal corresponds to which terminal. The signals and terminal colors are shown in the table below.

Signal	Label	Color
Positive Supply Voltage	V+	Blue
Amplifier Output	S+	Yellow
Common	G	Gray
Negative Voltage	V-	Violet

Figure 1

The output high is measured relative to the ground wire. Michigan Scientific recommends that a separate wire for signal common be added to the common terminal to reduce errors from voltage drops along the power common wire. This wire can be added to the stator of a slip ring to decrease the amount of rings needed, but care should be taken to physically place the amplifier as close as possible to the slip ring.

Linearization Formulas

The output of the MicroTC is a linear 5mV/°C over an input range of -50 to 400 °C (5 to 400 °C for single-supply). Outside of that range, linearizing formulas can be used to determine temperature within the specified error. The following formulas use the voltage from the amplifier as the independent variable and generate temperature in °C.

Dual Supply

Range: *-60 to 1360*°C

$$T = -0.00036 \times V^6 - 0.0031 \times V^5 + 0.1248 \times V^4 - 0.014 \times V^3 - 4.419 \times V^2 + 207.488 \times V - 1.1$$

Range: *-200 to 100*°C

$$T = -142.644 \times V^4 + 30.529 \times V^3 + 3.504 \times V^2 + 207.53 \times V - 0.1077$$

Single Supply

Range: *5 to 1360*°C

$$T = 0.02327 \times V^4 + 0.5818 \times V^3 - 5.5369 \times V^2 + 208.0778 \times V - 1.9183$$

T = Temperature in °C
V = Voltage from amplifier

Troubleshooting

Symptom	Possible Cause	Test to Verify Problem	Solution
Output noisy with thermocouple spinning	Thermocouple could be opening momentarily; frequency response of data acquisition system may be to slow to show complete drop out of signal	Look at dynamic signal with an oscilloscope	Repair thermocouple junction Restrain thermocouple better
Output near 0 V regardless of thermocouple temperature	Amplifier Out High could be shorted to Common	With amplifier power off, measure resistance from Amplifier Out High to Common. The resistance should be between 100 and 200 Kohm	Remove short
	Amplifier Out High conductor could be open	Measure resistance from one end of conductor to the other	Repair open wire
Output near +Vs when thermocouple is at room temperature	Open thermocouple	Connect known good thermocouple to amplifier input. If voltage drop-out is a result of the open thermocouple; the output should now be near room temperature	Repair thermocouple junction
	Negative supply is disconnected	Measure continuity from power supply to amp's violet terminal	Repair broken wire
	Common is disconnected	Measure continuity from power supply to amp's gray terminal	Repair broken wire
Output near -0.9 V when thermocouple is at room temperature	Positive supply is disconnected	Measure continuity from power supply to amp's blue terminal	Repair broken wire

Table 2