Practical Instrument Electronics

PIECAL 211
Automated RTD Calibrator
Operating Instructions

Product Description

- **Easy to use**
  With the PIECAL 211 you can check & calibrate all your RTD instruments and measure RTD Sensors. Automatic indication of connections on the display for simple hookups.

- **Take it into the shop, plant or field**
  Carry it without worry - it comes protected with a rubber boot and rugged, low profile switch. Easy to operate even in the dark areas of the plant with the backlit display.

- **Calibrate directly in temperature (°C & °F)**
  Stop carrying around a decade box and RTD resistance tables. The PIECAL 211 works with the RTDs you use including Platinum 100 (alpha = 3850, 3902, 3926) & 1000 (alpha = 3850, 3750) Ohm, Copper 10 & 50 Ohm, and Nickel 120 Ohm. Easily set any value quickly to within 0.1° with the adjustable digital potentiometer "**DIAL**" plus store any three temperatures for instant recall with the EZ-CHECK™ switch.

- **Calibrate quickly with automatic output stepping**
  Choose between 2, 3, 5, 11 and 21 steps to automatically increment the output in 100%, 50%, 25%, 10% or 5% of span. Select the step time to match your system from 5, 6, 7, 8, 9, 10, 15, 20, 25, 30 and 60 seconds.

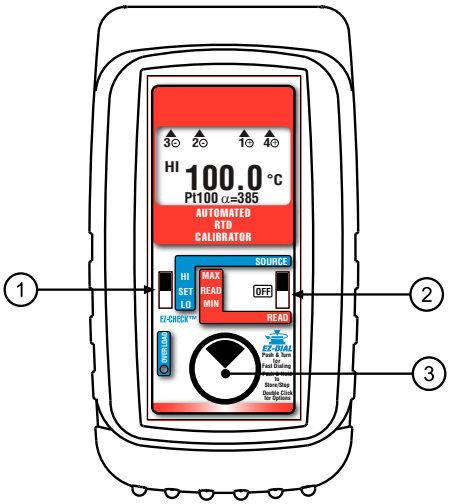
- **Compatible with all process instruments**
  Connect directly to the RTD inputs of smart transmitters, PLCs, DCS and multichannel recorders and verify their outputs or displays. Works with older instruments with fixed excitation currents and newer multichannel instruments that switch the excitation current between input channels.

CE

- **Measure RTD Sensors**
  Troubleshoot sensor connections and find broken wires with patented technology. Connect your two, three or four wire RTDs and the PIECAL 211 automatically detects the connections and measures the RTD in degrees C or F.

Practical Instrument Electronics
82 East Main Street Suite 3.14 • Webster, NY 14580 Tel: 585.872.9350 • Fax: 585.872.2638 • sales@piecal.com • www.piecal.com

Basic Operation



① **EZ-CHECK™ SWITCH**

SOURCE: Instantly output two preset RTD temperatures by moving the EZ-CHECK™ switch to the **"LO"** position or **"HI"** position. For fast three point checks select the **"DIAL"** position. The PIECAL 211 will remember the last **"DIAL"** value, even with the power off.
These values can easily be changed to suit the calibration requirements. The temperatures stored in the HI and LO positions are also used for Auto Stepping.

READ: Slide the switch to the DIAL position. The PIECAL 211 will display the current temperature from the RTD sensor. Slide the switch to HI and the highest temperature measured since turn-on or reset will be displayed; slide the switch to LO and the lowest temperature measured since turn-on or reset will be displayed.

② **SOURCE/OFF/READ Switch**
Select "**SOURCE**" to output in °C, °F or ohms.
Select "**READ**" to read an RTD sensor or ohms.

③ **EZ-DIAL™ KNOB**
SOURCE: Turn the knob to adjust the output level. Turn clockwise to increase the output, counter clockwise to decrease the output in 0.1° steps at a time. Push down and turn the EZ-DIAL knob for faster dialing.
Press and hold the knob for two seconds to store desired EZ-Check™ HI/LO points in SOURCE mode. *Continue to press and hold the knob for two more seconds to start the automatic stepping.*

READ: Press and hold to transfer the current temperature into the EZ-Check™ HI/LO points. This clears the HI/LO temperature readings which will update as the temperature changes.

Double click the knob to get into the PIECAL 211 menu. Use the menu to select RTD or Ohms, °C or °F, 400Ω or 2000Ω, RTD Type, Backlight On/Off, Step Size, Step Time and Auto Off On/Off.

CHANGING BATTERIES
Low battery is indicated by a battery symbol on the display. Approximately one to four hours of typical operation remain before the PIECAL 211 will automatically turn off. To change the batteries; remove the rubber boot, remove the battery door from the back of the unit by sliding the door downward. This allows access to the battery compartment. Replace with four (4) "AA" 1.5V batteries being careful to check the polarity. Replace the battery door and replace the boot. All stored configuration options (RTD Type, EZ-CHECK Memories, etc., are reset to factory settings when the batteries are removed.

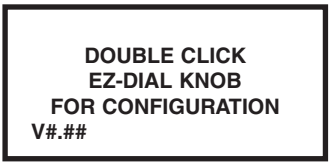
Note: Alkaline batteries are supplied and recommended for maximum battery life and performance.

Configuration

Power on & MAIN manu

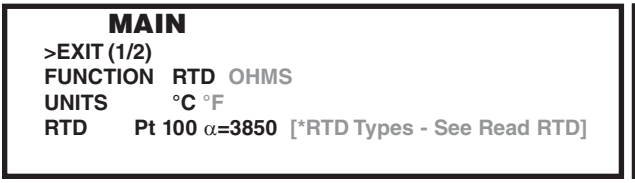
Move ② POWER SWITCH to **"SOURCE"** or **"READ"**.

Setup

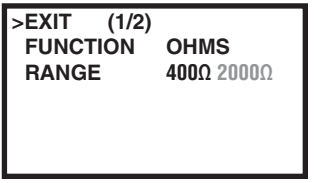


Double click the ③ DIAL KNOB at any time the unit is on and the following displays will appear for 15 seconds:

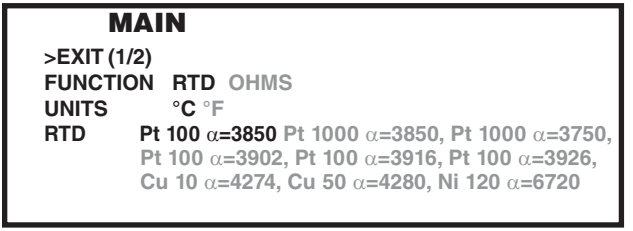
Source RTD



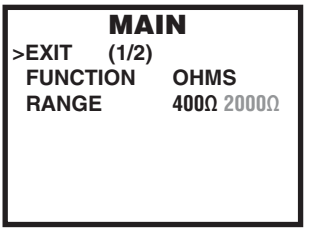
Source Ohms



Read RTD



Read Ohms



Turn the ③ DIAL KNOB to move through the menu. Press the ③ DIAL KNOB to toggle between OFF and ON or to scroll through the settings.

EXIT MENU - exits this menu immediately and saves any changes. Menu will automatically exit after 15 seconds of inactivity (countdown timer is displayed).

FUNCTION - pressing the knob will toggle between RTD and OHMS.

UNITS/RANGE - pressing the knob will toggle between °C and °F for RTD or 400Ω and 2000Ω for OHMS.

RTD - pressing the knob will cycle through the various RTD (Pt, Cu & Ni) at different base resistances and alpha values.

DISPLAY OHMS - If DISPLAY OHMS is ON the resistance associated with the RTD temperature will appear in small digits on the display.

Note: All settings are remembered even with the power off. Removing the batteries resets the values to factory defaults.

FEATURES - Auto Off, Backlight & Automatic Stepping

EXIT MENU - exits this menu immediately and saves any changes. Menu will automatically exit after 30 seconds of inactivity.

AUTO OFF - If AUTO OFF is ON, the unit will turn off after 30 minutes of inactivity to save battery life. If AUTO OFF is OFF the unit will stay on until the POWER SWITCH is moved to the off position.

FEATURES		
>	EXIT (2/2)	
	AUTO OFF	ON OFF
	BACKLIGHT	ON OFF
	STEPS	3
	STEP TIME	5

BACKLIGHT - If BACKLIGHT is ON the backlight will light all the time the unit is powered up. For maximum battery life turn the backlight off when using the calibrator in areas with enough ambient light to read the display.

STEPS - pressing the knob will cycle through 2, 3, 5, 11 and 21 steps then reverse direction. The endpoints of the steps are based on the values stored in the **HI** and **LO** EZ-CHECK outputs.

2 steps will automatically switch between the values stored in the HI & LO EZ-CHECK (0 & 100%).

3 steps between the HI, Midpoint and LO EZ-CHECK (0, 50 & 100%).

5 steps between the HI and LO EZ-CHECK in 25% increments (0, 25, 50, 75 & 100%).

11 steps between the HI and LO EZ-CHECK in 10% increments (0, 10, 20...80, 90 &100%).

21 steps between the HI and LO EZ-CHECK in 5% increments (0, 5, 10... 90, 95 & 100%).

Note: All settings are remembered even with the power off. Removing the batteries resets the values to factory defaults.

STEP TIME - pressing the knob will cycle through 5, 6, 7, 8, 9, 10, 15, 20, 25, 30 and 60 seconds.

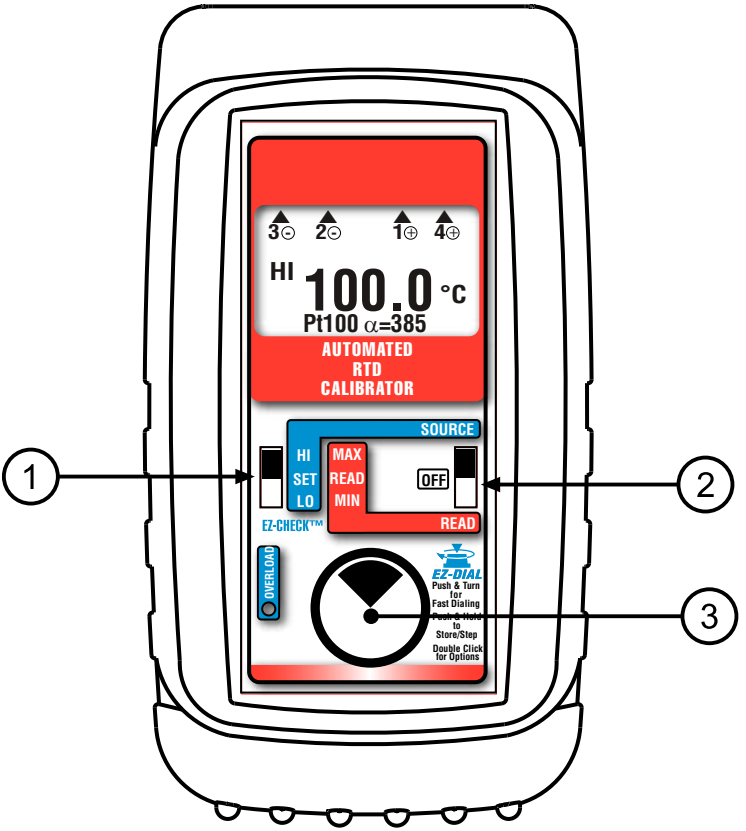
To start the Automatic Stepping
Start automatic stepping by placing the EZ-CHECK Switch into the HI or LO position then press and hold the ③ DIAL KNOB for 6 seconds (the word STORE will appear on the display after 3 seconds and continue to press the DIAL KNOB) until the word STEPPING appears on the display. The word STEPPING will appear on the display anytime the selected automatic function is running. Stop the stepping by again pressing and holding the ③ DIAL KNOB for 3 seconds.

Storing EZ-CHECK Outputs

STORING HI and LO EZ-CHECK Outputs

Choose this function to select commonly used temperature output values, and set high and low values for stepping.

1) Store your high (SPAN) output temperature by moving the EZ-CHECK switch to the **HI** position and turn the ③ EZ-Dial knob until the desired temperature is on the display. Press and hold the EZ-Dial knob until **STORED** appears to store the value. Release the EZ-Dial knob.
2) Store your low (ZERO) output temperature by moving the EZ-CHECK switch to the **LO** position and turn the ③ EZ-Dial knob until the desired temperature is on the display. Press and hold the EZ-Dial knob until **STORED** appears to store the value. Release the EZ-Dial knob.
3) Instantly output your SPAN and ZERO temperature outputs by moving the EZ-CHECK switch between HI and LO. You may also select any third temperature output (such as mid-range) using the SET position on the EZ-CHECK switch.



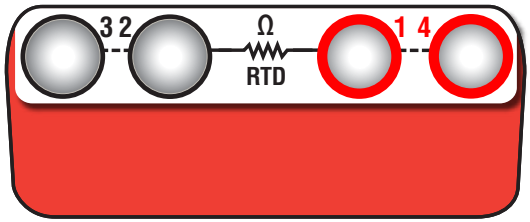
Connections

Connecting 2, 3 or 4 Wire instruments or sensors

The PIECAL 211 has four standard banana jacks for 2, 3 or 4 wire instruments or sensors. All connections are made at the top of the calibrator where the jacks are numbered for ease of use.

SOURCE
Plug in the 2, 3 or 4 wires to match the connection on the instrument being calibrated.

READ
Plug in the 2, 3 or 4 wires from the sensor and the PIECAL 211 will automatically detect the correct setting for 2, 3 or 4 wire simulation using a patented circuit.



Calibrating RTD Instruments

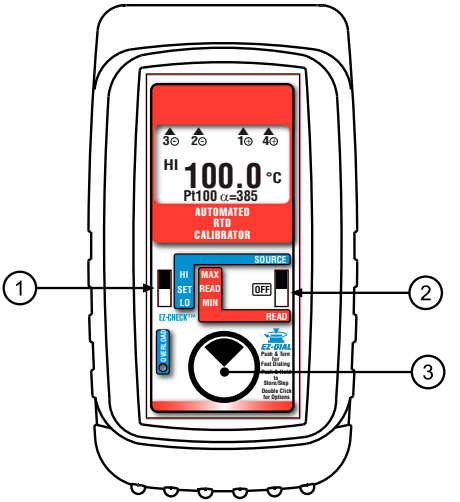
SOURCE

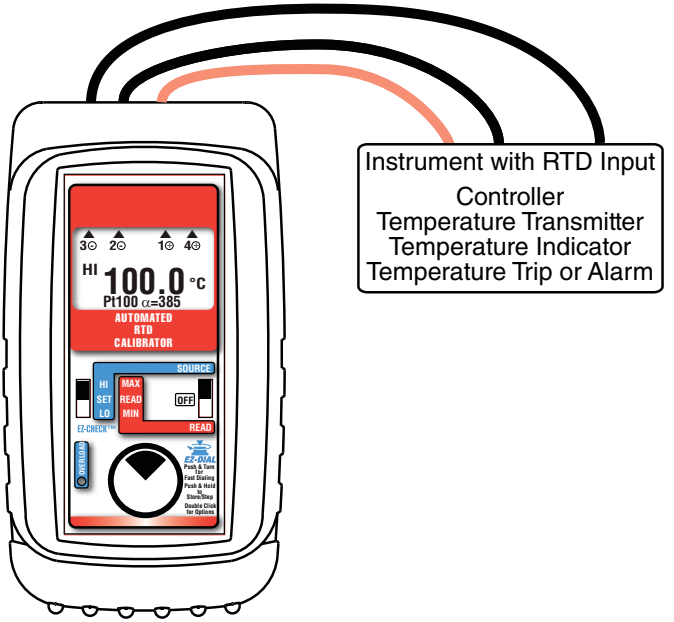
Choose this function to provide a simulated RTD signal into controllers, temperature transmitters, indicators or any input devices that measure RTD sensors.

1) Disconnect the RTD sensor from the device to be calibrated.
2) Select "**SOURCE**" with slide switch ②.
3) Connect the PIECAL 211 to the device using 2, 3 or 4 wires matching the connections of the sensor that was just removed.

The output is adjusted in 0.1° (or 0.01/0.1 ohm) increments by turning the knob ③ while the EZ-CHECK™ switch ① is in the "HI", "LO" or "SET" position. Press and turn the knob for faster dialing with 10° (or 1.00/10.0 ohm) increments.

The OVERLOAD indicator will light if excessive voltage or current is detected by the calibrator.





Reading RTD Sensors

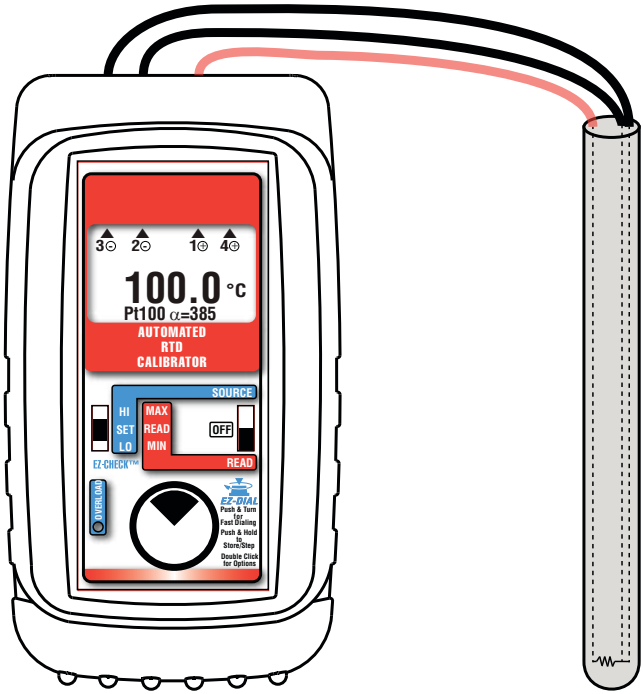
READ

Choose this function to measure temperatures with an RTD probe or sensor.

1) Disconnect the RTD sensor from any other device.
2) Select "**READ**" with slide switch ②.
3) Place the EZ-CHECK switch into the READ position.
4) Connect the PIECAL 211 to the device using 2, 3 or 4 wires.

The PIECAL 211 measures the temperature signal and constantly updates the display with the current temperature reading. Move the EZ-CHECK switch to MAX to see the highest temperature reading and to MIN to see the lowest temperature reading. Press and hold the knob ③ to clear the MAX and MIN readings.

The OVERLOAD indicator will light if excessive voltage or current is detected by the calibrator.



Troubleshooting RTD Sensors

Troubleshooting RTD Sensors

When troubleshooting a problem with an RTD input it is useful to check that the sensor and the wiring to the instrument is operating properly.

The PIE 211 automatically detects 2, 3 and 4 wire RTD connections with a patented circuit. It will also display the connections on the display and indicate when there is a missing connection due to a loose connector, corrosion or a broken wire.

Here is an example of the PIECAL 211 reading a sensor with all 4 wire connected.

Here is an example where connections are made to a 4 wire sensor and the 211 indicates that only Wires 1, 2 & 4 are connected. There may be a loose connection or a break in wire 3 somewhere between the sensor and the 211.

This is much simpler and quicker than going through the process of testing each pair of wires to figure out which, if any, connection is loose or which wire is broken.

Ranges & Accuracies

Table based on 3 & 4 Wire RTD (ITS-90) Accuracy*:
≤ ± (0.025 % of Reading +0.05 Ohms)

RTD Type	Alpha	Degrees C Range	Accuracy °C	Degrees F Range	Accuracy °F
Pt 100 Ohm (DIN/IEC/JIS 1989) Based on ITS-90	1.3850 (0.00385)	-200.0 to 160.0 1600 to 450.0 450.0 to 710.0 710.0 to 850.0	±0.2° ±0.3° ±0.4° ±0.5°	-328.0 to 320.0 320.0 to 842.0 842.0 to 1310.0 1310.0 to 1562.0	±0.4° ±0.6° ±0.8° ±0.9°
Pt 100 Ohm (Burns)	1.3902 (0.003902)	-195.6 to 170.0 170.0 to 460.0 460.0 to 648.9	±0.2° ±0.3° ±0.4°	-320.1 to 338.0 338.0 to 860.0 860.0 to 1200.0	±0.4° ±0.6° ±0.8°
Pt 100 Ohm (Old JIS 1981)	1.3916 (0.003916)	-200.0 to 170.0 170.0 to 460.0 460.0 to 648.9	±0.2° ±0.3° ±0.4°	-328.0 to 338.0 338.0 to 860.0 860.0 to 1200.0	±0.4° ±0.6° ±0.8°
Pt 100 Ohm (US Lab)	1.3926 (0.003926)	-200.0 to 170.0 170.0 to 460.0 460.0 to 720.0 720.0 to 850.0	±0.2° ±0.3° ±0.4° ±0.5°	-328.0 to 338.0 338.0 to 860.0 866.0 to 1328.0 1328.0 to 1562.0	±0.4° ±0.6° ±0.8° ±0.9°
Pt 1000 Ohm (DIN/IEC/JIS 1989)	1.3850 (0.00385)	-200.0 to 230.0 230.0 to 550.0 550.0 to 830.0 830.0 to 850.0	±0.1° ±0.2° ±0.3° ±0.4°	-328.0 to 446.0 446.0 to 1022.0 1022.0 to 1526.0 1526.0 to 1562.0	±0.3° ±0.4° ±0.6° ±0.6°
Pt 1000 Ohm Hy-Cal HVAC	1.3750 (0.00375)	-200.0 to 200.0 200.0 to 274.0	±0.3° ±0.4°	-328.0 to 392.0 392.0 to 525.0	±0.6° ±0.7°
Copper 10 Ohm (Minco)	1.4274 (0.004274)	-200.0 to -160.0 -160.0 to -30.0 -30.0 to 260.0	±1.2° ±1.3° ±1.4°	-328.0 to -256.0 -256.0 to -22.0 -22.0 to 500.0	±2.2° ±2.4° ±2.5°
Copper 50 Ohm	1.4280 (0.00428)	-50.0 to 150.0	±0.3°	-58.0 to 302.0	±0.6°
Ni 120 Ohm (Pure)	1.6720 (0.00672)	-80.0 to 260.0	±0.1°	-112.0 to 500.0	±0.2°

*Read based on 1.0 mA of fixed excitation current

PIECAL 211 Specifications

(Unless otherwise indicated all specifications are rated from a nominal 23 °C, 70 % RH for 1 year from calibration)

General	
Accuracy	±(0.025% of Reading + 0.05 Ohms)
Temperature Drift	± 0.01% of span outside of 23°C ±10 °C (73°C ±18 °F)
Operating Temperature Range	-25 to 60 °C (-10 to 140 °F)
Relative Humidity Range	10 % ≤RH ≤90 % (0 to 35 °C), Non-condensing
	10 % ≤RH≤ 70 % (35 to 60 °C), Non-condensing
Size	5.63 x 3.00 x 1.60 inches, 143 x 76 x 41 mm (L x W x H)
Weight	12.1 ounces, 0.34 kg (including boot & batteries)
Batteries	Four "AA" Alkaline 1.5V (LR6)
Battery Life	50 Hours
Optional NiMh Rechargeable battery kit	120 VAC for North America Only; charger, four NiMh batteries, AC & DC cords [Part # 020-0103]
Low Battery	Low battery indication with nominal 1 hour of operation left
Protection against misconnection	Over-voltage protection to 60 V dc (rated for 30 seconds)
Display	High contrast graphic liquid crystal display. LED backlighting for use in low lit areas.

Read	
Excitation Current	0.9 mA to 401 Ohms, 0.4 mA to 2010 Ohms (nominal)
Normal Mode Rejection	50/60 Hz, 50 dB
Common Mode Rejection	50/60 Hz, 120 dB

Source	
3 Wire & 4 Wire Accuracy	
From 1 to 10.2 mA External Excitation Current	±(0.025% of Reading + 0.05 Ohms)
Below 1 mA of External Excitation Current	$\pm(0.025\%\ \text{of Reading} + \frac{0.025\ \text{mV}}{\text{mA Excitation Current}} + 0.05\ \text{Ohms})$
2 Wire Accuracy	Add 0.1 Ohms to 3 Wire & 4 Wire Accuracy
Resistance Ranges	0.00 to 401.00, 0.0 to 2010.0 Ohms
Allowable Excitation Current Range	400 Ohm Range:10.2 mA max; steady or pulsed/intermittent 2000 Ohms Range: 1 mA max; steady or pulsed/intermittent
Pulsed Excitation Current Compatibility	DC to 0.01 second pulse width

Additional Information

This product is calibrated on equipment traceable to NIST and includes a Certificate of Calibration. Test Data is available for an additional charge.

Practical Instrument Electronics recommends a calibration interval of one year. Contact your local representative for recalibration and repair services.

Accessories

Included:

Red Rubber Boot (020-0212), Four "AA" Alkaline batteries, Certificate of Calibration

Evolution Hands Free Carrying Case — Part No. 020-0211

Evolution RTD Wire Kit — Part No. 020-0208

2 Red & 2 Black Leads with Banana Plugs & Spade Lugs

Optional:

Ni-MH 1 Hour Charger with 4 Ni-MH AA Batteries — Part No. 020-0103

(100-120 V AC input for North America Only)

Warranty

Our equipment is warranted against defective material and workmanship (excluding batteries) for a period of three years from the date of shipment. Claims under warranty can be made by returning the equipment prepaid to our factory. The equipment will be repaired, replaced or adjusted at our option. The liability of Practical Instrument Electronics (PIE) is restricted to that given under our warranty. No responsibility is accepted for damage, loss or other expense incurred through sale or use of our equipment. Under no condition shall Practical Instrument Electronics, Inc. be liable for any special, incidental or consequential damage.