



# MC1000 Multi-Function Calibrator

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# MC-1000

## 1. Introduction

The MC1000 is designed to be a versatile, easy to use multi-function calibrator with a simple user interface. The following instructions will allow the user to begin simple calibration tasks by learning the basic operation of the keys and their functions.

### 1.1 Customer Service

#### Corporate Office:

[www.martelcorp.com](http://www.martelcorp.com)

e-mail: [sales@martelcorp.com](mailto:sales@martelcorp.com)

Tel: (603) 434-8179 800-821-0023

Fax: (603) 434-1653

#### **Martel Electronics**

PO Box 770

1F Commons Drive

Londonderry, NH 03053

#### Texas Office:

[www.betalibrators.com](http://www.betalibrators.com)

Tel: 800-537-2181 or (972) 241-2200

Fax: (972) 241-2200

#### **Beta Calibrators**

2309 Springdale Rd.

Farmers Branch, Texas 75234

### 1.2 Standard Equipment












Check to see if your calibrator is complete. It should include:

MC1000 Calibrator, Instruction Manual, Test Leads, Rubber Boot and NIST Certificate.

## 1.3 Safety information

### Symbols Used

The following table lists the International Electrical Symbols. Some or all of these symbols may be used on the instrument or in this manual.

Symbol	Description
	AC (Alternating Current)
	AC-DC
	Battery
	CE Complies with European Union Directives
	DC
	Double Insulated
	Electric Shock
	Fuse
	PE Ground
	Hot Surface (Burn Hazard)
	Read the User's Manual (Important Information)

 Off

 On



Canadian Standards Association

The following definitions apply to the terms “Warning” and “Caution”.

- “Warning” identifies conditions and actions that may pose hazards to the user.
- “Caution” identifies conditions and actions that may damage the instrument being used.

Use the calibrator only as specified in this manual, otherwise injury and damage to the calibrator may occur.



### ***Warning***

#### **To avoid possible electric shock or personal injury:**

- Do not apply more than the rated voltage. See specifications for supported ranges.
- Follow all equipment safety procedures.
- Never touch the probe to a voltage source when the test leads are plugged into the current terminals.
- Do not use the calibrator if it is damaged. Before you use the calibrator, inspect the case. Look for cracks or missing plastic. Pay particular attention to the insulation surrounding the connectors.
- Select the proper function and range for your measurement.
- Make sure the battery cover is closed and latched before you operate the calibrator.

- Remove test leads from the calibrator before you open the battery door.
- Inspect the test leads for damaged insulation or exposed metal. Check test leads continuity. Replace damaged test leads before you use the calibrator.
- When using the probes, keep your fingers away from the probe contacts. Keep your fingers behind the finger guards on the probes.
- Connect the common test lead before you connect the live test lead. When you disconnect test leads, disconnect the live test lead first.
- Do not use the calibrator if it operates abnormally. Protection may be impaired. When in doubt, have the calibrator serviced.
- Do not operate the calibrator around explosive gas, vapor, or dust.
- When using a pressure module, make sure the process pressure line is shut off and depressurized before you connect it or disconnect it from the pressure module.
- Disconnect test leads before changing to another measure or source function.
- When servicing the calibrator, use only specified replacement parts.
- To avoid false readings, which could lead to possible electric shock or personal injury, replace the battery as soon as the battery indicator appears.
- To avoid a violent release of pressure in a pressurized system, shut off the valve and slowly bleed off the pressure before you attach the pressure module to the pressure line.

 **Caution****To avoid possible damage to calibrator or to equipment under test:**

- Disconnect the power and discharge all high-voltage capacitors before testing resistance or continuity.
- Use the proper jacks, function, and range for your measurement or sourcing application.
- To avoid mechanically damaging the pressure module, never apply more than 10 ft-lb. of torque between the pressure module fittings, or between the fittings and the body of the module.
- To avoid damaging the pressure module from overpressure, never apply pressure above the rated maximum printed on the module.
- To avoid damaging the pressure module from corrosion, use it only with specified materials. Refer to the pressure module documentation for material compatibility.

## 2. Quick Start Instructions

### A. Key Functions

<b><u>Key</u></b>	<b><u>Function</u></b>
<b>Input/Output</b>	Toggles the function selected from measurement mode to source mode.
<b>V/mA/Hz</b>	Selects between volts, milliamps, and frequency modes
<b>TC/RTD</b>	Selects between temperature modes either T/C or RTD. Ohms and mV ranges are also included in these functions.
<b>Ranges/Units</b>	This key toggles through all the ranges for a chosen function. Example: If T/C mode is selected the Range key toggles through the ranges J, K, T, E, etc.
<b>0-9 keys</b>	These keys allow a user to enter an output value. Example: to output 20 mA select mA output and Press the "2" key then the "0" key followed by the "ENTER" key.
<b>Arrow</b> ↑ ↓	These keys allow small changes to be made to an output value. Press either the up or the down arrow key to set the value as desired.
<b>CE</b>	The clear entry key allows the user to clear a value before the enter key is pressed.
<b>Shift</b>	This key has a blue text color



and acts as a second function key to all keys that have an associated second function. Features such as setpoints, °F/°C, backlight and external pressure module activation all use the Shift key.

## **B. Setpoints**

### **1. Storing Setpoints**

The setpoint mode allows up to 9 setpoints to be stored in non-volatile memory for each range. The procedure is as follows:

- a. Set the output to the desired value.
- b. Press shift followed by the "SET" key.
- c. Choose the desired setpoint storage location by pressing a key (1-9).
- d. Enter a new value and repeat steps 1 thru 3 as needed, up to 9 setpoints for each range can be stored.

### **2. Recalling Setpoints**

- a. To recall a setpoint, press shift followed by the "SPT" key.
- b. You will be prompted to enter the number of the desired setpoint location stored previously.
- c. Press the desired location number and the unit will go to that output.

### **3. Automated Stepping**

The MC1000 can auto-step through some or all of the stored setpoints for a given range. The procedure is as follows:

- a. Press "Shift" followed by auto.
- b. "Auto SPT ?" will appear. Enter the

ending setpoint location. Example: if you have all 9 setpoints stored but only want to step through the first 3 then enter "3" for this question.

- c. The next screen prompts you to enter the dwell time from 5 to 500 seconds. Simply enter a number in that range. Then press the "Enter" key.
- d. Auto-step will begin.
- e. To exit auto-step press "CE" key or enter a value.


#### 4. Manual Stepping

The MC1000 can be manually stepped through all or some of the stored setpoints. The procedure is as follows:

- a. Press "Shift" followed by "Man".
- b. Using the arrow keys, toggle up and down through the stored setpoints.
- c. To exit press CE or simply enter a new output value.

#### 5. Pressure Module Interface

The MC1000 has the capability to interface with a family of pressure modules available from Martel. The procedure is as follows:

- a. Connect the pressure module to the 15 pin "D" connector on top of the MC1000.
- b. Press "Shift" followed by the " " key.
- c. Always zero the pressure module before starting a calibration. Press "Shift" followed by the "Zero" key.

**Note:** More detailed information can be found with the instructions packaged with each module.

**BETA**  
CALIBRATORS

**MC1000**



**MARTEL** ELECTRONICS

INPUT OUTPUT	V/mA/Hz		
RANGE	TC RTD	SHIFT	
7 SET	8 SPT	9 AUTO	↑ 2,3,4 W
4 °F/°C	5 %mA	6 MAN	2,3,4 W ↓
1	2	3 ZERO	CE
-	0	.	ENTER

**MEASURE / SOURCE** **MEASURE**

TC 	+	+	+
	3W	mA	V/Ω/Hz
	-	-	-
	4W		

MULTIFUNCTION CALIBRATOR

### 3. Connection Diagrams & Instructions

#### A. Measuring High Voltage AC or DC

1. Select the Voltage Input Mode. Use the "Range" key to select either AC or DC input.
2. Connect the device to be measured as shown in Figure 1.

**! WARNING !** When measuring high voltage be sure to use proper connections as shown in Figure 1. Failure to do so will cause serious damage to the calibrator.

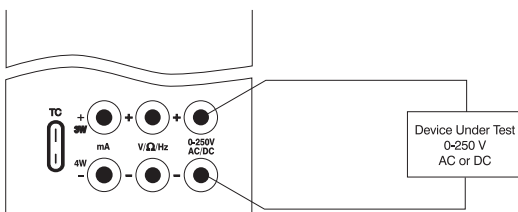


Figure 1.

#### B. Measuring Low Voltage and Frequency

1. Select the desired mode Voltage or Frequency. Use the "Range" key to select the proper range for the mode chosen.
2. Connect the device under test as shown in Figure 2.

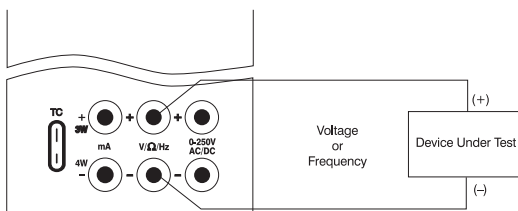


Figure 2.

**! WARNING !** Do not exceed 20 VDC at the V/Ω/Hz input.

### C. Measuring Current

1. Select the mA input mode. **Note:** To power the loop while reading current, select the "mAPW" mode.
2. Connect the device under test as shown in Figure 3.
3. Current can either be measured directly in mA or as a percentage such that 4 to 20 mA corresponds to 0 to 100%.

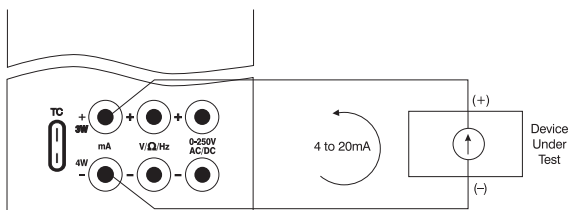


Figure 3.

### D. Sourcing Current

1. Select the mA output mode on the calibrator.
  2. Connect device under test as shown in Figure 4.
  3. Enter the value of desired output current.
- Note:** If the loop is open "OL" will appear in the display.

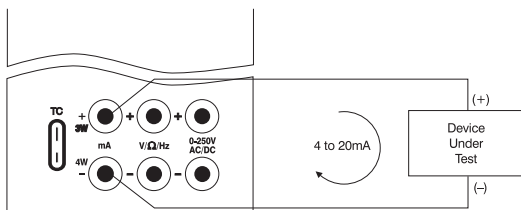


Figure 4.

## E. Simulating Current

The MC1000 can act as a two-wire transmitter and control a 4-20mA loop from the external power supply for that loop.

1. Select the mA "2W" output mode.
2. Connect the device as shown in figure 5.
3. Enter the desired output.

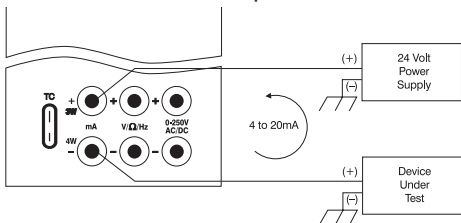


Figure 5.

## F. Sourcing

### Voltage/Resistance/Frequency

1. Select the proper operation mode: volts, ohms, frequency.
2. Connect device under test as shown.
3. In the resistance or frequency modes use the "Range" key to choose the desired range for the mode you're operating in.
4. The MC1000 is capable of driving up to  $\pm 1$  mA on the Voltage and Frequency ranges and is able to handle up to a 3 mA excitation on the Resistance Simulation Range. Exceeding these limits will result in a warning on the display.

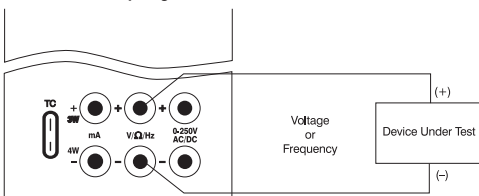


Figure 6.

**Note:** The frequency output is a 5 Volt square wave with  $-0.1$  volt offset

## G. Sourcing a Thermocouple Signal

TC wire must be used to achieve an accurate calibration.

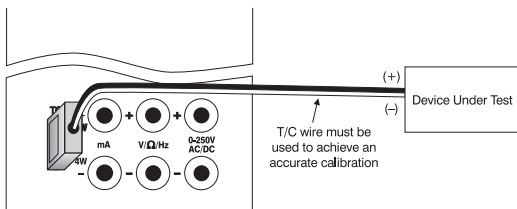


Figure 7.

**Note:** For best accuracy allow a 10 minute warm-up period after the MC1000 is turned on.

## H. Measuring Temperature Using a Thermocouple

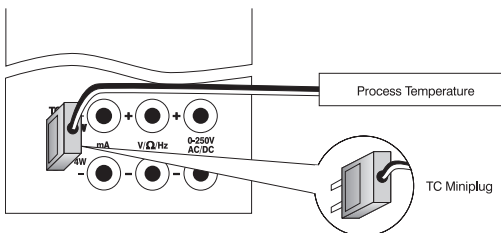


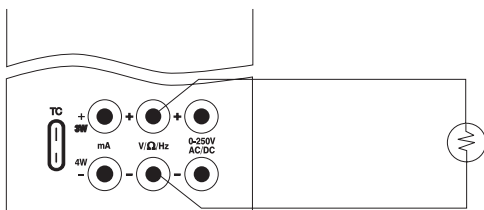
Figure 8.

## I. Measuring Resistance (RTDs)

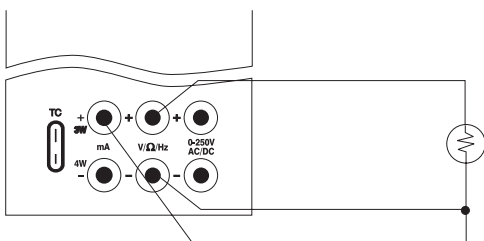
When measuring resistance (ohms) there are 3 choices when using the MC1000; 2-wire, 3-wire, and 4-wire. While 4-wire offers the highest accuracy, most industrial RTDs are a balance 3-wire. Figure 9. shows how to hook up the MC1000 for the 3 types of measurements.

1. Choose the desired RTD/ohms range by first pressing the "TC/RTD" key to get into the RTD mode. Then use the "Range" key to select the desired range within the RTD mode.

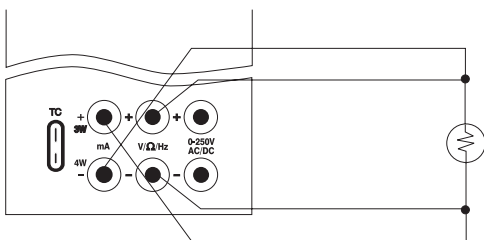
2. Make sure the MC1000 is in the Input Mode (Note: that it will indicate 2, 3, or 4W in the upper left corner of the LCD). To set the desired wire configuration use the "Up/Down arrow" keys to toggle through the 2, 3, and 4 wire modes.



**Measuring a 2 Wire RTD or Using the Continuity Function**



**Measuring a 3 Wire RTD**

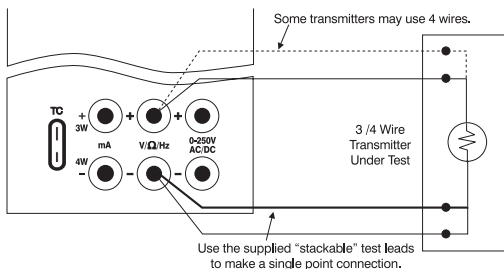


**Measuring a 4 Wire RTD**



## J. Sourcing Resistance Into a RTD Transmitter

1. As described previously in section F the MC1000 can source resistance in a RTD Transmitter or measuring device. In many cases the unit under test will require a 3 or 4 wire connection to achieve best accuracy. Refer to Figure 10 for connection information.



**Figure 10.**

## 4. Serial Communications

The MC1000 calibrator is equipped with a RS-232 serial communications port, which can be located on the top of the case.

Note: This jack was chosen for its small size and sealing ability. As a consequence, the user will require a special RS-232 cable to connect the calibrator to a computer or terminal.

### Communication

Once the cable is attached, set the communications program settings as follows:

- Baud Rate = 9600
- Data Bits = 8
- Stop Bits = 1
- Parity = None
- Flow Control = Xon/Xoff

The MC1000 calibrator can be used with virtually any terminal emulation software. (i.e. Procomm or HyperTerminal)

When connected properly, data will be transmitted as soon as the calibrator is turned on. The data transmitted to the terminal or computer will mirror that sent to the calibrators LCD display and will be updated approximately every 0.4 seconds.

## Serial Communications Procedure for HyperTerminal Program

1. From the Windows® '95 main menu, click on "Start".
2. Click on "Programs".
3. Under the category "Accessories", click on "Hyper Terminal".
4. Double click on "Hypertrm.exe".
5. Next appears a screen labeled: CONNECTION DESCRIPTION. In the box titled: Name, enter a name for your program settings... example: "MC Connection". In a box titled: Icon, click on the icon which resembles a phone and some papers in front of a bulletin board. (Note: this icon lies between icons containing a GE logo on the left and an icon containing a red umbrella on the right.) Click on the OK box to accept these entries.
6. Next appears a screen labeled: PHONE NUMBER. In the box titled: Connect Using, select the serial port that corresponds to the computer serial port that you'll be using to communicate to the MC1000 calibrator. Click on the OK box to accept this entry.
7. Next appears a screen labeled: COM X PROPERTIES (where X corresponds to the serial port selected in step #6). Enter port

settings as follows:

- (A.) Bits per second: 9600
- (B.) Data bits: 8
- (C.) Parity: None
- (D.) Stop Bits: 1
- (E.) Flow Control: Xon/Xoff

Click OK box to accept these entries.

8. Hook up the MC1000 calibrator to the PC utilizing the special Martel Electronics RS-232 cable as follows:

- (A.) Plug the 9 pin connector end of the cable to the appropriate serial port on the computer.
- (B.) With the MC1000 calibrator switched off, plug the other end of the cable (male phono jack) into the port labeled "RS-232" on the top of the MC1000 calibrator.

9. Power up the MC1000 calibrator per the appropriate instruction manual. The computer screen should now be displaying data being sent directly from the MC1000 calibrator.

Note: You may wish to save these settings when exiting HyperTerminal. If so, click on the OK box when prompted "Do you want to save X?", where X corresponds to the name entered in Step #5.

## Computer Controlled Operation

The MC1000 calibrator can be operated remotely via a computer or terminal. When connected to a computer, via the RS-232 serial data port and appropriate cabling, the user may control the calibrator functions remotely by utilizing simple computer keyboard commands.

The following chart details which computer keys control which MC1000 calibrator functions:

Serial Input	Description
A	mA measurement
a	mA source
I	mA loop
i	mA 2W Sim
V	Volts measurement
v	Volts source
M	mV measurement
m	mV source
E	HVAC measure
e	HVDC measure
K	Khz measurement
k	Khz source
H	Hz measurement
h	Hz source
P	CPM measurement
p	CPM source
W	2-wire measurement (Ohms and RTDs)
X	3-wire measurement (Ohms and RTDs)
Y	4-wire measurement (Ohms and RTDs)
T	Thermocouple measurement (default Type J) use "S" command to select sensor type
t	Thermocouple source (default Type J) use "S" command to select sensor type
C	Selects Centigrade ( T/C - RTD )
F	Selects Fahrenheit ( T/C - RTD )
R	RTD measurement mode (default Pt100 385) use "S" command to select sensor type
r	RTD measurement mode (default Pt100 385) use "S" command to select sensor type
0-9 -. <CR>	Enter a source value using ascii characters 0,1,2,...,9,-,., terminated by <CR> (carriage return)
D	Single Broadcast of most recent display value and units
d	Single Broadcast of most recent display value

## "S" Commands Select Sensor Type

Serial Input	Selection Entry		Description
S	No.	T/C Type	RTD Type
	1	J	Pt100 (3926)
	2	K	Pt100 (385)
	3	T	Pt100 (3916)
	4	E	Cu10
	5	R	Pt200 (385)

Serial Input	Selection Entry		Description
S	No.	T/C Type	RTD Type
	6	S	Pt500 (385)
	7	B	Pt1000 (385)
	8	L	NI120
	9	U	YSI
	A	N	OHMS
	B	mV	

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## 5. Maintenance

### A. Power Requirements

The MC1000 operates on 4 AA alkaline batteries only.

### B. Calibration

The MC1000 should hold its rated specifications for a minimum of one year. Given this, annual re-calibration is required for best performance. See the customer service section (7.) to contact Martel for re-calibration information.

### C. Field Replacement Fuse

MC1000 comes with a field replaceable mini-fuse. This fuse protects the MC1000 inputs and outputs. If an overload condition occurs and a blown fuse is suspected perform the following fuse check/replacement procedure:

1. Remove the four screws on the rear of the MC1000 that hold the enclosure together.  
NOTE: Two of the screws are under the battery compartment door.
2. With the case top open, locate the two socketed mini fuses mounted near the input/output connection jacks.

3. Remove one fuse at a time and check continuity using an ohmmeter. A good fuse will read 10 ohms or less. A blown fuse will have a very high reading and generally show as an open circuit.
4. If a blown fuse is found replace with the enclosed spare fuse.
5. To order more fuses contact Martel Electronics and order part no. 3535039.

## 6. Specifications

Pressure Ranges:	Module Dependent. Operates with Fluke 700 Series Modules		
T/C Ranges:	J, K, T, E, R, S, N, B, L, U including – 10 to 70mV		
RTD Ranges:	Pt 385 (100, 200, 500, 1000 ohms) Pt 392, JIS, Ni120, CU10, YSI400		
Ohms Ranges:	0 to 400.00 and 400.0 to 3200.0		
mA Range:	0 to 24.000 mA		
Voltage:	(Low) Input 0-20.000 V, Output 0-20.000 V (High) Input only 0-250 VDC or VAC		
Frequency:		<u>Source</u>	<u>Measure</u>
	CPM	2.0-1000.0	0.0-1000.0
	Hz	0-1000	0.0-1000.0
	kHz	1.0-10.0	0.0-10.00
Continuity:	0 to 400.0 ohms, audible tone when under 10 ohms		
Accuracy:	T/C Type J: $\pm .3^{\circ}\text{C} \pm 10 \mu\text{V}$ ( $\pm 0.4^{\circ}\text{C}$ total error) RTD PT100: $\pm .1^{\circ}\text{C} \pm .075 \Omega$ ( $\pm 0.3^{\circ}\text{C}$ total error) Ohms (400): $\pm 0.1 \Omega$ Ohms (3200): $\pm 1.0 \Omega$		
mA Compliance:	Up to 1000 $\Omega$ load		
Voltage Drive Capability:	1 mA		
RTD IEX-range:	0.01 mA to 3 mA		
RTD Frequency Response:	10 mS – works with all pulsed XMTR's		
Oper. Temp:	-10°C to 50°C		
Storage Temp:	-40°C to 60°C		
Loop Power:	4 AA alkaline batteries, 25 hours typical operating time		
Size:	7.5" x 4" x 1.5"		

# Range & Accuracy

Range	Min	Max	Accuracy (% of reading $\pm$ counts)
V Read (low)	0.000	20.000	0.015% $\pm$ 2
VDC Read (high)	0.0	250.0	0.05% $\pm$ 2
VAC Read (high)	0.0	250.0	0.5% $\pm$ 2
V Source	0.000	20.000	0.015% $\pm$ 2
mV Read	-10.00	75.00	0.015% $\pm$ 2
mV Source	-10.00	75.00	0.015% $\pm$ 2

mA Read	0.000	24.000	0.015% $\pm$ 2
mA Source	0.000	24.000	0.015% $\pm$ 2

CPM Source	2.0	1000.0	0.05%
Hz Source	1	1000	0.05%

KHz Source	1.0	10.0	0.25%
CPM Read	0.0	1000.0	0.05% $\pm$ 1
Hz Read	0.0	1000.0	0.05% $\pm$ 1
KHz Read	0.00	10.00	0.05% $\pm$ 1

Range	Min	Max	Accuracy
Ohms Read (low)	0.00	400.00	0.1 ohm
Ohms Read (high)	400.0	1500.0	0.5 ohm
	1500.1	3200.0	1.0 ohm

Range	Min	Max	Excitation Current	Accuracy
Ohms Source (low)	5.00	400.00	0.1 to 0.5 mA	0.15 ohm
	5.00	400.00	0.5 to 3 mA	0.1 ohm
Ohms Source (high)	400.0	1500.0	0.05 to 0.8 mA	0.5 ohm
	1500.0	3200.0	0.05 to 0.4 mA	1.0 ohm

## Thermocouple Read and Source (All errors included)

Range	Min	Max	Accuracy
J Thermocouple	-200.0	0.0	0.6°C
	0.0	1200.0	0.4°C
K Thermocouple	-200.0	0.0	0.8°C
	0.0	1370.0	0.5°C
T Thermocouple	-200.0	0.0	0.8°C
	0.0	400.0	0.5°C
E Thermocouple	-200.0	0.0	0.5°C
	0.0	950.0	0.4°C
R Thermocouple	-20	0.0	2.49°C
	0	500	1.7°C
	500	1750	1.3°C
S Thermocouple	-20	0	2.4°C
	0	500	1.7°C
	500	1750	1.4°C
B Thermocouple	600	800	2.1°C
	800	1000	1.7°C
	1000	1800	1.3°C

**Thermocouple Read and Source (All errors included) (cont.)**

<b>Range</b>	<b>Min</b>	<b>Max</b>	<b>Accuracy</b>
L Thermocouple	-200 0.0	0.0 900.0	0.45°C 0.4°C
U Thermocouple	-200 0.0	0.0 400.0	0.7°C 0.45°C
N Thermocouple	-200 0.0	0.0 1300.0	1.1°C 0.6°C
mV Read/Source	-10.00	75.00	0.015% ±.02 mV

**RTD Read and Source**

<b>Range</b>	<b>Min</b>	<b>Max</b>	<b>Accuracy</b>
Ni120 (672)	-80.0	260.0	0.2°C
Pt100 (385)	-200.0	800.0	0.33°C
Pt100(3926)	-200.0	630.0	0.3°C
Pt100(3916)	-200.0	630.0	0.3°C
Pt200(385)	-200.0	630.0	0.8°C
Pt500(385)	-200.0 500.0	500.0 630.0	0.3°C 0.4°C
Pt1000(385)	-200.0 100.0	100.0 630.0	0.2°C 0.3°C
Cu10	-100.0	250.0	2.2°C
YSI400	15.00	50.00	0.05°C



## 7. Warranty

Martel Electronics Corporation warrants all products against material defects and workmanship for a period of twelve (12) months after the date of shipment. Problems or defects that arise from misuse or abuse of the instrument are not covered. If any product is to be returned, a "Return Material Authorization" number must be obtained from our Customer Service Department. This number must be indicated on the return package as notice to our Receiving Department to accept the shipment. Any package not so marked will not be accepted and will be returned to the shipper. Martel will not be responsible for damage as a result of poor return packaging. Out of warranty repairs and recalibration will be subject to specific charges. Under no circumstances will Martel Electronics be liable for any device or circumstance beyond the value of the product.





[www.martelcorp.com](http://www.martelcorp.com)

e-mail: [sales@martelcorp.com](mailto:sales@martelcorp.com)

Tel: (603) 434-8179 800-821-0023

Fax: (603) 434-1653

**Martel Electronics**

PO Box 770

1F Commons Drive

Londonderry, NH 03053



[www.betacalibrators.com](http://www.betacalibrators.com)

Tel: 800-537-2181 or (972) 241-2200

Fax: (972) 241-2200

**Beta Calibrators**

2309 Springdale Rd.

Farmers Branch, Texas 75234