



# PIE 850 Process Calibrator

# NEW!

## Get more tools in a smaller calibrator

Carry eight single function calibrators  
**plus** a 4-20/10-50 milliamp calibrator with loop supply  
**plus** a loop troubleshooter in the palm of your hand!

Milliamp • Voltage • Frequency • pH  
Ohms • Thermocouples • RTDs • Pressure  
Loop Diagnostics • Transmitter Supply

## 10-50 mA Multifunction Calibrator with troubleshooting tools

- 1 Detect 'hidden' loop problems**  
Quickly diagnose troublesome ground faults & current leakage with patented **Loop Diagnostic** technology. *These problems are undetectable with other instruments!*
- 2 Check all loop parameters at once with the LoopScope™**  
Simultaneously displays current, voltage and resistance to let you know the condition of a live loop. Finds problems with power supplies & loops with too many loads. *Patented by PIE!*
- 3 Troubleshoot wiring problems without a multimeter**  
Built in continuity checker with 'beeper' quickly finds broken wires or shorts in instrumentation wiring. Also handy for checking operation of relays and controller outputs.

The PIE Model 850 is more than a multifunction calibrator. It is also a loop detective that is able to diagnose common problems that other test equipment just can't find. Have a flooded junction box or unknown ground faults? Our Loop Diagnostic technology will detect it. Or use the *LoopScope* to see at a glance all the parameters - milliamps, voltage and resistance - in the loop.

Become a troubleshooting technician with Patented Diagnostic Technology - *Available only with PIE Calibrators!*



Actual Size



## Easy to use Multifunction Calibrator

- **Technician friendly operation**

Intuitive *EZ-DIAL Double Click Menu* makes it easier to setup than other multifunction calibrators. As easy to use as single function PIE Calibrators. Turn on the backlight to easily see the display in dark areas of the plant. Connections diagrams are indicated on the display for each function along with a labeled connector and a help chart behind the tilt stand.

- **Calibrate with Confidence**

Accurate to  $\pm 0.02\%$  of Reading + 0.01% Full Scale.

- **Measure temperature sensors, frequency pickups, loop currents, voltage levels & pressures**

Check the values of your process sensors. Instantly recall MAX and MIN values to see process variability.

- **Guaranteed Compatibility with process inputs**

Compatible with the instruments you use including all brands of smart transmitters and PLCs with 14 T/C and 9 RTD types to 0.1°C and 0.1°F

- **Quickly set any three outputs plus automatic stepping & ramping**

Easily set any value with the adjustable "DIAL" plus store any three output settings for instant recall with the EZ-CHECK™ switch. 2, 3, 5 & 11 steps automatically increment output in 100%, 50%, 25% or 10% of span plus continuous ramp. Set step/ramp time to 5, 6, 7, 8, 10, 15, 20, 25, 30 & 60 seconds.



## Milliamp Calibrator

- **Easy to use**

With the 850 you can check, calibrate and measure all of your current signal instruments in 4 to 20 & 10 to 50 milliamp DC loops. It can be used at any access point in your loop.



Source & Read 0.000 to 24.000 or 52.000 mA, Simulate a 2 Wire Transmitter or use the 850 to simultaneously power your 2 Wire Transmitter and measure its output.

- **Source milliamps**

Calibrate recorders, digital indicators, stroke valves or any instruments that get their input from a 4 to 20 or 10 to 50 mA loop. Easily set any value quickly to within 0.001 mA with the adjustable digital potentiometer "EZ-DIAL" or use preset **4.000 or 10.000 mA (0.00%)** and **20.000 or 50.000 mA (100.00%)** EZ-CHECK™ settings.

- **Calibrate using loop power**

Check loop wiring and receivers by using the 850 in place of a 2 Wire transmitter. Uses any loop power from 2 to 60 V DC.

- **Read loop current**

Check controller outputs or measure the milliamp signal anywhere in the loop. The 850 measures 0.000 to 52.000 mA (-25.00 to 125.00%) signals with greater accuracy than a typical multimeter.

- **Power & measure 2 wire transmitters**

The 850 can simultaneously output 24V DC @ 20 mA or 40V DC @ 50 mA to power any and all devices in a process loop using the internal batteries and internal switching power supply, while measuring the output of a 2 Wire Transmitter and any other loop devices. Powers HART™ transmitters (4-20 mA only) with built-in 250 ohm resistor simplifying hookups with HART communicators.

The 850 has an internal 40 V power supply which is able to drive transmitters and positioners in 10-50 mA loops. Some other brands of calibrators have a 24 V supply which are unable to supply the power required to properly drive these control devices.

## Voltage Calibrator

- **Source three ranges of mV & V dc**

With the 850 you can check, calibrate and measure all your voltage, millivolt and pH signal instruments in your plant. Source 0.000 to 10.250 V dc, -500.00 to 999.99 mV and -20.000 to 99.999 mV.



- **Read DC volts**

The 850 can measure from 0.000 to 10.250 V, -999.99 to 999.99 mV, -99.999 to 99.999 mV and 0.00 to 60.0 VDC. Use it to check loop power supplies, I/V converters, 1 to 5 Volt signals, and other voltages.

## Thermocouple Calibrator

- **Calibrate directly in temperature to 0.1°C & 0.1°F**

Stop carrying around a millivolt source and thermocouple tables. The 850 works with the thermocouples you use including types J, K, T, E, R, S, B, N, G, C, D, L (J-DIN), U (T-DIN) and P (Platinel II). Easily set any value quickly to within 0.1° with the adjustable digital potentiometer “EZ-DIAL” plus recall any three temperatures for instant recall with the EZ-CHECK™ switch.



- **Measure thermocouple sensors**

Trouble shoot sensor connections and find broken wires or corroded connections. Connect your thermocouple with a miniature thermocouple connector and the 850 measures the probe to 0.1 degree C or F. Check the values of your process sensors. Instantly recall MAX and MIN values to see process variability.

## RTD, Resistance Calibrator

- **Calibrate ALL your RTD instruments**

With the 850 you can check & calibrate all your RTD instruments and measure RTD Sensors.



- **Calibrate directly in temperature (°C & °F)**

Stop carrying around a decade box and RTD resistance tables. The 850 works with the RTDs you use including Platinum 100 (alpha = 3850, 3902, 3916, 3926) & 1000 (alpha = 3850) Ohm, Copper 10 & 50 Ohm, Nickel 100 and 120 Ohm. Easily set any value quickly to within 0.1° with the adjustable digital potentiometer “EZ-DIAL” plus store any three temperatures for instant recall with the EZ-CHECK™ switch. Or use like a decade box from 0.00 to 401.00 and from 0.0 to 4010.0 Ohms.

- **Compatible with ALL process instruments**

No competitor's calibrator is compatible with as many 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.

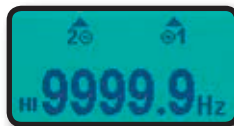
- **Measure RTD sensors**

Connect your two, three or four wire RTDs and the 850 measures the RTD within 0.1 degree C or F. Check the values of your process sensors. Instantly recall MAX and MIN values to see process variability.

## Frequency Calibrator

- **Calibrate flow meters and frequency instruments**

Generate zero crossing square waves to check, calibrate and measure all the frequency signal instruments in your plant. Source and read frequencies from 1 to 2000 CPM (Counts-Per-Minute), 0.01 to 999.00 Hz, 0.1 to 9999.9 Hz and 0.001 to 20.000 kHz.



- **Checkout optical pickups**

The 850 has a green LED that flashes in sync with the output frequency. Select a frequency and hold the calibrator up to the optical sensor.

- **Measure frequency signals**

Check the values of your process frequency outputs. Instantly recall MAX and MIN values to see process variability.

## pH Simulator

- **Simulate pH probes into transmitters & analyzers**

Use the pH simulator to verify proper operation of pH devices before you place a probe into a calibrated buffer. Adjusting the pH transmitter or analyzer without a probe allows you to make sure the device is calibrated and doesn't require too much offset with the probe. If the probe requires more than the manufacturer's

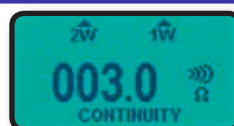
recommendations (typically 5%) it is time to replace the probe. The 850 simulates 0.000 to 14.000 pH @ 25°C corresponding to +414.12 to -414.12 mV.



## Continuity Checker

- **Troubleshoot wiring and connection problems**

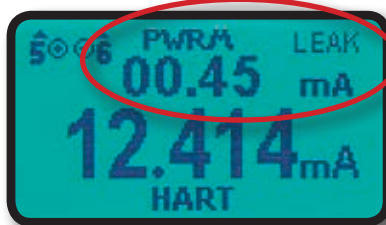
Use the built-in continuity checker to look at wiring and connections during installation or to locate shorts. Beeps from 0 to 100 Ohms.



## Troubleshoot Loop Problems

- Find current leaks in loops before swapping instruments

Automatic indication of Loop Current and Leakage Current (US Patent #7,248,058) in both 4-20 and 10-50 mA loops. Measure ground current leakage from faulty wiring, flooded conduit and corrosion bridges to help you decide if there is a wiring problem in the loop (diagrams below).



850 detects uncontrolled current in the loop due to a flooded junction box.

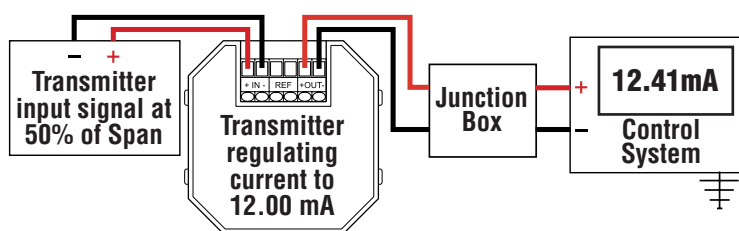
### Typical problem found with Leak Detection

Have you ever replaced a “faulty” transmitter only to find the problem was somewhere else in the loop? And did you end up throwing the transmitter away after you fixed the other problem “just in case” the transmitter was faulty?

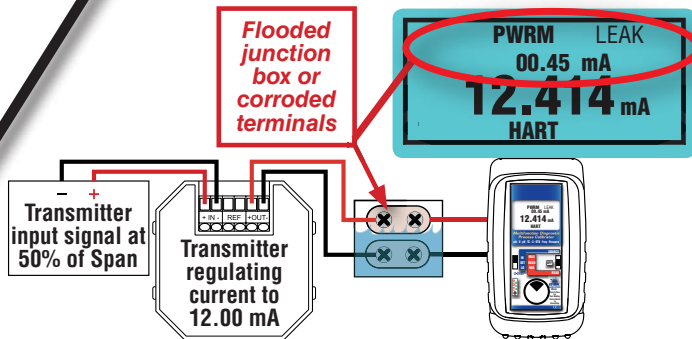
If you find a loop where the transmitter is calibrated correctly but all the readings elsewhere in the loop have a fixed offset this is due to a *Zero Shift*. This zero shift is typically caused by some current in the loop bypassing the transmitter. This might be caused by ground faults, moisture or corrosion.

If you have some loops that are erratic after it rains there may be moisture present in a junction box or where insulation has broken down. Turn on Ground Leak Detection and use the PIE 850 to power up the loop. Any current that isn't controlled by the transmitter or other current control element will be indicated as leakage on the PIE 850 display. Undetected current leaks may cause calibration errors which can lead to dangerous operating conditions or catastrophic results.

The PIE 850 powers up the 2-Wire transmitter or loop and indicates the total current and the uncontrolled current. This provides information useful in troubleshooting loop errors.



Here is a loop where a technician has just recalibrated the transmitter but the control room still sees a problem. The problem started just after a rainstorm.



Using the PIE 850 to power up the loop the technician detects a leakage of 0.45 mA - approximately the offset seen in the control room. He walks the loop and opens a junction box releasing a stream of water. The loop is again in control.

## Become a Loop Detective - Locate hidden loop problems with LoopScope

When you need to find out why a loop is out of control and all the wiring seems to be in order turn on the 850's LoopScope and simultaneously see all the parameters of the loop. The LoopScope simultaneously displays the current, DC voltage and total resistance in the loop. Observing the SUPPLY (DC voltage) and the LOAD (resistance) lets you see if the loop power supply has enough capacity to power all the devices in the loop.

By observing all three signals at the same time you can see how the voltage and resistance respond as the current changes. If the voltage drops too far as the current goes up you may need a power supply with more capacity or the power supply itself may be failing. If the resistance in the loop is too high you may have more devices in the loop than the power supply can handle or there may be an instrument in the loop that is drawing too much power and requires replacement.



*With LoopScope running the 850 simultaneously controls and displays the loop current while measuring & displaying the power supply voltage and loop load in ohms.*

### Why buy a PIE calibrator with loop diagnostics

Undiagnosed loop problems often cause calibration errors which can lead to dangerous operating conditions or catastrophic results. Only PIE makes *troubleshooting multifunction calibrators* that can detect and indicate these problems due to the patented troubleshooting features.

### Evolutionary Design

- **Designed for you by experienced calibrator manufacturers**

PIE Calibrators are designed and built by members of the same team that designed and built the calibrators manufactured by Fluke\* under the Altek\* label. The 850 improves upon other brands by including a rubber boot, backlit display with larger digits, troubleshooting tools, higher accuracy and more ranges for flexibility.

\* PIE Calibrators are not manufactured or distributed by Fluke Corp or Altek Industries Inc, manufacturers of Altek Calibrators.

## Ordering Information

| Description                            | Part No       |
|--|---------------|
| PIE Model 850 Process Calibrator ..... | PIE Model 850 |

### Included:

|  |          |
|--|----------|
| Four "AA" Lithium Ion batteries, Certificate of Calibration with Test Data |          |
| Blue Rubber Boot .....   | 020-0213 |
| Evolution Hands Free Carrying Case .....                                   | 020-0211 |
| Evolution mA/V Test Leads .....  | 020-0207 |
| 1 Red & 1 Black Lead with Banana Plugs & Alligator Clips                   |          |
| Evolution RTD Wire Kit .....   | 020-0208 |
| 2 Red & 2 Black Leads with Banana Plugs & Spade Lugs                       |          |

## Accessories

### Optional

|   |          |
|---|----------|
| Three Year Repair/Replacement Warranty.....                         | RP-WAR-B |
| Evolution Hands Free Carrying Case with Pressure Module Pocket..... | 020-0223 |

### Optional Hand Pumps, Tubing & Fitting Kits

|  |          |
|--|----------|
| APOV 0-300 PSI/20.7 bar Pneumatic Scissor Hand Pump .....                  | 020-0224 |
| HPOV 0-3000 PSI/206.9 bar Hydraulic Scissor Hand Pump .....                | 020-0225 |
| DPPV 0-125 PSI/8.6 bar Pressure, 23"/584 mm Hg Vacuum hand pump .....      | 020-0226 |
| 1/8" male NPT x Male Quick-Test™ Fitting with Cap.....                     | 020-0227 |
| Adapter kit (1/8" MNPT&FNPT; 1/4" MNPT, FNPT & Tube Adapter) .....         | 020-0228 |
| Quick-Test™ 6900 psi/475 bar hose, 3ft (1 m) .....                         | 020-0229 |
| PKIT1 (020-0224 Pneu Scissor Pump, 020-0229 Hose & 020-0227 fitting).....  | 020-0230 |
| PKIT2 (020-0225 Hydr Scissor Pump, 020-0229 Hose & 020-0227 fitting) ..... | 020-0231 |
| PKIT3 (020-0226 Press/Vac Pump, 020-0229 Hose & 020-0227 fitting).....     | 020-0232 |

### Optional Pressure Modules

|   |        |
|---|--------|
| 0-10"/24.9 mbar H2O Differential, Non Isolated.....                 | DN0010 |
| 0-28"/69.7 mbar H2O Differential, Non Isolated.....                 | DN0028 |
| 0-200"/498 mbar H2O Differential, Non Isolated.....                 | DN0200 |
| 0-415"/1 bar H2O Differential, Non Isolated.....                    | DN0415 |
| 0-2000"/5 bar H2O Differential, Non Isolated.....                   | DN2000 |
| 0-1 PSI/68.9 mbar Differential, Isolated.....                       | DI0001 |
| 0-5 PSI/344.7 mbar Differential, Isolated.....                      | DI0005 |
| 0-15 PSI/1 bar Differential, Isolated.....                          | DI0015 |
| 0-30 PSI/2 bar Differential, Isolated.....                          | DI0030 |
| 0-100 PSI/6.9 bar Differential, Isolated.....                       | DI0100 |
| 0-300 PSI/20.7 bar Differential, Isolated.....                      | DI0300 |
| 0-500 PSI/34.5 bar Differential, Isolated.....                      | DI0500 |
| 0 to 15 PSI/1 bar Gauge, Isolated.....                              | GI0015 |
| 0 to 30 PSI/2 bar Gauge, Isolated.....                              | GI0030 |
| 0 to 50 PSI/3.4 bar Gauge, Isolated.....                            | GI0050 |
| 0 to 100 PSI/6.9 bar Gauge, Isolated.....                           | GI0100 |
| 0 to 300 PSI/20.7 bar Gauge, Isolated.....                          | GI0300 |
| 0 to 500 PSI/34.5 bar Gauge, Isolated.....                          | GI0500 |
| 0 to 1,000 PSI/69 bar Gauge, Isolated.....                          | GI1000 |
| 0 to 3,000 PSI/206.8 bar Gauge, Isolated.....                       | GI3000 |
| -14.7 PSIG/1 bar to +15 PSIG/1 bar Compound, Isolated .....         | CI0015 |
| -14.7 PSIG/1 bar to +30 PSIG/2 bar Compound, Isolated .....         | CI0030 |
| -14.7 PSIG/1 bar to +50 PSIG/3.4 bar Compound, Isolated .....       | CI0050 |
| -14.7 PSIG/1 bar to +100 PSIG/6.9 bar Compound, Isolated .....      | CI0100 |
| -14.7 PSIG/1 bar to +300 PSIG/20.7 bar Compound, Isolated .....     | CI0300 |
| -14.7 PSIG/1 bar to +500 PSIG/34.5 bar Compound, Isolated .....     | CI0500 |
| -14.7 PSIG/1 bar to +1,000 PSIG/69 bar Compound, Isolated .....     | CI1000 |
| -14.7 PSIG/1 bar to +3,000 PSIG/ 206.8 bar Compound, Isolated ..... | CI3000 |
| 0-17 PSIA/1.2 bar Absolute, Isolated.....                           | AI0017 |
| 0-38 PSIA/2.6 bar Absolute, Isolated.....                           | AI0038 |
| 0-100 PSIA/6.9 bar Absolute, Isolated.....                          | AI0100 |
| 0-1,000 PSIA/69 bar Absolute, Isolated.....                         | AI1000 |

### Pressure Module Media Compatibility

Non-isolated DN sensors: clean, dry,  
non-corrosive, non-condensing gases only

Isolated DI sensors: any media  
compatible with 316L SS & Viton®

Isolated GI, CI & AI sensors: any media  
compatible with 316L SS

## Measure Pressure

- **Easily measure pressure with a plug in pressure module**

Purchase any of the pressure modules from the table below along with one of the three hand pumps and tubing kits for a complete pressure calibration system.

| Sensor Code | Application                | Ranges Available  |
|-------------|----------------------------|---|
| DNxxxx      | Differential, Non-isolated | 0 to 0010*, 0028, 0200, 0415, 2000" H2O                       |
| DIxxxx      | Differential, Isolated     | 0 to 0001, 0005, 0015, 0030, 0100, 0300, 0500 PSID            |
| GIxxxx      | Gauge, Isolated            | 0 to 0015, 0030, 0050, 0100, 0300, 0500, 1000, 3000 PSIG      |
| CIxxxx      | Compound, Isolated         | -14.7 to +0015, 0030, 0050, 0100, 0300, 0500, 1000, 3000 PSIG |
| AIxxxx      | Absolute, Isolated         | 0 to 0017, 0038, 0100, 1000 PSIA                              |

### Media Compatibility

Non-isolated DN sensors: clean, dry, non-corrosive, non-condensing gases only

Isolated DI sensors: any media compatible with 316L SS & Viton®

Isolated GI, CI & AI sensors: any media compatible with 316L SS

### Accuracy

±0.025% of full scale including all effects of linearity, repeatability and hysteresis from -20° to +50°C (-4° to +122°F)

\* The DN0010 sensor accuracy is ±0.050% of full scale

### 32 Engineering Units:

PSI • inches, feet, mm, cm and meter of H2O @ 4°C, 20°C & 60°F • inches, meter, cm and mm of Hg @ 0°C;  
 torr • kg/cm2 • kg/m2 • Pa • hPa • kPa • MPa • Bar • mBar • ATM • oz/in2 • lb/ft2



**PIE 850 with Pressure Module, Pressure/Vacuum Pump & Hose**

## Hand Pumps, Tubing & Fitting Kits

- **Generate pressure with a full set of hand pumps**

Choose from a selection hand pumps, tubing & fittings made in the USA by Ralston Instruments. All pumps have two pressure ports - one port & hose go the PIE pressure module and the other to the pressure input of your instrument.

### Pneumatic Pressure/Vacuum Pump

0 to 125 psi & 0 to 23 inches vacuum



### Pneumatic Scissor Hand Pump

0 to 300 psi



### Hydraulic Scissor Hand Pump

0 to 3,000 psi



### Quick-test™ Hoses

Microbore hoses provide a very quick, low volume, high pressure way of connecting any pressure instrumentation to the hand pump and pressure module.



### Pressure Fitting Kit

Adapts from Quick-test™ hose to 1/4" male & female NPT, 1/8" male & female NPT and 1/4" tube fitting



**Hands free carrying case with pockets for the PIE 850 and the Pressure Module. Back of case has zippered pocket for the manual, test leads, hoses & pressure fittings.**



**Hands free carrying case with pockets for the PIE 850 and the Pressure Module.**

**Designed to be worn around your neck so that you can safely use both hands to calibrate.**

# PIE 850 Specifications

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

| General                          |  |
|----------------------------------|--|
| Operating Temperature Range      | -20 to 60 °C (-5 to 140 °F)  |
| Storage Temperature Range        | -30 to 60 °C (-22 to 140 °F)   |
| Temperature effect               | ≤ ± 0.005 %/°C of Full Scale   |
| Relative Humidity Range          | 10 % ≤RH ≤90 % (0 to 35 °C), Non-condensing<br>10 % ≤RH ≤ 70 % (35 to 60 °C), Non-condensing   |
| Common Mode Rejection            | 50/60 Hz, 100 dB   |
| Normal Mode Rejection            | 50/60 Hz, 50 dB  |
| Noise                            | ≤ ± ½ Least Significant Digit from 0.1 to 10 Hz  |
| Size                             | 5.63 x 3.00 x 1.60 in, 143 x 76 x 41mm (L x W x H)   |
| Weight                           | 12.1 ounces, 0.34 kg (including boot & batteries)  |
| Batteries                        | Four "AA" Lithium 1.5V (LR6)   |
| Battery Life                     | Read Functions ≥ 20 hours; Read Pressure ≥ 7 hours<br>Source mA: ≥ 14 hours @ 12 mA into 250Ω<br>≥ 9.5 hours @ 30 mA into 250Ω<br>Pwr/Meas: ≥ 12 hours @ 20 mA, ≥ 4.5 hours @ 50 mA<br>Source V, Ω, T/C, pH, RTD & Hz ≥ 20 hours |
| Low Battery                      | Low battery indication with nominal 1 hour of operation left   |
| Protection against misconnection | Over-voltage protection to 60 vrms (rated for 30 seconds). Red LED indicates OVERLOAD or out of range conditions   |
| Display                          | High contrast graphic liquid crystal display with 0.35" (9 mm) high digits on main & 0.2" (5 mm) on mA display. LED backlighting for use in low lit areas.   |

| Read mA                           |   |
|-----------------------------------|---|
| Ranges and Resolution             | 0.000 to 24.000 mA or -25.00 to 125.00% of 4-20 mA<br>0.000 to 52.000 mA or -25.00 to 105.00% of 10-50 mA |
| Accuracy                          | ≤ ± (0.02 % of Reading + 0.003 mA)  |
| Voltage burden                    | ≤ 2V at 24 mA. ≤ 2V at 52 mA.   |
| Overload/Current limit protection | 25 mA nominal in 20 mA range<br>52.5 mA nominal in 50 mA range  |

| Source mA / Power & Measure Two Wire Transmitters & PWRM LEAK |  |
|---|--|
| Ranges and Resolution   | 0.000 to 24.000 mA or -25.00 to 125.00% of 4-20 mA<br>0.000 to 52.000 mA or -25.00 to 105.00% of 10-50 mA                          |
| Accuracy  | ≤ ± (0.02 % of Reading + 0.003 mA)   |
| Loop compliance voltage                                       | ≥ 24 DCV @ 20.00mA. ≥ 40 DCV @ 50.00mA   |
| Loop drive capability   | 1200 Ω at 20 mA for 15 hours nominal; 800 Ω at 50 mA for 4.5 hours nominal<br>Subtract 250Ω with Hart Resistor enabled (4-20 Only) |

| mA 2-Wire Transmitter Simulation  |   |
|-----------------------------------|---|
| Accuracy                          | Same as Source/Power & Measure                                      |
| Voltage burden                    | ≤ 2V at 24 mA. ≤ 2V at 52 mA.                                       |
| Overload/Current limit protection | 25 mA nominal in 20 mA range<br>52.5 mA nominal in 50 mA range      |
| Loop voltage limits               | 2 to 60 VDC (fuse-less protected from reverse polarity connections) |

| pH Source      |  |
|----------------|--|
| Accuracy in mV | ≤ ± (0.02 % of Reading in mV + 0.1 mV) |
| Accuracy in pH | ≤ ± 0.003 pH @ 25°C                    |

| Voltage Read         |  |
|----------------------|--|
| Range and Resolution | ±99.999 mV, ±999.99mV, 0 to 10.250V, 0.00 to 60.00V DC |
| Accuracy             | ≤ ± (0.02 % of Reading + 0.01% Full Scale)             |
| Input resistance     | ≥ 1 MΩ   |

| Source V dc            |  |
|------------------------|--|
| Ranges and Resolution  | -20.000 to 99.999 mV, -500.00 to 999.99 mV, 0.000 to 10.250V |
| Accuracy               | ≤ ± (0.02 % of Reading + 0.01% Full Scale)                   |
| Source Current         | ≥ 20 mA  |
| Sink Current           | > 16 mA  |
| Output Impedance       | < 1 Ohm  |
| Short Circuit Duration | Infinite   |

| Thermocouple Source        |                                     |
|----------------------------|-------------------------------------|
| Accuracy                   | ≤ ± (0.02 % of Reading + 0.01 mV)   |
| Cold Junction Compensation | ± (0.1°C + 0.005%/°C)               |
| Output Impedance           | < 1 Ohm                             |
| Source Current             | > 20 mA (drives 80 mV into 10 Ohms) |

| Thermocouple Read                     |  |
|---------------------------------------|--|
| Accuracy & Cold Junction Compensation | Same as Thermocouple Source                            |
| Input Impedance                       | > 1 Megohms  |
| Open TC Threshold; Pulse              | 10K Ohms; <5 μamp pulse for 300 milliseconds (nominal) |

| RTD, OHMS and Continuity Read |   |
|-------------------------------|---|
| Resistance Ranges             | 0.00 to 401.00, 0.0 to 4010.0 Ohms                |
| Accuracy                      | ±(0.025% of Reading + 0.075 Ohms)                 |
| Excitation Current            | 1.0 mA to 401 Ohms, 0.5 mA to 4010 Ohms (nominal) |
| Continuity                    | 0.0 to 401.0 Ohms; Beeps from 0.0 to 100.0 Ohms   |

| RTD and OHMS Source                           |   |
|---|---|
| <b>3 Wire &amp; 4 Wire Accuracy</b>           | ±(0.025% of Reading + 0.075 Ohms)   |
| From 1 to 10.2 mA External Excitation Current |   |
| Below 1 mA of External Excitation Current     | ±(0.025% of Reading+0.075 Ohms + $\frac{0.025 \text{ mV}}{\text{mA Excitation Current}}$ )                            |
| <b>2 Wire Accuracy</b>                        | Add 0.1 Ohms to 3 Wire & 4 Wire Accuracy  |
| Resistance Ranges                             | 0.00 to 401.00, 0.0 to 4010.0 Ohms  |
| Allowable Excitation Current Range            | 400 Ohm Range: 10.2 mA max; steady or pulsed/intermittent<br>4000 Ohms Range: 1 mA max; steady or pulsed/intermittent |
| Pulsed Excitation Current Compatibility       | DC to 0.01 second pulse width   |

| Frequency Source                  |   |
|-----------------------------------|---|
| Ranges                            | 1 to 2000 CPM, 0.01 to 999.99 Hz, 0.1 to 9999.9 Hz, 0.001 to 20.000 kHz |
| Accuracy                          | ±(0.02% of Reading + 0.01% of Full Scale)                               |
| Output Waveform                   | Square Wave, Zero Crossing -1.0 to +5V peak-to-peak ±10%                |
| Risetime (10 to 90% of amplitude) | < 10 microseconds   |
| Output Impedance                  | < 1 Ohm   |
| Source Current                    | > 1 mA rms at 20 kHz  |
| Short Circuit Duration            | Infinite  |
| Optical Coupling                  | Green LED (HZ SYNC) flashes at output frequency                         |

| Frequency Read    |   |
|-------------------|---|
| Ranges & Accuracy | Same as Frequency Source                  |
| Accuracy          | ±(0.02% of Reading + 0.01% of Full Scale) |
| Trigger Level     | 1 V rms, dc coupled                       |
| Input Impedance   | > 1 Meg Ohm + 60 pF                       |

## Thermocouple Ranges & Accuracies @ 23°C

| T/C      | Degrees C Range  | °C    | Degrees F Range  | °F    | T/C Material            |
|----------|------------------|-------|------------------|-------|-------------------------|
| <b>J</b> | -200.0 to -50.0  | ±0.5° | -328.0 to -58.0  | ±1.0° | +Iron<br>-Constantan    |
|          | -50.0 to 300.0   | ±0.2° | -58.0 to 572.0   | ±0.4° |                         |
|          | 300.0 to 900.0   | ±0.3° | 572.0 to 1652.0  | ±0.6° |                         |
|          | 900.0 to 1200.0  | ±0.4° | 1652.0 to 2192.0 | ±0.8° |                         |
| <b>K</b> | -230.0 to -50.0  | ±1.2° | -382.0 to -58.0  | ±2.2° | +Chromel®<br>-Alumel®   |
|          | -50.0 to 550.0   | ±0.3° | -58.0 to 1022.0  | ±0.6° |                         |
|          | 550.0 to 1000.0  | ±0.5° | 1022.0 to 1832.0 | ±0.8° |                         |
|          | 1000.0 to 1371.1 | ±0.6° | 1832.0 to 2500.0 | ±1.1° |                         |
| <b>T</b> | -260.0 to -230.0 | ±2.9° | -436.0 to -382.0 | ±5.2° | +Copper<br>-Constantan  |
|          | -230.0 to -210.0 | ±1.0° | -382.0 to -346.0 | ±1.9° |                         |
|          | -210.0 to -50.0  | ±0.8° | -346.0 to -58.0  | ±1.4° |                         |
|          | -58.0 to 50.0    | ±0.3° | -58.0 to 122.0   | ±0.6° |                         |
|          | 50.0 to 400.0    | ±0.2° | 122.0 to 752.0   | ±0.4° |                         |
| <b>E</b> | -240.0 to -200.0 | ±0.9° | -400.0 to -328.0 | ±1.7° | +Chromel<br>-Constantan |
|          | -200.0 to 0.0    | ±0.5° | -328.0 to 32.0   | ±0.8° |                         |
|          | 0.0 to 350.0     | ±0.2° | 32.0 to 662.0    | ±0.3° |                         |
|          | 350.0 to 1000.0  | ±0.3° | 662.0 to 1832.0  | ±0.6° |                         |
| <b>R</b> | -18.3 to 100.0   | ±2.1° | -1.0 to 212.0    | ±3.8° | +Pt/13Rh<br>-Platinum   |
|          | 100.0 to 500.0   | ±1.3° | 212.0 to 932.0   | ±2.4° |                         |
|          | 500.0 to 1400.0  | ±1.0° | 932.0 to 2552.0  | ±1.8° |                         |
|          | 1400.0 to 1767.8 | ±1.2° | 2552.0 to 3214.0 | ±2.0° |                         |
| <b>S</b> | -18.3 to 100.0   | ±2.0° | -1.0 to 212.0    | ±3.7° | +Pt/10Rh<br>-Platinum   |
|          | 100.0 to 350.0   | ±1.4° | 212.0 to 662.0   | ±2.5° |                         |
|          | 350.0 to 1600.0  | ±1.1° | 662.0 to 2912.0  | ±2.0° |                         |
|          | 1600.0 to 1767.8 | ±1.3° | 2912.0 to 3214.0 | ±2.4° |                         |
| <b>B</b> | 315.6 to 600.0   | ±3.2° | 600.0 to 1122.0  | ±5.7° | +Pt/30Rh<br>-Pt/6Rh     |
|          | 600.0 to 850.0   | ±1.7° | 1122.0 to 1562.0 | ±3.1° |                         |
|          | 850.0 to 1100.0  | ±1.3° | 1562.0 to 2012.0 | ±2.4° |                         |
|          | 1100.0 to 1820.0 | ±1.1° | 2012.0 to 3308.0 | ±2.0° |                         |

| T/C            | Degrees C Range  | °C    | Degrees F Range  | °F    | T/C Material                      |
|----------------|------------------|-------|------------------|-------|-----------------------------------|
| <b>N</b>       | -230.0 to -150.0 | ±1.9° | -382.0 to -238.0 | ±3.4° | +Nicrosil<br>-Nisil               |
|                | -150.0 to -50.0  | ±0.7° | -238.0 to -58.0  | ±1.2° |                                   |
|                | -50.0 to 950.0   | ±0.4° | -58.0 to 1742.0  | ±0.8° |                                   |
|                | 950.0 to 1300.0  | ±0.5° | 1742.0 to 2372.0 | ±1.0° |                                   |
| <b>G (W)</b>   | 100.0 to 350.0   | ±1.7° | 212.0 to 662.0   | ±3.0° | +Tungsten<br>-W26/Re              |
|                | 350.0 to 1700.0  | ±0.8° | 662.0 to 3092.0  | ±1.5° |                                   |
|                | 1700.0 to 2000.0 | ±1.0° | 3092.0 to 3632.0 | ±1.8° |                                   |
|                | 2000.0 to 2320.0 | ±1.1° | 3632.0 to 4208.0 | ±2.1° |                                   |
| <b>C (W5)</b>  | -1.1 to 100.0    | ±0.8° | 30.1 to 212.0    | ±1.4° | +W5/Re<br>-W26/Re                 |
|                | 100.0 to 1000.0  | ±0.7° | 212.0 to 1832.0  | ±1.3° |                                   |
|                | 1000.0 to 1750.0 | ±1.2° | 1832.0 to 3182.0 | ±2.1° |                                   |
|                | 1750.0 to 2320.0 | ±2.0° | 3182.0 to 4208.0 | ±3.5° |                                   |
| <b>D</b>       | -1.1 to 150.0    | ±1.0° | 30.1 to 302.0    | ±1.8° | +W3/Re<br>-W25/Re                 |
|                | 150.0 to 1100.0  | ±0.7° | 302.0 to 2012.0  | ±1.3° |                                   |
|                | 1100.0 to 1750.0 | ±1.0° | 2012.0 to 3182.0 | ±1.8° |                                   |
|                | 1750.0 to 2320.0 | ±2.0° | 3182.0 to 4208.0 | ±3.6° |                                   |
| <b>P</b>       | 0.0 to 600.0     | ±0.3° | 32.0 to 1112.0   | ±0.6° | +Pd55/Pt31/<br>Au14<br>-Au65/Pd35 |
|                | 600.0 to 900.0   | ±0.4° | 1112.0 to 1652.0 | ±0.8° |                                   |
|                | 900.0 to 1200.0  | ±0.6° | 1652.0 to 2192.0 | ±1.1° |                                   |
|                | 1200.0 to 1395.0 | ±0.7° | 2192.0 to 2543.0 | ±1.2° |                                   |
| <b>L J-DIN</b> | -200.0 to -50.0  | ±0.4° | -328.0 to -58.0  | ±0.7° | +Iron<br>-Constantan              |
|                | -50.0 to 300.0   | ±0.2° | -58.0 to 572.0   | ±0.4° |                                   |
|                | 300.0 to 900.0   | ±0.3° | 572.0 to 1652.0  | ±0.5° |                                   |
| <b>U T-DIN</b> | -200.0 to -50.0  | ±0.6° | -328.0 to -58.0  | ±1.1° | +Copper<br>-Constantan            |
|                | -50.0 to 50.0    | ±0.3° | -58.0 to 122.0   | ±0.5° |                                   |
|                | 50.0 to 550.0    | ±0.2° | 122.0 to 1022.0  | ±0.4° |                                   |
|                | 550.0 to 600.0   | ±0.3° | 1022.0 to 1112.0 | ±0.5° |                                   |

Table based on Thermocouple Accuracy  $\leq \pm (0.02\% \text{ of Reading in mV} + 0.01 \text{ mV})$   
 Note: Doesn't include cold junction error of  $\pm 0.05^\circ\text{C}$

## RTD Ranges & Accuracies

| RTD Type  | Alpha                | Degrees C Range | °C    | Degrees F Range  | °F    |
|---|----------------------|-----------------|-------|------------------|-------|
| Pt 100 Ohm<br>DIN/IEC/JIS 1989<br>Based on ITS-90 | 1.3850<br>(0.00385)  | -200.0 to 0.0   | ±0.2° | -328.0 to 32.0   | ±0.4° |
|   |                      | 0.0 to 340.0    | ±0.3° | 248.0 to 644.0   | ±0.6° |
|   |                      | 340.0 to 640.0  | ±0.4° | 644.0 to 1184.0  | ±0.8° |
|   |                      | 640.0 to 850.0  | ±0.5° | 1184.0 to 1562.0 | ±1.0° |
| Pt 100 Ohm<br>(Burns)                             | 1.3902<br>(0.003902) | -200.0 to 10.0  | ±0.2° | -328.0 to 50.0   | ±0.4° |
|   |                      | 10.0 to 350.0   | ±0.3° | 50.0 to 662.0    | ±0.6° |
|   |                      | 350.0 to 650.0  | ±0.4° | 662.0 to 1202.0  | ±0.8° |
|   |                      | 650.0 to 850.0  | ±0.5° | 1202.0 to 1562.0 | ±0.9° |
| Pt 100 Ohm<br>(Old JIS 1981)                      | 1.3916<br>(0.003916) | -200.0 to 20.0  | ±0.2° | -328.0 to 68.0   | ±0.4° |
|   |                      | 20.0 to 360.0   | ±0.3° | 68.0 to 680.0    | ±0.6° |
|   |                      | 360.0 to 650.0  | ±0.4° | 680.0 to 1202.0  | ±0.8° |
|   |                      | 650.0 to 850.0  | ±0.5° | 1202.0 to 1562.0 | ±0.9° |
| Pt 100 Ohm<br>(US Lab)                            | 1.3926<br>(0.003926) | -200.0 to 20.0  | ±0.2° | -328.0 to 68.0   | ±0.4° |
|   |                      | 20.0 to 360.0   | ±0.3° | 68.0 to 680.0    | ±0.6° |
|   |                      | 360.0 to 660.0  | ±0.4° | 680.0 to 1220.0  | ±0.8° |
|   |                      | 660.0 to 850.0  | ±0.5° | 1220.0 to 1562.0 | ±0.9° |

| RTD Type                        | Alpha                | Degrees C Range | °C    | Degrees F Range  | °F    |
|---------------------------------|----------------------|-----------------|-------|------------------|-------|
| Pt 1000 Ohm<br>DIN/IEC/JIS 1989 | 1.3850<br>(0.00385)  | -200.0 to 0.0   | ±0.2° | -328.0 to 32.0   | ±0.4° |
|                                 |                      | 0.0 to 340.0    | ±0.3° | 248.0 to 644.0   | ±0.6° |
|                                 |                      | 340.0 to 640.0  | ±0.4° | 644.0 to 1184.0  | ±0.8° |
|                                 |                      | 640.0 to 850.0  | ±0.5° | 1184.0 to 1562.0 | ±1.0° |
| Copper 10 Ohm<br>(Minco)        | 1.4274<br>(0.004274) | -200.0 to 260.0 | ±2.0° | -328.0 to 500.0  | ±3.6° |
| Copper 50 Ohm                   | 1.4280<br>(0.00428)  | -50.0 to 150.0  | ±0.4° | -58.0 to 302.0   | ±0.8° |
| Ni 120 Ohm<br>(Pure)            | 1.6720<br>(0.00672)  | -80.0 to 260.0  | ±0.1° | -112.0 to 500.0  | ±0.3° |
| Ni 110<br>(Bristol 7 NA)        | 1.5801<br>(0.005801) | -100.0 to 260.0 | ±0.2° | -148.0 to 500.0  | ±0.4° |

Table based on 3 & 4 Wire RTD Accuracy:  $\leq \pm (0.025\% \text{ of Reading} + 0.075 \text{ Ohms})$

## Standard 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.

Pressure sensors that have been damaged by over pressurization or contaminated by process chemicals are not covered by our warranty. Pneumatic pumps that are contaminated with process chemicals are also not covered by our warranty.

## Optional Repair/Replacement Warranty

Under our Repair/Replacement Warranty (RP-WAR-B), our equipment is warranted against ANY damage or malfunction that may cause the unit to fail for a period of three (3) years from the date of shipment.

This warranty is limited to one complete replacement against any damage or malfunction during the warranty period. If replaced, the new calibrator will carry our Standard Warranty for the remainder of the three (3) years or a minimum of one (1) year from the date of shipment.

## Additional Information

PIE Calibrators are manufactured in the USA. This product is calibrated on equipment traceable to NIST and *includes* a Certificate of Calibration with Test Data.

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



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