

# PIE 901

## Diagnostic Calibrator

### 4-20 mA • V • Pressure

## Operating Instructions

#### • Easy to Use

With the PIE 901 you can check, calibrate and measure all your current signal and pressure instruments in a 4 to 20 milliamp DC loop. It can be used at any access point in your loop. Source & Read to 24.000 mA, Simulate a 2 Wire Transmitter or use the PIE 901 to simultaneously power your 2 Wire Transmitter and measure its output. Source up to 24.000 V DC to calibrate voltage inputs. Measure from -60.000 to +60.00 V DC to check loop power supplies & batteries without carrying a separate multimeter. Pressure modules may be connected via a cable or wirelessly with future PIE Bluetooth pressure modules. Rugged design with bright, color display for use in the shop, field, or on the bench. Optional rechargeable "AA" batteries and AC adapter for charging or for bench use.

#### • Troubleshoot Loop Problems

Quickly diagnose ground fault and current leakage with the patented loop diagnostic technology (US Patent# 7,248,058).

#### • Calibrate I/P, P/I & other Pressure Instruments

Compact design for easy carrying & connection directly to hand pump or process. Use a cable for long term pressure tests on the bench or with wireless pressure modules.

#### • Calibrate Milliamp & Voltage Receivers

Calibrate recorders, digital indicators, stroke valves or any instruments that get their input from a 4 to 20 mA loop or voltage devices. Easily set any value quickly to within 0.001 mA or 0.001 V with the adjustable digital potentiometer "DIAL" or use preset **LO 4.000 mA (0.00%)** and **HI 20.000 mA (100.00%)** EZ-CHECK™ settings. Store any three mA or V output values for instant recall.

#### • Calibrate quickly with automatic output stepping

Press & hold the dial to automatically step from 4 to 20 in 2, 3 or 5 steps or choose a continuous ramp.

#### • Calibrate using Loop Power

Check loop wiring and receivers by using the PIE 901 in place of a 2 Wire transmitter with any loop power from 3 to 60 V DC.

#### • Measure Milliamp Control Signals

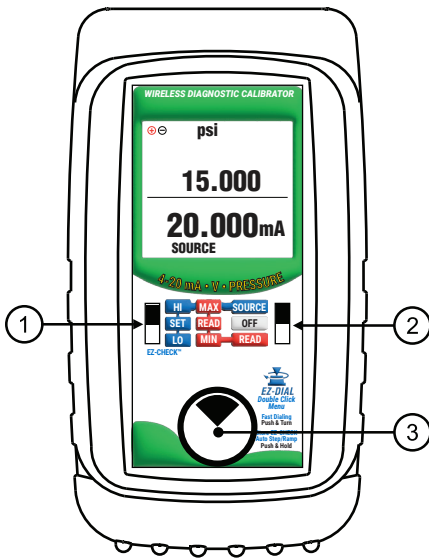
Check controller outputs or measure the milliamp signal anywhere in the loop. Measure 0.000 to 24.000 mA (-25.00 to 125.00%) signals with greater accuracy than a typical multimeter.

#### • Calibrate 2 Wire Transmitters with Built-In power supply

The PIE 901 can simultaneously output 24V DC 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 with built-in 250 ohm resistor simplifying hookups with HART communicators.



# Basic Operation



## ① EZ-CHECK™ Switch

Instantly output 4.000 mA or 20.000 mA (or output of your choice by moving the EZ-CHECK™ switch to the “HI” position or “LO” position. You may also store any two voltages from 0.000 to 24.000 for instant recall. For fast three point checks select the “DIAL” position. The PIE 901 will remember the last “DIAL” value, even with the power off.

## ② SOURCE / READ Switch

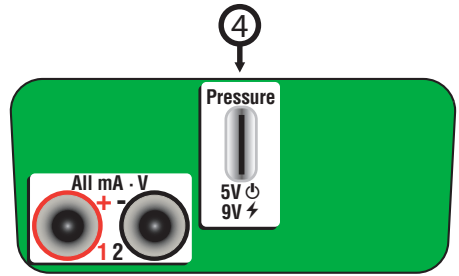
Select “SOURCE” to output in mA, mA percent, DC Volts, or to calibrate current to pressure transducers.

Select “READ” to read mA, mA percent, DC Volts, to measure pressure, or to calibrate pressure to current transducers.

## ③ Dial Knob

Turn the knob to adjust output level. Turn clockwise to increase the output, counter clockwise to decrease the output 0.001 mA (0.01%) or V at a time. Push & turn the knob for faster dialing adjusting 0.100 mA (1.00%) or V at a time. Press & Hold the knob to start automatic stepping or ramping. Double click the knob to get into the simple tabbed settings menu.

Note: The same “DIAL” value is stored for both mA and %. The recalled value will be displayed in the units selected.



## ④ Pressure USB-C Jack

The optional PIE/Meriam pressure modules may be plugged in using a USB-C to PIE Pressure Module adaptor (PIE Part # 020-0241).

## ④ USB-C Power Jack & Battery Charging

The PIE 901 will operate (SOURCE & READ) with any USB-C AC Adaptor or portable power pack which will eliminate the drain on your “AA” batteries. This is handy for jobs that require extended bench or field use of the PIE 901.

When used with the optional 9V USB-C AC Adaptor (PIE Part # 020-0104), the USB-C jack will also charge the optional ‘AA’ NiMH batteries (Part # 020-0105) so you can stop replacing alkaline batteries.

## Changing or Charging Batteries



Battery level is indicated by a symbol on the display. When partially used the indicator will have 1 green and 1 orange bar. When the batteries are nearly depleted the indicator will have one red bar. Approximately one hour of battery life remains when the indicator first displays one red bar.

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 & replace the boot. All stored configuration options are reset to factory settings when the batteries are removed.

If NiMH rechargeable batteries are installed, plug the 9V USB-C AC Adaptor (020-0104) into a 100 to 240 VAC outlet using the proper plug to recharge the batteries.

Practical Instrument Electronics

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# Operating Instructions

## Double Click Menu - MAIN Page

### Configure the Calibrator

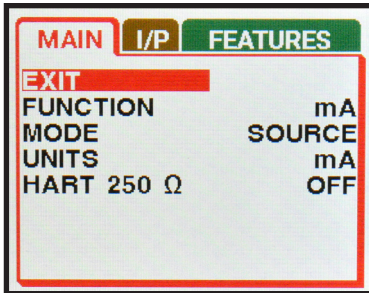
Double click the EZ-DIAL knob to access the Double Click Menu. Shown are the MAIN menus for each function. Turn the knob to scroll thru the menus and press the knob to select. Available choices are shown in grey.

The following display will appear for 3 seconds:

**DOUBLE CLICK  
EZ-DIAL KNOB FOR  
CONFIGURATION  
REV #.#**

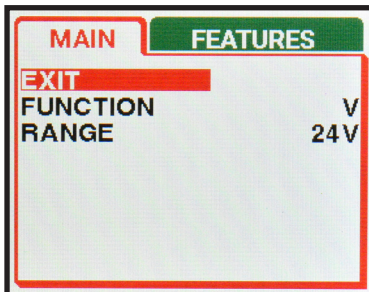
Double click the ③ DIAL KNOB at any time the unit is on and the following display will appear for 30 seconds:

### Source mA & Simulate 2 Wire Transmitters

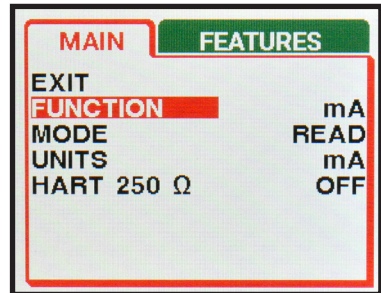


**MENU SELECTIONS**  
MODE SOURCE 2 WIRE  
UNITS mA %  
HART 250Ω ON OFF

### Source V

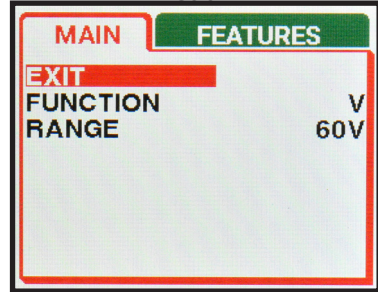


### Read mA



**MENU SELECTIONS**  
MODE READ PWRM  
UNITS mA %  
HART 250Ω ON OFF

### Read V



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

**GROUND LEAK DETECTION** - when ON the PIE 901 has the ability to check for current leaks caused by ground faults, moisture or corrosion. This operates in Power/Measure mode while powering up a 2-wire transmitter or loop.

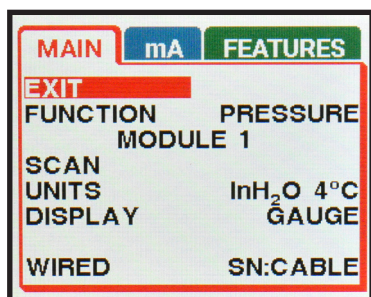
**HART MODE** - when ON a 250 Ohm resistor is automatically inserted in series with the leads in all mA modes. This allows a HART Communicator to communicate with a HART Transmitter without adding an external resistor in the loop.

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

## Operating Instructions

### Double Click Menus - Read Pressure, Calibrate I/P and P/I Transducers

#### Read Pressure



#### Available Pressure Units (Range Dependant)

psi inH<sub>2</sub>O\* ftH<sub>2</sub>O\* mmH<sub>2</sub>O\* cmH<sub>2</sub>O\* mH<sub>2</sub>O\*  
 inHg mHg cmHg mmHg torr kg/cm<sup>2</sup> kg/m<sup>2</sup>  
 hPa kPa MPa bar mbar atm oz/in<sup>2</sup> lb/ft<sup>2</sup>

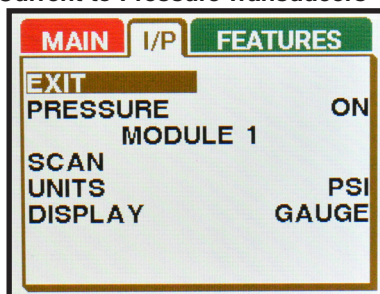
*\*Engineering unit at 4°C, 20°C & 60°F*

#### Available Display Types (Module Dependant)

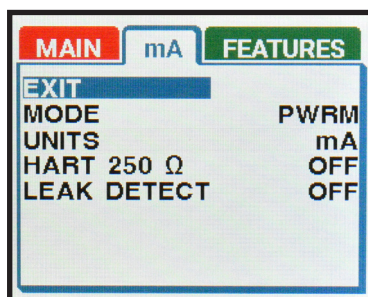
GAUGE (Default), BARO, ABS

*(Barometric & Absolute are not available on the PIE/Meriam Pressure Modules)*

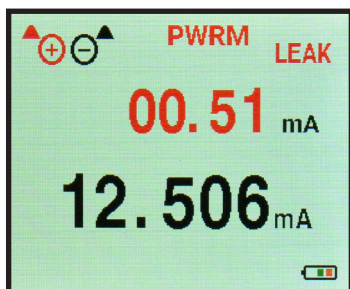
#### Calibrate I/P Current to Pressure Transducers



#### Calibrate P/I Pressure to Current Transmitters



## Easy to Read Color Display



Full color display is easy to read in most situations. Red color highlights when troubleshooting is required!



Turn on DARK MODE (high contrast white on black) to read the display in bright sunlight.

# Operating Instructions

## Double Click Menu - FEATURES

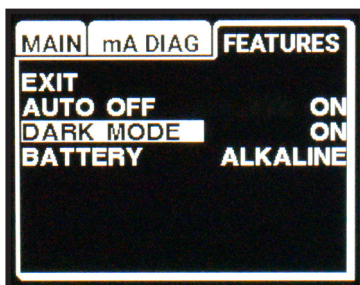
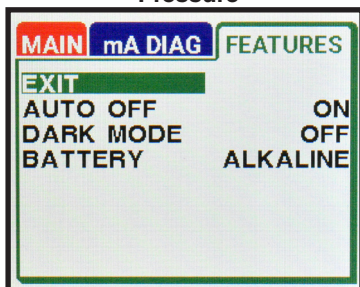
### To change the Feature Settings

Turn the ③ DIAL KNOB to move to the second, third or fourth menu tab so the word **FEATURES** appears at the top of the menu.

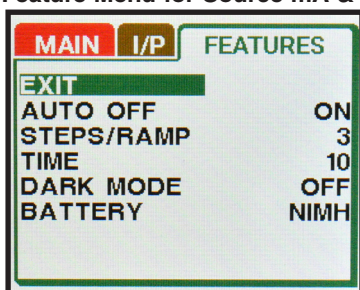
Double click the ③ DIAL KNOB at any time the unit is on and the following typical display (will be different for each FUNCTION) will appear for 15 seconds.

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

### Feature Menu for Read mA, V & Pressure



### Feature Menu for Source mA & V



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

**DARK MODE** - If you are having difficulty seeing the display in bright sunlight turn DARK MODE on to enable the high contrast black background with white lettering. Turn DARK MODE off to view the display in color.

**BATTERY** - Indication of the type of battery selected. See Operating with Batteries for instructions on changing battery type.

### To change the Automatic Stepping settings for SOURCE mA & V

**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.

# Sourcing Milliamps

## mA SOURCE, % SOURCE (Percent of 4 to 20 mA)

Choose this function to provide an output from 0.000 to 24.000 milliamps. The compliance voltage is a nominal 24 VDC to provide the driving power to your milliamp 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 mA for the FUNCTION and SOURCE for the MODE. Choose either mA or % and whether you need the 250Ω HART resistor active in the loop.

Connect the output leads of the PIE 901 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 (defaults to 20 & 4 mA). 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 mA (0.01%) increments by turning the knob ③. Press and turn the knob for faster dialing with 0.100 mA (1.00%) increments.

Start automatic stepping or ramping by pressing and holding the ③ DIAL KNOB for 3 seconds. The word STEPPING or RAMPING will flash on the display anytime the selected automatic function is running. The PIE 901 will automatically step or ramp between 4 mA & 20 mA (or 20 mA & 4 mA) for 30 seconds then reverse direction. Stop the stepping or ramping by pressing or turning the knob or moving any switch.

### OPEN LOOPS

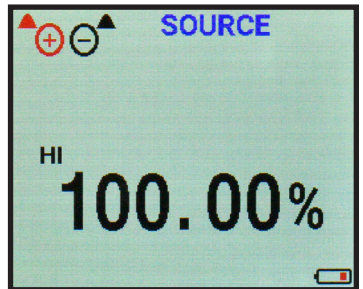
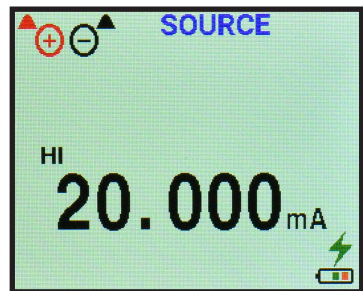
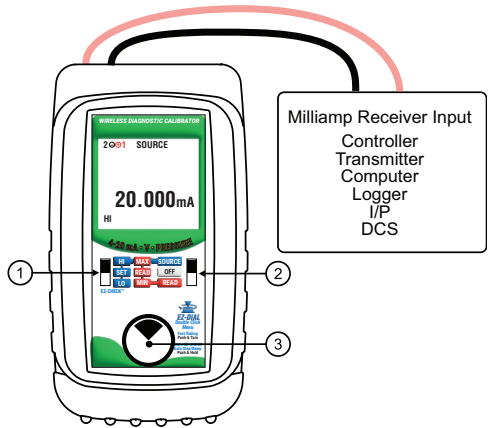
The display will indicate ERROR and 0.000 mA or -25.00% if there is an open loop or if the polarity is reversed. Check all the connections in the loop or try reversing the leads.

**Note:** Percent mode can also be used with chart recorders, valves or trips that display in percent.

- 100.00% = 20.000 mA
- 75.00% = 16.000 mA
- 50.00% = 12.000 mA
- 25.00% = 8.000 mA
- 0.00% = 4.000 mA
- 25.00% = 0.000 mA

To convert from Milliamps to Percent:  
Percent = (Milliamps - 4) / 0.16

To convert from Percent to Milliamps:  
Milliamps = Percent / 6.25 + 4

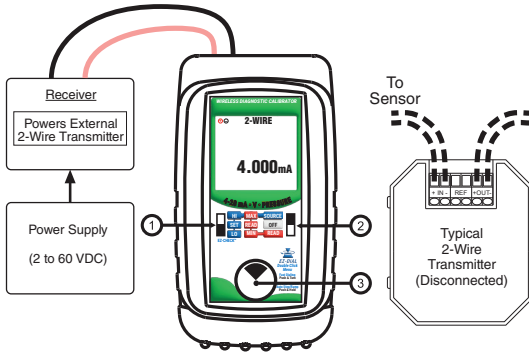


# Simulate 2-Wire Transmitters

## 2 Wire SIM mA, 2 Wire SIM % (Percent of 4 to 20 mA)

Choose this function to simulate a 2 Wire Transmitter output from 0.000 to 24.000 milliamps. Operates in loops with power supply voltages from 3 to 60 VDC.

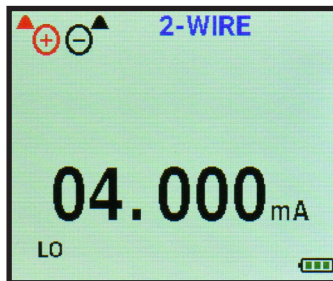
Move the power switch ② to SOURCE then Double Click the EZ-DIAL knob to get into the Menu. Turn the knob to scroll through the settings and press the knob to make your selection. Select mA for the FUNCTION and 2W SIM for the MODE. Choose either mA or % and whether you need the 250Ω HART resistor active in the loop.



Connect the output leads of the PIE 901 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 (defaults to 20 & 4 mA). 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 mA (0.01%) increments by turning the knob ③. Press and turn the knob for faster dialing with 0.100 mA (1.00%) increments.

Start automatic stepping or ramping by pressing and holding the ③ DIAL KNOB for 3 seconds. The word STEPPING or RAMPING will flash on the display anytime the selected automatic function is running. The PIE 901 will automatically step or ramp between 4 mA & 20 mA (or 20 mA & 4 mA) for 30 seconds then reverse direction. Stop the stepping or ramping by pressing or turning the knob or moving any switch.



901 Simulating a Transmitter

## Reading Milliamp Outputs

### READ mA, READ % (Percent of 4 to 20 mA)

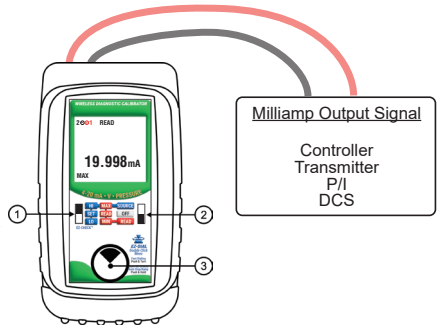
Choose this function to measure from 0.000 to 24.000 milliamps or -25.00 to 125.00%.

Move the power switch ② to READ then Double Click the EZ-DIAL knob to get into the Menu. Turn the knob ③ to scroll through the settings and press the knob to make your selection. Select mA for the FUNCTION and READ for the MODE. Choose either mA or % and whether you need the 250Ω HART resistor active in the loop.

Connect the red input lead (+) of the PIE 901 to the more positive point of the break and the black input to the more negative point.

Signals below 0 mA or open circuits are indicated by 0.000 mA (-25.00%) on the display. Signals above 24 mA are current limited by protection circuitry with "OVERRANGE" flashed on the display.

The PIE 901 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.



## Power & Measure 2-Wire Transmitters

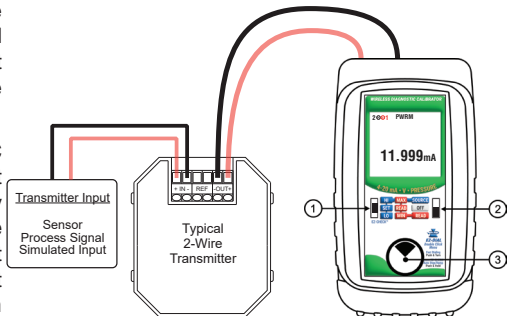
### Power/Measure mA, Power/Measure % (Percent of 4 to 20 mA)

Choose this function to simultaneously supply power to a 2 Wire Transmitter while displaying the 4.000 to 20.000 mA output of the transmitter.

Move the power switch ② to READ then Double Click the EZ-DIAL knob to get into the Menu. Turn the knob ③ to scroll through the settings and press the knob to make your selection. Select mA for the FUNCTION and PWR MEAS for the MODE. Choose either mA or % and whether you need the 250Ω HART resistor active in the loop.

Disconnect one or both input wires from the device to be calibrated. Connect the red source lead of the PIE 901 to the plus (+) input of the device and the black source lead to the minus (-).

The PIE 901 supplies a nominal 24 volts DC at 24 mA to the 2 Wire Transmitter. The current passed by the transmitter will be accurately displayed by the PIE 901. Calibrate the transmitter in the usual manner and disconnect the PIE 901. Signals above 24 mA are current limited by protection circuitry with "OVERRANGE" flashed on the display.



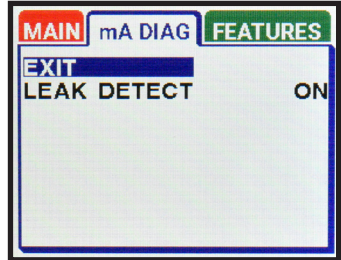


## Using Ground Leak Detection

### mA OUT, % OUT (Percent of 4 to 20 mA)

Find current leaks in loops caused by ground faults, moisture or corrosion. The 901 simultaneously supplies power to a 2 Wire Transmitter (or loop with a transmitter) while displaying the 4 to 20 mA output and the amount of current leaking in the loop.

- 1) Move the power switch ② to READ then Double Click the EZ-DIAL knob to get into the Menu. Turn the knob ③ to scroll through the settings and press the knob to make your selection. Select mA for the FUNCTION and PWR MEAS for the MODE. Choose either mA or %.
- 2) Turn the knob ③ until the following menu appears.
- 3) Turn the knob ③ to scroll through the settings and press the knob to make your selection. Turn on the LEAK DETECT.
- 4) Connect the red source lead from the mA (+) jack of the 901 to the plus (+) input of the device and the black source lead from the mA (-) to the minus (-).

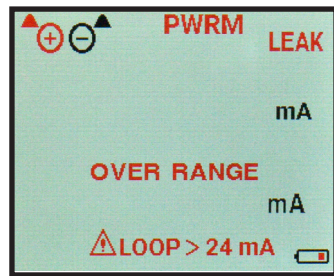
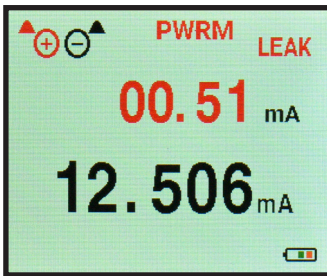


The PIE 901 supplies a nominal 24 volts DC at 24 mA to the 2 Wire Transmitter or loop. The current passed by the transmitter will be accurately displayed by the 901 along with an indication of leakage current at the top of the display. If there is an uncontrolled loop, a transmitter with upscale burnout and bad or missing sensor or a short the display shows "OVER RANGE"

**Note:** Many installed transmitters will normally indicate 0.01 to 0.10 mA leakage without significant control problem. Unstable readings may indicate loose connections or the presence of moisture.

**GROUND LEAK DETECTION** - when ON the PIE 901 has the ability to check for current leaks caused by ground faults, moisture or corrosion that bypass the current control element or transmitter.

### Typical Error Conditions



The PIE 901 is supplying the loop voltage. A calibrated transmitter is limiting the loop current to 12.00 mA. An additional 0.51 mA is not controlled by the transmitter and is leaking somewhere in the loop.

The PIE 901 is supplying the loop voltage. There is a control loop error. This may be a transmitter (set for upscale burnout) with a bad or missing sensor, or a short in the loop.

## Sourcing DC Volts

### V SOURCE

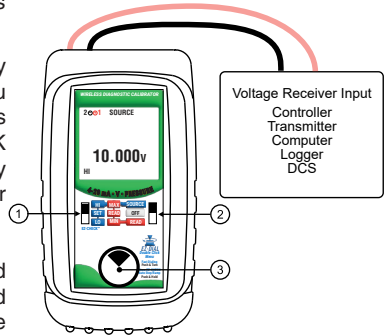
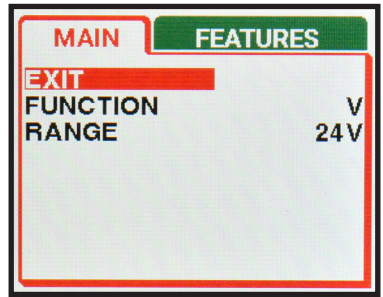
Choose this function to provide an output from 0.000 to 24.000 V. The source current is a nominal 20 mA to provide the driving power to your voltage receivers.

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.

Connect the output leads of the PIE 901 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 increments by turning the knob ③. Press and turn the knob for faster dialing with 0.100 V increments.

Start automatic stepping or ramping by pressing and holding the ③ DIAL KNOB for 3 seconds. The word STEPPING or RAMPING will flash on the display anytime the selected automatic function is running. The PIE 901 will automatically step or ramp between LO & HI values (or HI & LO) for 30 seconds then reverse direction. Stop the stepping or ramping by pressing or turning the knob or moving any switch.



## Reading DC Volts

### Read DC V

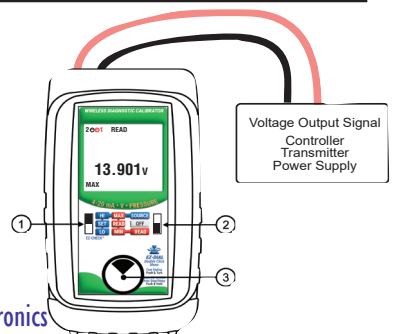
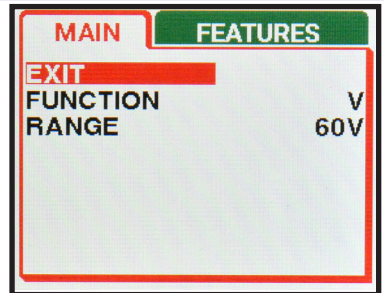
Measure loop power supplies, batteries, 1 to 5 V control signals and other DC Voltages from -60.000 to 60.000 V.

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.

Connect the red input lead (+) of the PIE 901 to the more positive point of the break and the black input to the more negative point.

Signals above the maximum scale are limited by protection circuitry and indicated by  $\Delta$  symbol flashed on the display.

The PIE 901 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.

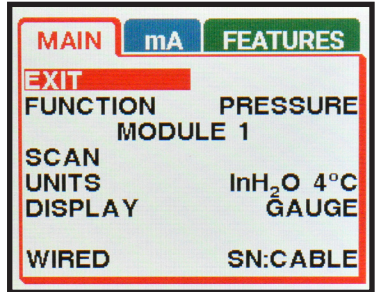


# Reading Pressure with Wired Pressure Modules

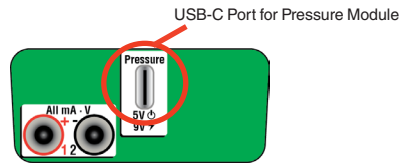
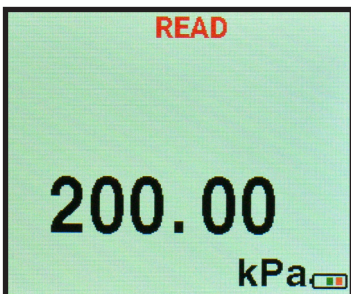
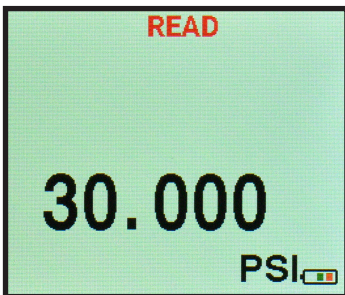
## Read Pressure with a PIE or PIE/Meriam Pressure Module

Choose this function to measure pressure in one of 32 different engineering units using a PIE (more models will be available) or PIE/Meriam Pressure Module along with optional converter cable for connection to a PIE/Meriam Module (Part # 020-0241).

- 1) 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 PRESSURE for the FUNCTION and make your choice of UNITS to match the pressure instrument to be checked.
- 2) Remove the covers from the ends of the connector on the pressure module cable and the pressure connector of the optional converter cable. Plug the converter cable into the 901.
- 3) Connect pressure hoses, fittings & pumps (if required) to the pressure instrument to be checked.
- 4) Press and hold the ③ E-Z DIAL KNOB for 2 seconds (after MAX/MIN RESET appears) to 'Zero' the pressure.



The PIE 901 measures the pressure 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 for 1 second to clear the MAX and MIN readings.



**Available Pressure Units  
(Range Dependant)**  
psi inH<sub>2</sub>O\* ftH<sub>2</sub>O\* mmH<sub>2</sub>O\* cmH<sub>2</sub>O\* mH<sub>2</sub>O\*  
inHg mHg cmHg mmHg torr kg/cm<sup>2</sup> kg/m<sup>2</sup>  
hPa kPa MPa bar mbar atm oz/in<sup>2</sup> lb/ft<sup>2</sup>

*\*Engineering unit at 4°C, 20°C & 60°F*

**Available Display Types  
(Module Dependant)**  
GAUGE (Default), BARO, ABS

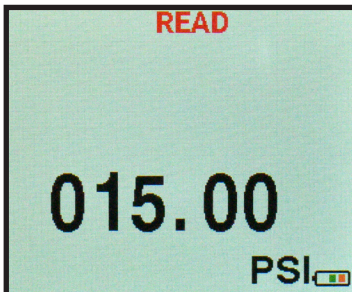
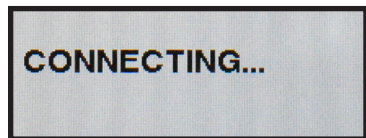
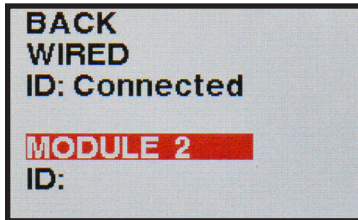
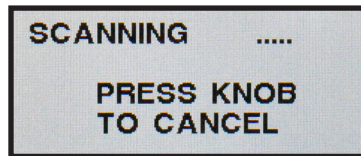
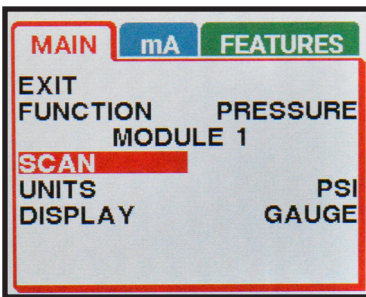
*(Barometric & Absolute are not available on the PIE/Meriam Pressure Modules)*

# Reading Pressure with Wireless Pressure Modules

## Read Pressure with a PIE Wireless Pressure Module

Choose this function to measure pressure in one of 32 different engineering units using a PIE 50 Series Pressure Module through a wireless connection (Bluetooth Modules are in development. Please contact PIE for availability).

- 1) Turn the PIE 50 Series Pressure Module on
- 2) Move the power switch of the Model 901 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 PRESSURE for the FUNCTION.
- 3) Turn the knob to CONNECT MODULE and press the knob to select. If a pressure module is already connected turn the knob to move to that module and press the knob to select a different module.
- 4) SCANNING... will appear on the display until a wireless connection has been established.
- 5) Rotate the knob to select the module you wish to display from the list.
- 6) Turn the knob to EXIT and press the knob to select.
- 7) Connect pressure hoses, fittings & pumps (if required) to the pressure instrument to be checked.
- 8) Press and hold the ③ E-Z DIAL KNOB for 2 seconds (after MAX/MIN RESET appears) to 'Zero' the pressure.

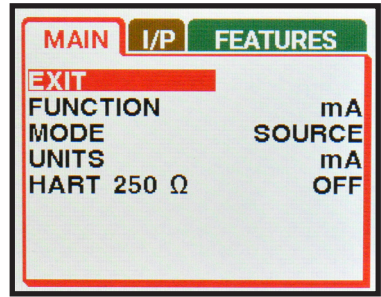


The PIE 901 measures the pressure and constantly updates the display with the current reading. Move the EZ-CHECK switch ① to MAX to see the highest reading and to MIN to see the lowest reading. Press and hold the knob ③ for 1 second to clear the MAX and MIN readings.

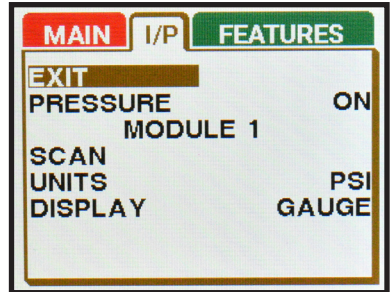
# Current to Pressure (I/P) Calibration

## Calibrating Current to Pressure (I/P) Transducers

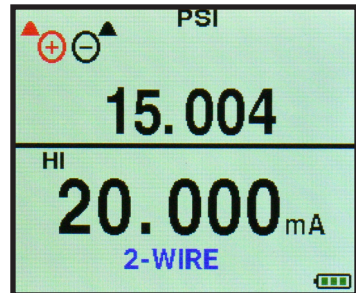
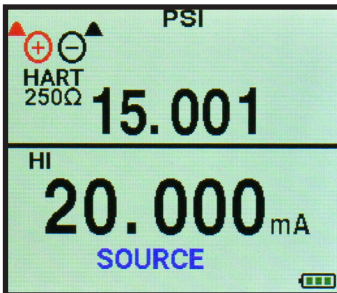
The Model 901 can simultaneously control a milliamp signal while measuring the output pressure from an I/P Transducer. If there is no loop power setup the Model 901 to SOURCE mA or, if there is a power supply in the loop, setup the Model 901 to 2-WIRE (acting as a 2-Wire Transmitter to limit the mA signal in the loop). Refer to the Sourcing Milliamps (Page 6) or Simulate 2-Wire Transmitters (Page 7).



Once SOURCE or 2W SIM have been selected for MODE continue turning the knob until the I/P tab appears at the top of the display. If the calibrator is already sourcing mA or 2W SIM is running double click the knob to get into the menus and turn the knob until I/P is displayed at the top. Follow the setting for Wired Pressure Modules (Page 11) or Wireless Pressure Modules (Page 12) to configure the pressure module then EXIT the menu. Once the pressure connections have been made and the pressure is bled by opening a valve or on the hand pump put the EZ-CHECK switch in the SET position then press and hold the knob until ZERO appears in the top half of the display.



Connect the wires from the Model 901 to the input and the pressure module to the output of the I/P converter. Adjust the mA setting using the EZ-CHECK switch and the knob to control the 4-20 input to the I/P converter and monitor the I/P output pressure on the Model 901 display.

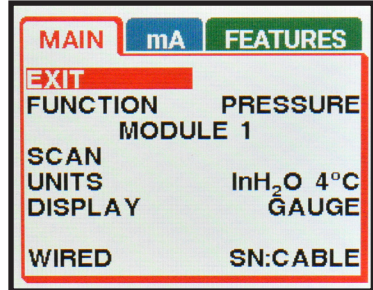


# Pressure to Current Calibration

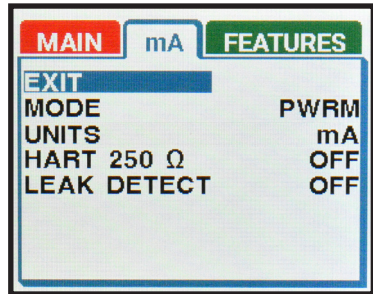
## Calibrating Pressure Transmitters

The Model 901 can simultaneously monitor a pressure while measuring the output current from an Pressure Transmitter with or without an external power supply in the loop.

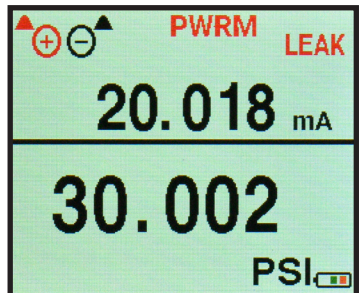
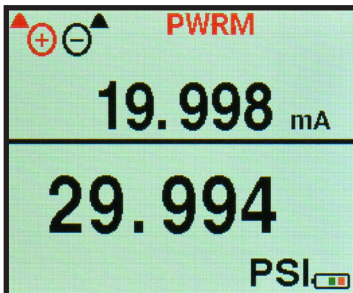
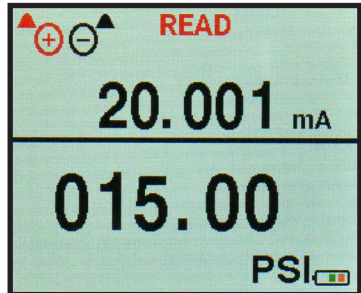
Follow the setting for Wired Pressure Modules (Page 11) or Wireless Pressure Modules (Page 12) to configure the pressure module then EXIT the menu.



If there is no loop power setup the Model 901 to Power & Measure mA or, if there is a power supply in the loop, setup the Model 901 to READ mA (Refer to Page 8).



Connect the pressure module to the input and the mA wires to the output of the P/I Transmitter. Adjust the pressure to the P/I Transmitter using a hand pump or regulator and monitor the milliamp output on the Model 901 display. To troubleshoot the loop turn on LEAK DETECT in the mA Menu shown above. If the word "LEAK" appears on the display there is current in the loop that is not being controlled by the pressure transmitter. You should walk the loop, open covers, checking all connections for water, moisture, or corrosion.



## Stroking Valves

### SETTING UP VALVES

When setting up a valve it is important to correctly set the end stops. Use the PIE 901 to supply the 4 to 20 mA control signal to stroke the valve. Select "SOURCE mA" and the PIE 901 will use the internal power source for outputting current or switch to 2-WIRE SIMULATOR to stroke a valve using any pre-existing installed loop power supply as the power source.

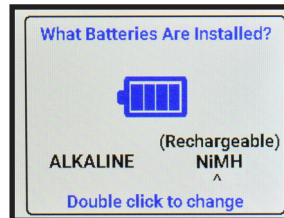
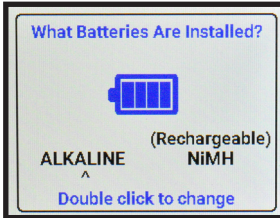
Example:

- 1) Disconnect the 4-20 mA control wires from the Current-to Pressure (I/P) converter or the actuator.
- 2) Connect the PIE 901 following the connection diagrams on page 7.
- 3) Move the EZ-CHECK™ switch to "LO" and adjust the fully closed stop on the actuator.
- 4) Turn the PIE 901's knob slowly counterclockwise and verify that the actuator and valve don't move. Repeat steps 3 & 4 until no movement is detected.
- 5) Move the EZ-CHECK™ switch to **DIAL** and quickly back to "LO" then turn the PIE 901's knob ④ clockwise. The actuator and valve should begin to move.
- 6) Move the EZ-CHECK™ switch to "HI" and adjust the fully open stop on the actuator.
- 7) Turn the PIE 901's knob slowly clockwise and verify that the actuator and valve don't move. Repeat steps 6 & 7 until no movement is detected.
- 8) Move the EZ-CHECK™ switch to **DIAL** and quickly back to "HI" then turn the PIE 901's knob counterclockwise. The actuator and valve should begin to move.

# Operating with Batteries, AC Adaptor, and NiMH Charging

## Operating with Alkaline Batteries or AC Adaptor

The Model 901 will operate with your choice of batteries. It is shipped from the factory with four "AA" Alkaline batteries. The optional 9V USB-C (020-0104) charger will operate as external power to operate the calibrator without draining the batteries. This is ideal for use on the bench or for long term instrumentation testing. The following screen will appear when the batteries are first installed or replaced and either the 901 is turned on or the charger is plugged in. You may wait for the message to disappear or hold down the knob to exit the window.

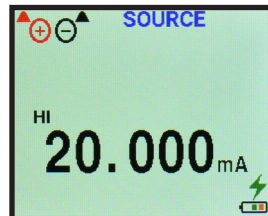
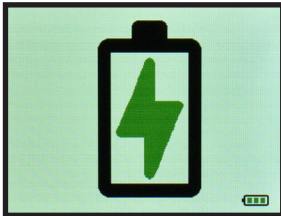


## Operating with and Charging NiMH Batteries

If you purchase and install the optional NiMH batteries (Part # 020-0105) the 901 will charge them with the optional 9V USB-C AC Adaptor (100 to 240 VAC) with international plugs (Part # 020-0104). *It will not charge with any other USB-C chargers.*

Double click the knob to change from ALKALINE (default) to NIMH when you have installed the optional rechargeable batteries (020-0105). Press and hold the knob or wait 5 seconds to accept your choice.

With the calibrator turned off with the charger plugged in the following screen will appear. When the calibrator is turned on and the charger is plugged in a green charging symbol will appear on the screen above the battery status indicator.

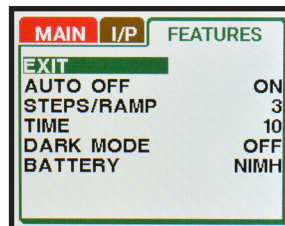


## Battery Status

When either type of batteries are nearly full the battery indicator will have 3 green bars. When partially used the indicator will have 1 green and 1 orange bar. When the batteries are nearly depleted the indicator will have one red bar. Approximately one hour of battery life remains when the indicator first displays one red bar.

## Checking the Battery Type

Double click the knob to access the menus and turn the knob until the FEATURES tab appears. The currently selected battery type is listed at the bottom of the menu. You must remove and replace the batteries to change the selection between Alkaline and NiMH as shown at the top of this page.



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# Application Notes

## GROUND 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 901 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 901 display.

The PIE 901 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.

## KEEPING THE PROCESS GOING - USE THE PIE 901 AS A MANUAL LOADING STATION

When an instrument in a critical control loop develops a problem it is important to maintain control of the process. The PIE 901 can be substituted for a faulty controller or transmitter to provide temporary manual control of the process. One technician takes manual control of the process while a second technician retrieves, installs and configures a replacement instrument. Plug in a USB-C adapter or portable power pack to continuously run without draining the batteries.

## OUT OF RANGE SIGNALS

Signals below 0 mA or open circuits are indicated by 0.000 mA (-25.00%) on the display. Signals above 24 mA are current limited by protection circuitry to approximately 25 mA and are indicated with “LOOP > 24 mA” on the display.

## OPEN LOOPS

The display will indicate ERROR and 0.000 mA or -25.00% if there is an open loop or if the polarity is reversed. Check all the connections in the loop or try reversing the leads.

## POWER TRANSMITTER

Selecting Power Measure (PWRM) supplies a nominal 24V DC to power a 2 Wire Transmitter while simultaneously displaying the 4 to 20 mA output of the transmitter.

## READ MILLIAMPS

Select READ “mA” or “% 4 to 20mA” Place the PIE 901 in the loop in series with the current to be measured.

## SOURCE MILLIAMPS or 2-WIRE SIMULATOR

Select “SOURCE mA” to output from 0.000 to 24.000 milliamps using the PIE 901's internal power source. This will provide 24V DC. Select “2-WIRE” to control the current in a loop that is using an existing power supply.

To change the output current adjust the dial knob. Turning clockwise will increase the output value, turning counter-clockwise will decrease the output value with 0.001 mA (0.01%) resolution. Press and turn the knob for faster dialing with 0.100 mA (1.00%) resolution. The output's adjustable in all EZ-CHECK™ positions.

When returning to the “4.00mA”/“0.0%” and “20.00mA”/“100%” positions they will always return to 4.00 (0.0%) and 20.00 (100.0%) mA or to any mA value you have stored. This method is superior to keypad units. The zero and full scale positions can be adjusted smoothly making easy valve end stop testing, trip point testing, alarm testing, etc. There's virtually no overshoot/undershoot simplifying testing.

## SOURCE DC VOLTS

Select SOURCE V to generate from 0.000 to 24.000 volts DC. You may store 1.000 and 5.000 V or 0 to 10.000 V into the EZ-CHECK memories to instantly recall your commonly used voltage outputs. Clip across 250 Ohm resistors on recorder inputs and calibrate without disconnecting the recorder from the loop!

## READ DC VOLTS

Select READ V to read from -60.000 to +60.000 volts DC. Clip the leads across the voltage to be measured. You are now able to check the loop power supply, voltage control signals (1 to 5 V for example) and batteries without carrying a separate multimeter.

## PIE 901 Specifications

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

<b>General</b>	
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 range for the temperature ranges -20 to 18°C and 28 to 60°C
Relative Humidity Range	10 % ≤RH ≤90 % (0 to 35 °C), Non-condensing
	10 % ≤RH≤ 70 % (35 to 60 °C), Non-condensing
Isolation:	Voltage: 60V rms between all mA & voltage functions / Pressure Common Mode: 50/60 Hz, 100 dB
Normal Mode Rejection	50/60 Hz, 50 dB
Noise	≤ ± ½ Least Significant Digit ???
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)
Optional AC Adaptor	100 to 240 VAC 50/60 Hz [Part # 020-0104]
Optional NiMh Rechargeable battery set	Four NiMh batteries [Part # 020-0105]
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)
Display	High contrast color graphic liquid crystal display with LED backlighting for use in low lit areas. Switch to DARK MODE for use in bright sunlight.

<b>Read mA</b>	
Ranges and Resolution	0.000 to 24.000 mA or -25.00 to 125.00% of 4-20 mA
Accuracy	≤ ± (0.01 % of Reading +0.002 mA)
Voltage burden	≤ 3V at 20 mA
Overload/Current limit protection	25 mA nominal
Battery life	Alkaline ≥ 10 hours NiMH ≥ 15 hours

<b>Battery Charging</b>	
Charge Time	<11.5 hours

## PIE 901 Specifications

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

Source mA/Power & Measure Two Wire Transmitters	
Ranges and Resolution	0.000 to 24.000 mA or -25.00 to 125.00% of 4-20 mA
Accuracy	$\leq \pm (0.01 \% \text{ of Reading} + 0.002 \text{ mA})$
Loop compliance voltage	$\geq 24 \text{ DCV @ } 20.00\text{mA}$
Loop drive capability - Leak Detection Off	1200 $\Omega$ at 20 mA 950 $\Omega$ with Hart Resistor enabled
Loop drive capability - Leak Detection On	1000 $\Omega$ at 20 mA 750 $\Omega$ with Hart Resistor enabled
Battery life	Alkaline $\geq 7.5$ Hours nominal NiMH $\geq 10$ Hours nominal

mA 2-Wire Transmitter Simulation	
Accuracy	Same as Source/Power & Measure
Voltage burden	$\leq 3\text{V}$ at 20 mA
Overload/Current limit protection	25 mA nominal
Loop voltage limits	3 to 60VDC (fuse-less protected from reverse polarity connections)

DC Voltage Read	
Range and Resolution	-60.000 to 60.000VDC
Accuracy	$\leq \pm (0.02 \% \text{ of Reading} + 0.01\% \text{ Full Scale})$
Input resistance	$\geq 2 \text{ M}\Omega$
Battery life	Alkaline $\geq 9$ hours NiMH $\geq 15$ hours

Source DC Voltage	
Range and Resolution	0.000 to 24.000VDC
Accuracy	$\leq \pm (0.02 \% \text{ of Reading} + 0.01\% \text{ Full Scale})$
Source Current; Sink Current	$\geq 20 \text{ mA}; > 16 \text{ mA}$
Output Impedance	$< 0.3 \text{ Ohm}$
Short Circuit Duration	Infinite

## Accessories

### INCLUDED:

<b>One pair of Red &amp; Black Standard Test Leads</b> <i>Three feet (1 meter) of wire with an alligator clip on one end and a banana plug on the other end.</i>	<b>Part No. 020-0207</b>
<b>“AA” Alkaline Batteries (set of 4)</b>	
<b>Rubber Boot (Black)</b>	<b>Part No. 020-0209</b>
<b>Deluxe Hands Free Case with pocket for test leads</b>	<b>Part No. 020-0211</b>

### OPTIONAL:

<b>Magnetic Hanging Strap</b>	<b>Part No. 020-0236</b>
<b>Cable for use with PIE Meriam Pressure Modules</b>	<b>Part No. 020-0241</b>
<b>“AA” NiMH Rechargeable Batteries (set of 4)</b>	<b>Part No. 020-0105</b>
<b>AC Adaptor (100 to 240 VAC) with international plugs and 9V DC output</b> <i>(AC Adaptor for full time bench use &amp; recharging NiMH Batteries)</i>	<b>Part No. 020-0104</b>

## 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.

## 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.

PIE Calibrators are designed, assembled, and calibrated in Webster, NY USA using parts from various countries.

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