

# Model 422

## Automated Thermocouple Calibrator

### Operating Instructions

## Product Description

- **Easy to use**

With the PIECAL 422 you can check & calibrate all your thermocouple instruments and measure thermocouple sensors.

- **Take it with you into the shop, plant or field**

Carry it without worry - it comes protected with a rubber boot and rugged, low profile switches. 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 millivolt source and thermocouple tables. The PIECAL 422 works with the thermocouples you use including types J, T, E, K, R, S, B, N, G, C, D, L (J-DIN), U (T-DIN) and Platinel II. 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 steps and ramp to automatically increment the output in 100%, 50%, 25%, 10% of span or continuously ramp between span and zero. 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 thermocouple inputs of smart transmitters, PLCs, DCS and multichannel recorders and verify their outputs or displays.

- **Measure Thermocouple Sensors**

Trouble shoot sensor connections and find broken wires. The PIECAL 422 measures the thermocouple in degrees C or F. Secondary display shows the millivolt value corresponding to the thermocouple temperature as well as the cold junction temperature measured by the calibrator.

- **Calibration Lab Accurate & Stable**

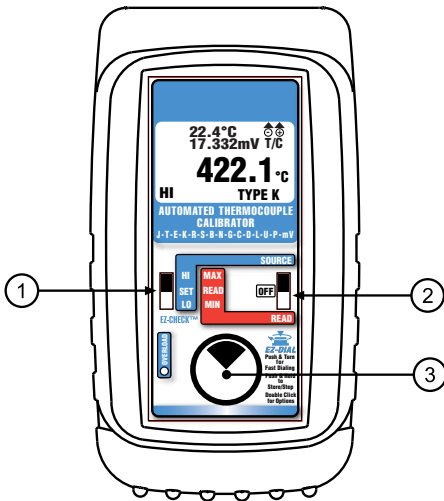
The internal cold junction thermistor is accurate to  $\pm 0.05^{\circ}\text{C}$  and is traceable to NIST. The sensor is thermally bonded to an isothermal mass which includes brass blocks with screw terminals for connection of bare thermocouple wires along with a miniature thermocouple connector for fast connections. The circuitry uses an extremely stable voltage reference and low drift components which make the PIECAL 422 more accurate than most other handheld and benchtop thermocouple calibrators.

- **Perform Heat Treating Uniformity Surveys and System Accuracy Tests**

The PIECAL 422 meets or exceeds the requirement of AMS 2750 as a Field Test Instrument.



## Basic Operation



### ① EZ-CHECK™ SWITCH

**SOURCE:** Instantly output two preset thermocouple temperatures by moving the EZ-CHECK™ switch to the “LO” position or “HI” position. For fast three point checks select the “SET” position. The PIECAL 422 will remember the last “SET” 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 SET position. The PIECAL 422 will display the current temperature from the thermocouple 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 millivolts. Select “READ” to read a thermocouple sensor or millivolts. Select “OFF” to turn the unit off.

### 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 or ramping.

**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 422 Configuration Mode. Use configuration to select °C or °F, T/C Type, Backlight On/Off, Step Size, Step Time and Auto Off On/Off, CJC & mV.

### CHANGING BATTERIES

Low battery is indicated by “BAT” on the display. Approximately one to four hours of typical operation remain before the PIECAL 422 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 (T/C Type, EZ-CHECK Memories, etc.) are reset to factory settings when the batteries are removed.

**Note:** Alkaline batteries are supplied and recommended. Purchase the optional Ni-MH rechargeable batteries for maximum battery life.

## Connections

Simulating or reading thermocouples requires the use of thermocouple or extension grade thermocouple wire.

Plug thermocouple wires into the miniature thermocouple jack or place bare thermocouple wires onto the brass block under the screws.

The PIECAL 422 has two banana jacks mounted in the top end of the housing. These are not temperature compensated and are to be used only for millivolt signals.

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# Configuration

## Configure the Calibrator

Move ② POWER SWITCH to “SOURCE” or “READ”.

**DOUBLE CLICK  
EZ-DIAL KNOB  
FOR CONFIGURATION**

V#.##

### Setup

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

Turn the ③ DIAL KNOB to move through the three pages of menus. Press the ③ DIAL KNOB to toggle between OFF and ON or to scroll through the settings.

### MAIN

> EXIT (1/3)  
FUNCTION T/C V  
UNITS °C °F  
T/C TYPE J K E T R S B N L U G C D P  
COLD JUNC ON OFF

### T/C DISPLAY

> EXIT (2/3)  
DISPLAY mV ON OFF  
DISPLAY CJ ON OFF

### FEATURES

> EXIT (3/3)  
AUTO OFF ON OFF  
BACKLIGHT ON OFF  
STEPS/RAMP 2 3 5 11 RAMP  
STEP/RAMP TIME 5 6 7 8 9 10 15 20 25 30 60

**EXIT** - exits this menu immediately and saves any changes. Menu will automatically exit after 15 seconds of inactivity).

**UNITS** - pressing the knob will toggle between °C and °F.

**FUNCTION** - pressing the knob will toggle between T/C and V. Select T/C for thermocouple or V for the -13.000 to 80.000 mV range.

**T/C TYPE** - pressing the knob will cycle through T/C types J, K, E, T, R, S, B, N, L (J-DIN), U (T-DIN), G (W), C (W5), D (W3) and P (Platinel II).

**COLD JUNC** - Automatic COLD JUNCTION (Cold Junction Compensation) may be turned on or off. It is recommended that CJC be left on (default). CJC should only be turned off if an external cold junction compensator or ice bath is used with the PIECAL 422.

**DISPLAY mV** - If DISPLAY mV is ON the mV value corresponding to the sourced or measured temperature is displayed.

**DISPLAY CJ** - If DISPLAY CJ is ON the cold junction temperature measured by the PIECAL 422 will be displayed.

**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.

**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/RAMP** - pressing the knob will cycle through 2, 3, 5, 11 and RAMP. The endpoints of the steps or ramp 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%).

**RAMP** continuously ramps up and down between the HI and LO EZ-CHECK outputs.

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

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

# Sourcing Thermocouple

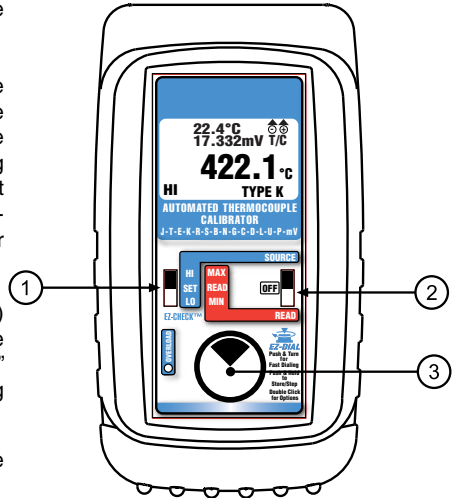
## SOURCE

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

- 1) Disconnect the thermocouple sensor from the device to be calibrated.
- 2) Select **"SOURCE"** with slide switch ②.
- 3) Connect a thermocouple wire (matching the type of wire to sensor being simulated) with miniature male T/C connector or bare leads under the brass screws to the inputs of the device being calibrated, making sure to check polarity. Millivolt outputs (without cold junction) may be connected with a copper (white) miniature T/C connector or the banana jacks with copper wire.

The output is adjusted in 0.1° (or 0.001 mV) 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 0.100 mV) increments.

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



# Reading Thermocouple Sensors

## READ

Choose this function to measure temperatures with a thermocouple probe or sensor.

- 1) Disconnect the thermocouple sensor from any other device.
- 2) Select **"READ"** with slide switch ②.
- 3) Place the EZ-CHECK switch into the **READ** position.
- 4) Connect a thermocouple probe (matching the type of wire to sensor being measured) with miniature male T/C connector or bare wire under the brass screws to the sensor. Millivolt outputs (without cold junction) are connected with a copper (white) miniature thermocouple connector or to the banana jacks with copper wire.

The PIECAL 422 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.

# 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.

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# Storing EZ-CHECK Outputs

## STORING HI and LO EZ-CHECK Outputs

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

- 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.

## Automatic Stepping

### To change the Automatic Stepping settings

Double click the ③ DIAL KNOB at any time the unit is on and the menu will appear for 15 seconds.

Turn the ③ DIAL KNOB to move through down to the third (FEATURES) menu. Press the ③ DIAL KNOB to toggle between OFF and ON or to change the STEPS and the STEP TIME settings. These settings are remembered even with the power off.

### FEATURES

> EXIT (3/3)

AUTO OFF

ON OFF

BACKLIGHT

ON OFF

STEPS/RAMP

2 3 5 11 RAMP

STEP/RAMP TIME

5 6 7 8 9 10 15 20 25 30 60

**EXIT MENU** - exits this menu immediately and saves any changes. Menu will automatically exit after 15 seconds of inactivity.

**STEPS** - pressing the knob will cycle through 2, 3, 5 and 11 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%).

**RAMP** continuously between the HI and LO EZ-CHECK.

**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 or ramping 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.

## Thermocouple Ranges & Accuracies

Based on  $\pm (0.008 \% \text{ of Reading} + 0.006 \text{ mV})$

T/C Type	Degrees C Range	Accuracy	Degrees F Range	Accuracy	T/C Material	ISA/ANSI Color
J	-200.0 to -180.0	$\pm 0.3^\circ$	-328.0 to -292.0	$\pm 0.5^\circ$	+Iron -Constantan Jacket	White Red Black
	-180.0 to -50.0	$\pm 0.2^\circ$	-292.0 to -58.0	$\pm 0.4^\circ$		
	-50.0 to 500.0	$\pm 0.1^\circ$	-58.0 to 932.0	$\pm 0.2^\circ$		
	500.0 to 1200.0	$\pm 0.2^\circ$	932.0 to 2192.0	$\pm 0.4^\circ$		
K	-230.0 to -100.0	$\pm 0.6^\circ$	-382.0 to -148.0	$\pm 1.1^\circ$	+ Chromel® -Alumel® Jacket	Yellow Red Yellow
	-100.0 to 1050.0	$\pm 0.2^\circ$	-148.0 to 1922.0	$\pm 0.4^\circ$		
	1050.0 to 1371.1	$\pm 0.3^\circ$	1922.0 to 2500.0	$\pm 0.5^\circ$		
T	-260.0 to -200.0	$\pm 1.0^\circ$	-436.0 to -328.0	$\pm 1.8^\circ$	+Copper -Constantan Jacket	Blue Red Blue
	-200.0 to -50.0	$\pm 0.5^\circ$	-328.0 to -58.0	$\pm 0.9^\circ$		
	-50.0 to 0.0	$\pm 0.2^\circ$	-58.0 to 32.0	$\pm 0.4^\circ$		
	0.0 to 400.0	$\pm 0.1^\circ$	32.0 to 752.0	$\pm 0.2^\circ$		
E	-240.0 to -200.0	$\pm 0.4^\circ$	-400.0 to -328.0	$\pm 0.7^\circ$	+Chromel -Constantan Jacket	Purple Red Purple
	-200.0 to -100.0	$\pm 0.2^\circ$	-328.0 to -148.0	$\pm 0.4^\circ$		
	-100.0 to 850.0	$\pm 0.1^\circ$	-148.0 to 1562.0	$\pm 0.2^\circ$		
	850.0 to 1000.0	$\pm 0.2^\circ$	1562.0 to 1832.0	$\pm 0.4^\circ$		
R	-18.3 to 250.0	$\pm 1.2^\circ$	-1.0 to 482.0	$\pm 2.2^\circ$	+Pt/13Rh -Platinum Jacket	Black Red Green
	250.0 to 750.0	$\pm 0.6^\circ$	482.0 to 1382.0	$\pm 1.1^\circ$		
	750.0 to 1600.0	$\pm 0.5^\circ$	1382.0 to 2192.0	$\pm 0.9^\circ$		
	1600.0 to 1767.8	$\pm 0.6^\circ$	2192.0 to 3214.0	$\pm 1.1^\circ$		
S	-18.3 to 100.0	$\pm 1.2^\circ$	-1.0 to 212.0	$\pm 2.1^\circ$	+Pt/10Rh -Platinum Jacket	Black Red Green
	100.0 to 400.0	$\pm 0.8^\circ$	212.0 to 752.0	$\pm 1.4^\circ$		
	400.0 to 1700.0	$\pm 0.6^\circ$	752.0 to 3092.0	$\pm 1.1^\circ$		
	1700.0 to 1767.8	$\pm 0.7^\circ$	3092.0 to 3214.0	$\pm 1.3^\circ$		
B	315.6 to 550.0	$\pm 1.8^\circ$	600 to 1022.0	$\pm 3.2^\circ$	+Pt/30Rh -Pt/6Rh Jacket	Grey Red Grey
	550.0 to 900.0	$\pm 1.1^\circ$	1022.0 to 1652.0	$\pm 2.0^\circ$		
	900.0 to 1150.0	$\pm 0.7^\circ$	1652.0 to 2102.0	$\pm 1.3^\circ$		
	1150.0 to 1820.0	$\pm 0.6^\circ$	2102.0 to 3308.0	$\pm 1.1^\circ$		

*Note: Doesn't include cold junction error of  $\pm 0.05^\circ\text{C}$*

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# Thermocouple Ranges & Accuracies

Based on  $\leq \pm (0.008 \% \text{ of Reading} + 0.006 \text{ mV})$

T/C Type	Degrees C Range	Accuracy	Degrees F Range	Accuracy	T/C Material	ISA/ANSI Color
N	-230.0 to -180.0	$\pm 1.0^\circ$	-382.0 to -292.0	$\pm 1.8^\circ$	+Nicrosil -Nisil Jacket	Orange Red Orange
	-180.0 to -50.0	$\pm 0.5^\circ$	-292.0 to -58.0	$\pm 0.9^\circ$		
	-50.0 to 1100.0	$\pm 0.2^\circ$	-58.0 to 2012.0	$\pm 0.4^\circ$		
	1100.0 to 1300.0	$\pm 0.3^\circ$	2012.0 to 2372.0	$\pm 0.5^\circ$		
G (W)	100.0 to 150.0	$\pm 1.2^\circ$	212.0 to 302.0	$\pm 2.2^\circ$	+Tungsten -W26/Re Jacket	White Red White/Blue
	150.0 to 400.0	$\pm 0.8^\circ$	302.0 to 752.0	$\pm 1.4^\circ$		
	400.0 to 1700.0	$\pm 0.4^\circ$	752.0 to 3092.0	$\pm 0.7^\circ$		
	1700.0 to 2320.0	$\pm 0.7^\circ$	3092.0 to 4208.0	$\pm 1.3^\circ$		
C (W5)	-1.1 to 1500	$\pm 0.5^\circ$	30.0 to 2372.0	$\pm 0.9^\circ$	+W5/Re -W26/Re Jacket	White Red White/Red
	1500 to 1900	$\pm 0.6^\circ$	2372.0 to 3452.0	$\pm 101^\circ$		
	1900.0 to 2100.0	$\pm 0.7^\circ$	3452.0 to 3812.0	$\pm 1.3^\circ$		
	2100.0 to 2320.0	$\pm 0.9^\circ$	3812.0 to 4208.0	$\pm 1.6^\circ$		
D (W3)	-1.1 to 50.0	$\pm 0.6^\circ$	30.0 to 122.0	$\pm 1.1^\circ$	+W3/Re -W25/Re Jacket	White Red White/Yellow
	50.0 to 1400.0	$\pm 0.4^\circ$	122.0 to 2552.0	$\pm 0.7^\circ$		
	1400.0 to 1800.0	$\pm 0.5^\circ$	2552.0 to 3272.0	$\pm 0.9^\circ$		
	1800.0 to 2320.0	$\pm 0.9^\circ$	3272.0 to 4208.0	$\pm 1.6^\circ$		
P Platinel®	0.0 to 1000.0	$\pm 0.2^\circ$	32.0 to 1832.0	$\pm 0.4^\circ$	+Pd55/Pt31/Au14 -Au65/Pd35 Jacket	Yellow Red Black
	1000.0 to 1395.0	$\pm 0.3^\circ$	1832.0 to 2543.0	$\pm 0.5^\circ$		
<b>DIN Colors</b>						
L J-DIN	-200.0 to -50.0	$\pm 0.2^\circ$	-328.0 to -58.0	$\pm 0.4^\circ$	+Iron -Connstantan Jacket	Red Blue Blue
	-50.0 to 500.0	$\pm 0.1^\circ$	-58.0 to 932.0	$\pm 0.2^\circ$		
	500.0 to 900.0	$\pm 0.2^\circ$	932.0 to 1652.0	$\pm 0.4^\circ$		
U T-DIN	-200.0 to -75.0	$\pm 0.3^\circ$	-328.0 to -103.0	$\pm 0.5^\circ$	+Copper -Constantan Jacket	Red Brown Brown
	-75.0 to 100.0	$\pm 0.2^\circ$	-103.0 to 212.0	$\pm 0.4^\circ$		
	100.0 to 600.0	$\pm 0.1^\circ$	212.0 to 1112.0	$\pm 0.2^\circ$		

*Note: Doesn't include cold junction error of  $\pm 0.05^\circ\text{C}$*

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## Thermocouple Ranges & Accuracies

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

<b>General</b>	
Accuracy	$\pm(0.008\% \text{ of Reading} + 0.006 \text{ mV})$
Cold Junction Compensation	$\pm 0.09^\circ\text{F} (\pm 0.05 \text{ }^\circ\text{C})$ - Thermistor traceable to NIST for 11 years
Millivolt Range	-13.000 to 80.000 mV
Operating Temperature Range	-25 to 60 °C (-10 to 140 °F)
Temperature Effect	$\leq \pm 50 \text{ ppm}/^\circ\text{C}$ ; Cold Junction Sensor $\leq \pm 25 \text{ ppm}/^\circ\text{C}$
Relative Humidity Range	10 % $\leq$ RH $\leq$ 90 % (0 to 35 °C), Non-condensing 10 % $\leq$ RH $\leq$ 70 % (35 to 60 °C), Non-condensing
Size	L=5.63 x W=3.00 x H=1.60 inches
Weight	12.1 ounces (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 life left
Protection against misconnection	Over-voltage protection to 60V dc (rated for 30 seconds)
Display	High contrast graphic liquid crystal display. LED backlighting for use in low lit areas.

<b>Read</b>	
Input Impedance	> 10 Megohms
Open Thermocouple Threshold Pulse	10,000 Ohms nominal < 10 microamp pulse for 300 milliseconds
Normal Mode Rejection	50/60 Hz, 50 dB
Common Mode Rejection	50/60 Hz, 120 dB

<b>Source</b>	
Output Impedance	< 0.3 Ohms
Source Current	> 20 mA (drives 80 mV into 10 Ohms)
Noise	$\leq 4 \text{ microvolts p-p}$ for frequencies of 10 Hz or below

## Accessories

- |   |                   |
|---|-------------------|
| Optional: T/C Wire Kit 1 for Types J, K, T & E  | Part No. 020-0202 |
| Optional: T/C Wire Kit 2 for Types B, R/S & N   | Part No. 020-0203 |
| Three feet (1 meter) of T/C extension wire, stripped on one end with a miniature T/C male connector on the other end. |                   |
| Standard Test Leads (Included with calibrator)  | Part No. 020-0207 |
| Three feet (1 meter) of wire with an alligator clip on one end and a banana plug on the other end.                    |                   |
| Optional Ni-MH 1 Hour Charger w/4 Ni-MH AA Batteries  | Part No. 020-0103 |
| (100-120 V AC input for North America Only)   |                   |

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