

# PIE Model 235 Process Voltage Calibrator Operating Instructions

- **Technician friendly operation**

Intuitive EZ-DIAL Double Click Menu makes it easier to setup than other 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 panel on the top.

- **Calibrate with Confidence**

Accurate to  $\pm 0.02\%$  of Reading + 0.01% Full Scale. Out of range or over current is indicated by an audible alarm, flashing display and the OVERLOAD LED will light.

- **Source three ranges of mV & V dc plus percent of 1 to 5 volts**

With the 235 you can check, calibrate and measure all your voltage, millivolt and pH signal instruments in your plant. Source -500.00 to 999.00 mV, 1.000 to 5.000 V, 0.0 to 100.0% of 1 to 5 V; 0.000 to 20.000 V.

- **Power your loops with over 1,000 Ohm loads**

The 20.000 V range has an extended span of up to 24.000 Volts giving you a portable source for powering your loops.

- **Read DC volts**

The 235 can measure from -500.00 to +999.00 mV, 0.000 to 5.000 V, 0.0 to 100.0 % of 1 to 5 V; 0 to 20.000 V and 0.00 to 60.00 V DC. Use it to check loop power supplies, I/V converters, 1 to 5 Volt signals, and other voltages.

- **Save time calibrating recorders and monitors in 4 to 20 mA loops**

Other brands of calibrators require that you break the loop to calibrate voltage inputs. With the PIE 235 you simply clip the test leads across the voltage inputs in a live 4 to 20 mA loop **without disconnecting any wires**.

- **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.

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

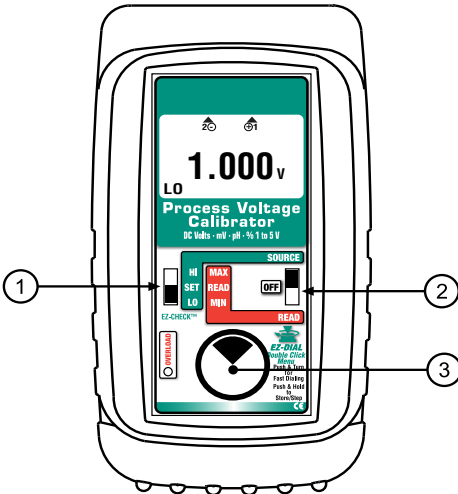
Easily set any value with the adjustable "DIAL" plus store any three output settings for instant recall with the EZ-CHECK™ switch. 2, 3, 5 & 11 steps automatically increment output in 100%, 50%, 25% or 10% of span plus continuous ramp. Set step/ramp time to 5, 6, 7, 8, 9, 10, 15, 20, 25, 30 & 60 seconds.

- **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 235 improves upon other brands by including a rubber boot, backlit display with larger digits, higher accuracy and more ranges for flexibility.



## Basic Operation



### ① EZ-CHECK™ SWITCH

**SOURCE:** Instantly output two preset voltages by moving the EZ-CHECK™ switch to the “LO” position or “HI” position. For fast three point checks select the “SET” position. The PIE Model 235 will remember the last “SET” value, even with the power off.

These values can easily be changed to suit the calibration requirements. The values stored in the HI and LO positions are also used for Auto Stepping.

**READ:** Slide the switch to the SET position. The PIE Model 235 will display the current voltage from the process output. Slide the switch to HI and the highest voltage measured since turn-on or reset will be displayed; slide the switch to LO and the lowest voltage measured since turn-on or reset will be displayed.

### ② SOURCE/OFF/READ Switch

Select “SOURCE” to output in volts, millivolts, % of 1 to 5 Volts or pH.

Select “READ” to read volts 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 0.001 V, 0.01 mV, 0.1% or 0.001 pH 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 voltage readings which will update as the input signal changes.

Double click the knob to get into the PIE Model 235 Configuration Mode. Use configuration to select voltage or pH, Range, Backlight On/Off, Step Size, Step Time and Auto Off On/Off.

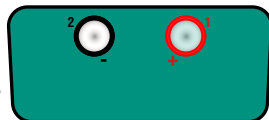
### CHANGING BATTERIES

Low battery is indicated by a battery symbol on the display. Approximately one to four hours of typical operation remain before the PIE Model 235 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 (Range, 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

The PIE Model 235 has two banana jacks mounted in the top end of the housing.



# Configuration

## Configure the Calibrator

Move ② POWER SWITCH to “SOURCE” or

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

V#.##

“READ”.

### 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 two pages of menus. Press the ③ DIAL KNOB to toggle between OFF and ON or to scroll through the settings.

### MAIN

> EXIT (1/2)  
FUNCTION V (pH only in SOURCE)  
RANGE 20V 5V, 999mV, (60V READ Only)  
UNITS V % (Only in 5V RANGE)

### FEATURES

> EXIT (2/2)  
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  
(STEP/RAMP settings only in SOURCE)

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

**FUNCTION** - pressing the knob will toggle between V and pH.

**RANGE** - pressing the knob will cycle through the Voltage ranges of 20V, 5V, 999mV and 60V.

**UNITS** - pressing the knob will toggle between V and % only in the 5 V RANGE. The 5 V RANGE is preset with EZ-CHECK LO and HI at 1.000 (0.0%) and 5.000 V (100.0%).

**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 DC Volts & Millivolts

## SOURCE

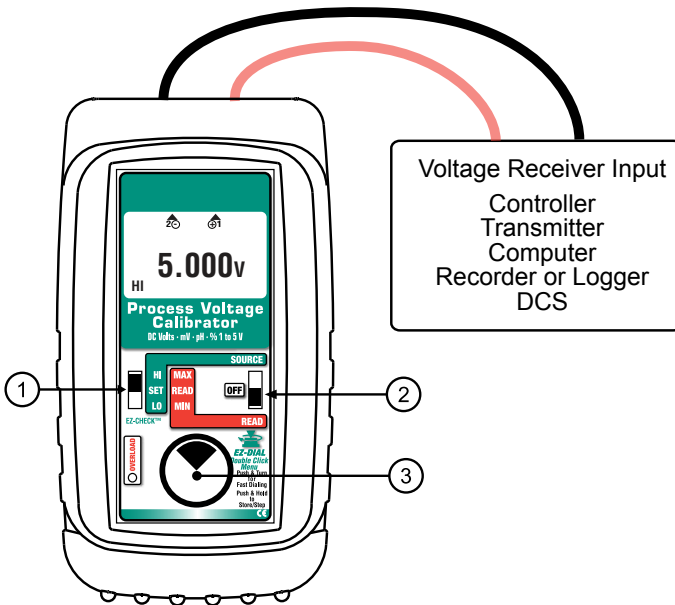
Choose this function to provide an output from -500.00 to 999.00 mV, from 0.000 to 20.000 V, from 1.000 to 5.000 V or from 0.0% to 100.0% of 1 to 5 Volts. The source current is a nominal 20 mA to provide the driving power to your voltage receivers.

Move the power switch ② to SOURCE then Double Click the EZ-DIAL knob to get into the Menu. Turn the knob to scroll through the settings and press the knob to make your selection. Select V for the FUNCTION and 999 mV, 20 V or 5 V for the RANGE.

Connect the output leads of the PIE Model 235 to the inputs of the device being calibrated, making sure to check polarity. Red lead to the plus (+) input and black lead to the minus (-) input.

Instantly output your SPAN and ZERO output settings by moving the EZ-CHECK switch between HI and LO. You may also select any third output setting (such as mid-range) using the SET position on the EZ-CHECK switch. The output is adjusted in 0.001 V, 0.01 mV or 0.1% increments by turning the knob ③. Press and turn the knob for faster dialing with 0.100 V, 1.00 mV or 10.0% increments.

The red OVERLOAD indicator will light, a beeper will sound, and the display will flash if excessive voltage or current is detected by the calibrator.



## Storing EZ-CHECK Outputs

### STORING HI and LO EZ-CHECK Outputs

Choose this function to quickly toggle between HI and LO signals into controllers, transmitters, recorders or any other input device that measure DC Voltages.

- 1) Store your high (SPAN) output voltage by moving the EZ-CHECK switch to the **HI** position and turn the ③ EZ-Dial knob until the desired voltage 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 voltage by moving the EZ-CHECK switch to the **LO** position and turn the ③ EZ-Dial knob until the desired voltage 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 voltage outputs by moving the EZ-CHECK switch between HI and LO. You may also select any third voltage 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 second (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 (2/2)

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 STEP appears on the display. The word STEP 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.

# Reading DC Voltages

## Read

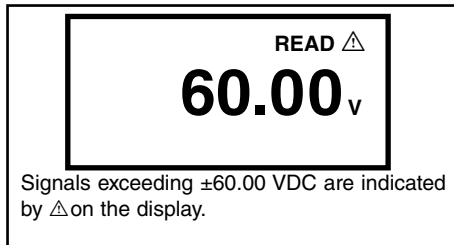
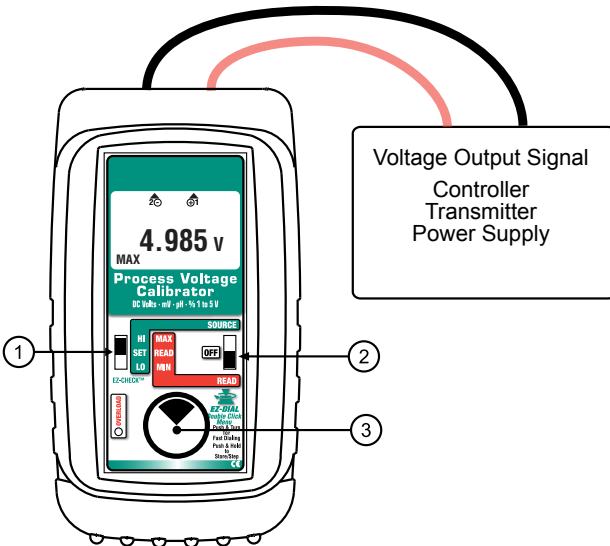
Choose this function to measure from -500.00 to +999.00 mV, 0.000 to 20.000 V, 1.000 to 5.000 V, 0.0% to 100.0% of 1 to 5 Volts or 0.00 to 60.00 V.

Move the power switch ② to READ then Double Click the EZ-DIAL knob to get into the Menu. Turn the knob to scroll through the settings and press the knob to make your selection. Select V for the FUNCTION and 999 mV, 5 V, 20 V or 60 V for the RANGE.

Connect the red input lead (+) of the PIE Model 235 to the more positive point of the break and the black input to the more negative point.

The PIE Model 235 measures the input signal and constantly updates the display with the current reading. Move the EZ-CHECK switch ① to MAX to see the highest reading and to MIN to see the lowest reading. Press and hold the knob ③ to clear the MAX and MIN readings.

Signals above the maximum scale are limited by protection circuitry with "OVER RANGE" flashed on the display and the red OVERLOAD LED lit.



# Sourcing pH

## pH SOURCE

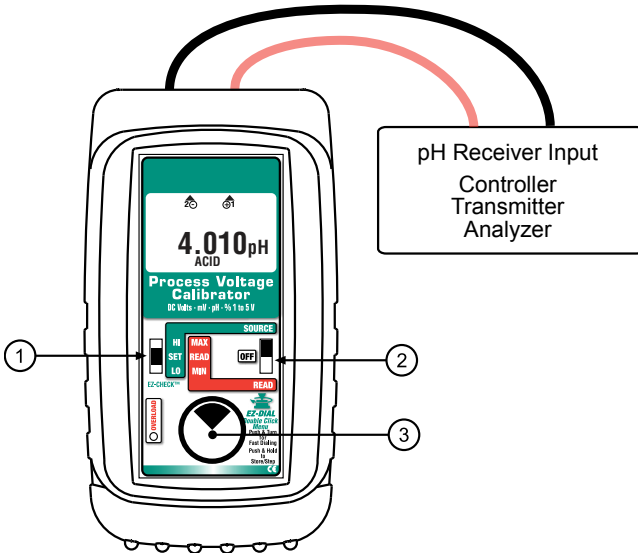
Choose this function to provide an output from 0.000 to 14.000 pH @ 25°C (77°F) which corresponds to 414.12 to -414.12 mV. BASE, NEUTRAL or ACID is indicated on the display. The source current is a nominal 20 mA to provide the driving power to your pH receivers.

Move the power switch ② to SOURCE then Double Click the EZ-DIAL knob to get into the Menu. Turn the knob to scroll through the settings and press the knob to make your selection. Select pH for the FUNCTION.

Connect the output leads of the PIE Model 235 to the inputs of the device being calibrated, making sure to check polarity. Red lead from the mV (+) jack of the Model 235 to the plus (+) input and black lead from the mV (-) jack to the minus (-) input.

Instantly output your SPAN and ZERO output settings by moving the EZ-CHECK switch between HI and LO. You may also select any third output setting (such as mid-range) using the DIAL position on the EZ-CHECK switch. The output is adjusted in 0.001 pH increments by turning the knob ③. Press and turn the knob for faster dialing with 0.100 pH increments.

The red OVERLOAD indicator will light, a beeper will sound, and the display will flash if excessive voltage or current is detected by the calibrator.



## 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 operating correctly. The PIE Model 235 simulates 0.000 to 14.000 pH @ 25°C corresponding to 414.12 to -414.12 mV.

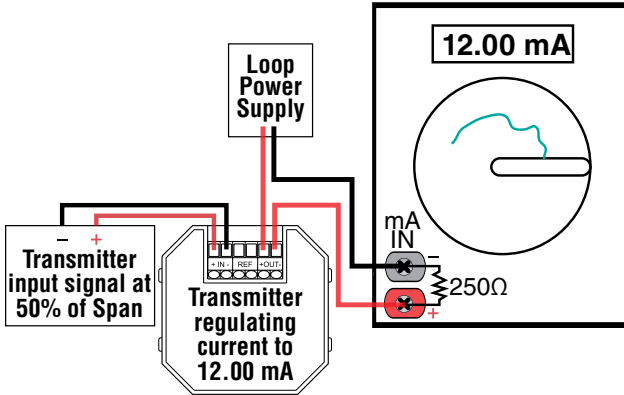
Once the pH instrument has been adjusted against the PIE Model 235 reconnect the pH probe and check it against the proper buffer (typically 7 pH). If the instrument zero point requires more than the manufacturer's recommendations (typically within 0.5 pH) it is time to clean or replace the probe.



## Calibrate 1 to 5 V instruments in live 4 to 20 mA loops

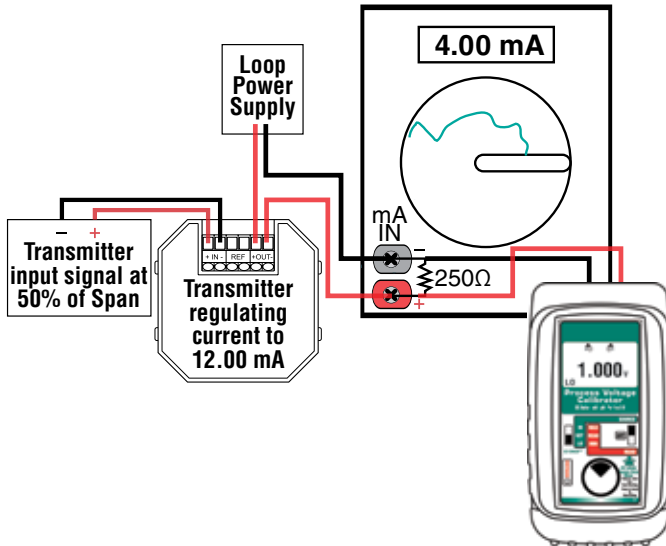
Calibrate 1 to 5 volt instruments without breaking the loop or turning off the loop current. You do not need to remove any 250 Ohm resistors. The PIE Model 235 drives only the voltage instrument it is connected to and has no effect on any other instruments in the 4 to 20 mA loop.

### This loop has a recorder monitoring the 4 to 20 mA signal



Control loop with the transmitter limiting the current to 12.00 mA.  
The recorder indicates 12.00 mA.

### Calibrating the recorder monitoring the 4 to 20 mA signal



Control loop with the transmitter limiting the current to 12.00 mA.  
The 235 sourcing 1V is clipped across the mA input driving the recorder to 4.00 mA. The rest of the instruments in the loop are still seeing 12.00 mA.





**Flip out stand for bench use**



**Hands free carrying case  
with pockets for the PIE  
235 & test leads.**

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

## PIE 235 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)
Relative Humidity Range	10 % ≤RH ≤90 % (0 to 35 °C), Non-condensing
	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 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
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 and audible alarm indicates OVERLOAD for 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.

*Specifications subject to change without notice.*

## PIE 235 Specifications

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

<b>Voltage Source</b>	
Ranges and Resolution -500.00 to 999.00 mV 1.000 to 5.000 V 0.000 to 20.000 V -25.0 to 125.0% of I to 5 V	Accuracy $\leq \pm (0.02 \% \text{ of Reading} + 0.01\% \text{ of Full Scale})$ $\leq \pm (0.02 \% \text{ of Reading} + 0.002 \text{ V})$ $\leq \pm (0.02 \% \text{ of Reading} + 0.01\% \text{ of Full Scale})$ $\leq \pm 0.1\%$
Source Current	$\geq 20 \text{ mA}$
Sink Current	$> 16 \text{ mA}$
Output Impedance	$\leq 0.3 \text{ Ohm at } \leq 20 \text{ mA load}$
Short Circuit Duration	Infinite

<b>Voltage Read</b>	
Range and Resolution -500.00 to 999.00 mV 1.000 to 5.000 V 0.000 to 20.000 V -25.0 to 125.0% of I to 5 V 0.00 to 60.00 V	Accuracy $\leq \pm (0.02 \% \text{ of Reading} + 0.01\% \text{ of Full Scale})$ $\leq \pm (0.02 \% \text{ of Reading} + 0.002 \text{ V})$ $\leq \pm (0.02 \% \text{ of Reading} + 0.01\% \text{ of Full Scale})$ $\leq \pm 0.1\%$ $\leq \pm (0.02 \% \text{ of Reading} + 0.02 \text{ V})$
Input resistance	$\geq 1 \text{ M}\Omega$

<b>pH Source</b>	
Accuracy in mV	$\leq \pm (0.02 \% \text{ of Reading in mV} + 0.1 \text{ mV})$
Accuracy in pH	$\leq \pm 0.003 \text{ pH @ } 25^\circ\text{C}$

## Ordering Information

Description	Part No
PIE Model 235 Process Voltage Calibrator.....	PIE Model 235

### Included:

Four "AA" Alkaline batteries, NIST Traceable Calibration Card	
Black Rubber Boot .....	020-0209
Evolution Hands Free Carrying Case .....	020-0211
Evolution mA/V Test Leads .....	020-0207
1 Red & 1 Black Lead with Banana Plugs & Alligator Clips	

### Optional

Certified Test Data when ordered new from the factory .....	Certified Test Data-1
Three Year Repair/Replacement Warranty.....	RP-WAR-A
Ni-MH 1 Hour Charger with 4 Ni-MH AA Batteries .....	020-0103

## 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.

## 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.