



Practical Instrument Electronics

Model 422-Plus Diagnostic Thermocouple & Milliamp Calibrator Operating Instructions

• Two Calibrators in One!

Calibrate all your thermocouple instruments AND your milliamp loops with the PIE 422Plus. It has all the functions of a 14 type thermocouple calibrator and can source 0 to 24 milliamps or simulate a two wire transmitter like a milliamp calibrator. You may also perform stand alone calibrations of two wire transmitters by simultaneously supplying the thermocouple input signal while supplying the 24 volts to power up the transmitter and monitoring the milliamp output signal. Powers HART™ transmitters with built-in 250 ohm resistor simplifying hookups with HART communicators.

• Troubleshoot loop problems

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

• Easy to use in the shop, plant or field

With the PIE 422Plus you can check & calibrate all your thermocouple instruments, measure thermocouple sensors, and calibrate 4 to 20 milliamp instruments. Automatic indication of connections on the display for simple hookups. Carry it without worry - it comes protected with a rubber boot and rugged, low profile switches. Easy to operate even in dark areas with the backlit display.

• Calibrate directly in temperature (°C & °F)

Stop carrying around a millivolt source and T/C tables. The PIE 422Plus 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 store any three temperatures for instant recall with the EZ-CHECK™ switch. Or calibrate from -13.000 to +80.000 mV. Connect your thermocouple and the PIE 422Plus measures it in degrees C or F. Secondary display shows the millivolt value corresponding to the T/C temperature.

• Checkout all your 4 to 20 mA loops & instruments

With the built-in milliamp calibrator you can check, calibrate and measure all your current signal instruments in a 4 to 20 milliamp DC loop. It can be used at any access point in your loop. Source & Read 0.000 to 24.000 mA, Simulate a 2 Wire Transmitter or use the PIE 422Plus to simultaneously power your 2 Wire Transmitter and measure its output while simulating the sensor input.

• Fast calibration with automatic output stepping

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

• Calibration Lab Accurate & Stable

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

• Perform Heat Treating Uniformity Surveys and System Accuracy Tests

The PIE 422Plus is capable of meeting the requirements of an AMS 2750 Field Test Instrument when certified by an accredited laboratory.



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

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Basic Operation



① EZ-CHECK™ SWITCH

SOURCE: Instantly output two preset thermocouple temperatures or milliamp values by moving the EZ-CHECK™ switch to the “LO” position or “HI” position. For fast three point checks select the “SET” position. The PIE 422Plus 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 422Plus will display the current temperature from the thermocouple sensor or the current milliamp value. Slide the switch to HI and the highest value measured since turn-on or reset will be displayed; slide the switch to LO and the lowest value measured since turn-on or reset will be displayed.

② SOURCE/OFF/READ Switch

Select “SOURCE” to output in °C, °F, millivolts or milliamps.

Select “READ” to read a thermocouple sensor, millivolts or milliamps. Select “OFF” to turn the unit off.

③ EZ-DIAL™ KNOB

SOURCE: Turn the knob to adjust the output level. Turn clockwise to increase the output, counter clockwise to decrease the output in 0.1°, 0.001 mV or 0.001 mA 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 the knob for two seconds to transfer the current measured value into the EZ-Check™ HI/LO points. This clears the HI/LO readings which will update as the measured value changes.

Double click the knob to get into the PIE 422Plus Configuration Mode.

CHANGING BATTERIES

Low battery is indicated by a battery symbol on the display. Approximately one hour of typical operation remain after the first time the low battery symbol appears. 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 the boot. All stored configuration options (T/C Type, EZ-CHECK Memories, etc..) are reset to factory settings when the batteries are removed.

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

Connections

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

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

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

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Configuration

Double Click Menus - MAIN Page

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

DOUBLE CLICK
EZ-DIAL KNOB
FOR CONFIGURATION

V#.#

Double click the EZ-DIAL knob to access the Double Click Menus. 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.

Source & Read Thermocouples

MAIN

> EXIT (1/4)
FUNCTION T/C mA V
UNITS °C °F
T/C TYPE J K E T R S B N L U G C D P
COLD JUNC ON OFF

Source & Read Millivolts

MAIN

> EXIT (1/3)
FUNCTION V mA T/C
RANGE 80mV

Source mA & Simulate 2 Wire Transmitters

MAIN

> EXIT (1/2)
FUNCTION mA
MODE SOURCE 2W SIM
UNITS mA %
HART 250Ω ON OFF

Read mA, Power/Measure Transmitters & Leak Detect

MAIN

> EXIT (1/3)
FUNCTION mA
MODE READ PWR MEAS
UNITS mA %
HART 250Ω ON OFF

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

Double Click Menu - T/C DISPLAY

T/C DISPLAY

> EXIT (2/4)
DISPLAY mV ON OFF
DISPLAY CJ ON OFF

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

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

* Display of mV & CJ disabled when T/C & mA are operating simultaneously.

Double Click Menu - mA DISPLAY

mA DISPLAY (For T/C)

> EXIT (3/4)
MODE OFF READ PWRM READ% PWRM%
HART 250Ω ON OFF
LEAK DETECT OFF ON

MODE - pressing the knob will cycle through **READ**, **PWRM**, **READ%**, **PWRM%** and **OFF**.

READ turns on the mA display and indicates current passing through the loop proportional to the input of the transmitter which is controlled by the output of the 422Plus. Choose **READ%** to display in percent of 4-20 milliamps.

PWRM is POWER MEASURE which uses the internal loop supply of the 422Plus to power up the transmitter while indicating the current passing through the loop proportional to the input of transmitter which is controlled by the output of the 422Plus. Choose **PWRM%** to display in percent of 4-20 milliamps.

If **PWRM** or **PWRM%** is selected an additional menu selection of **LEAK DETECT** will appear. When **LEAK DETECT** is turned on the 422Plus will display **LEAK** and the amount of current that is uncontrolled in the loop. This may be due to a faulty transmitter, corrosion causing a bridge to ground or moisture present at some connection point. When **LEAK DETECT** tests a loop with leakage the loop mA signal will be affected.

HART 250Ω - turn on the 250Ω resistor if you are powering up a HART transmitter. This provides the loop load required for HART communication.

Configuration

Double Click Menu - FEATURES

FEATURES

> EXIT (4/4)

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

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.

Accessories

Optional: T/C Wire Kit 1 for Types J, K, T & E	Part No. 020-0202
Optional: T/C Wire Kit 2 for Types B, R/S & N	Part No. 020-0203
Three feet (1 meter) of T/C extension wire, stripped on one end with a miniature T/C male connector on the other end.	
Standard Test Leads (Included with calibrator)	Part No. 020-0207
Three feet (1 meter) of wire with an alligator clip on one end and a banana plug on the other end.	
Magnetic Hanging Strap	Part No. 020-0236
Optional Ni-MH 1 Hour Charger w/4 Ni-MH AA Batteries	Part No. 020-0103

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.

Warranty

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

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Storing EZ-CHECK Outputs

STORING HI and LO EZ-CHECK Outputs

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

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

Automatic Stepping

To change the Automatic Stepping settings

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

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

FEATURES

> EXIT (3/3)

AUTO OFF

ON OFF

BACKLIGHT

ON OFF

STEPS/RAMP

2 3 5 11 RAMP

STEP/RAMP TIME

5 6 7 8 9 10 15 20 25 30 60

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

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

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

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

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

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

RAMP continuously between the HI and LO EZ-CHECK.

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

To start the Automatic Stepping

Start automatic stepping or ramping by placing the EZ-CHECK Switch into the HI or LO position then press and hold the ③ DIAL KNOB for 6 seconds (the word STORE will appear on the display after 3 seconds and continue to press the DIAL KNOB) until the word 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.

Note: Loop Leakage Detection is disabled during automatic stepping & ramping.

Operating Instructions

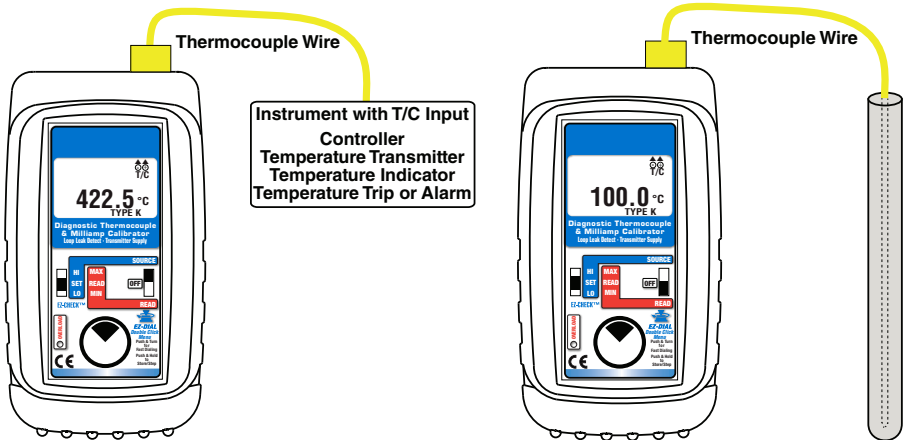
Thermocouple Source

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

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 **T/C** for the **FUNCTION**, **°F** or **°C** for the **UNITS**, **T/C Type** (J, K, E, T, R, S, B, N, L (J-DIN), U (T-DIN), G, C, D or P (Platinel II)) and internal **COLD JUNC ON** or **OFF** (ON is the default).

Connect the PIE 422Plus to the inputs of the device being calibrated using the proper type of thermocouple wire via the miniature thermocouple socket or place the thermocouple wires under the brass screws.

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 0.1° increments by turning the knob ③. Press and turn the knob for faster dialing with 10.0° increments.



Read Thermocouple Sensors

Choose this function to measure temperatures with a thermocouple probe, sensor or any device that output a thermocouple signal.

Move the power switch ② to READ then Double Click the EZ-DIAL knob to get into the Double Click Menu. Turn the knob to scroll through the settings and press the knob to make your selection. Select **T/C** for the **FUNCTION**, **°F** or **°C** for the **UNITS**, **T/C Type** (J, K, E, T, R, S, B, N, L (J-DIN), U (T-DIN), G, C, D or P (Platinel II)) and internal **COLD JUNC ON** or **OFF** (ON is the default).

Connect the PIE 422Plus to the inputs of the device being calibrated using the proper type of thermocouple wire via the miniature thermocouple socket or place the thermocouple wires under the brass screws. If no sensor is connected, a wire is broken or the sensor is burned out, OPEN TC will appear on the display. Signals above the maximum scale are limited by protection circuitry with "OVER RANGE" on the display.

The PIE 422Plus 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.

Operating Instructions

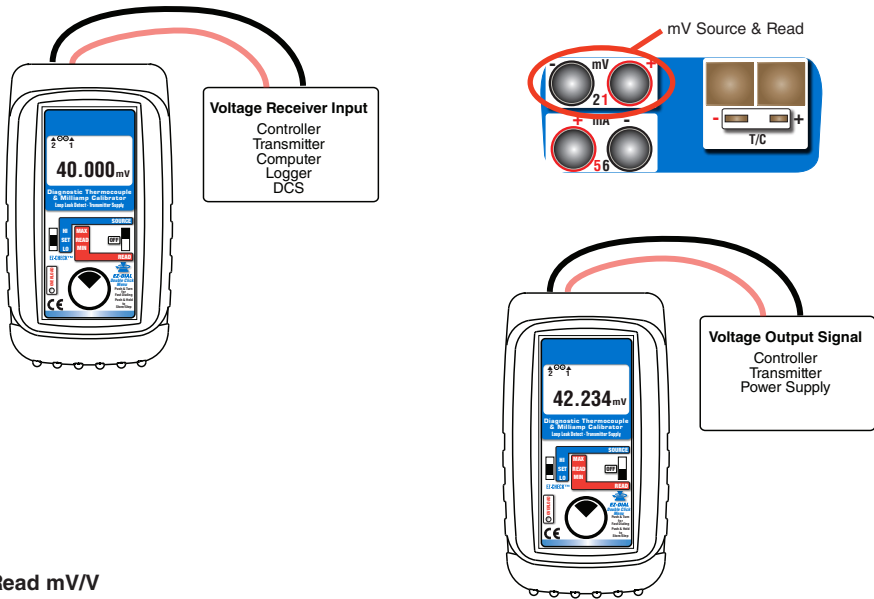
mV/V SOURCE

Choose this function to provide an output from -13.000 to 80.000 mV. 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 **mV** is automatically setup for the **RANGE**.

Connect the output leads of the PIE 422Plus 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 mV increments by turning the knob ③. Press and turn the knob for faster dialing with 0.100 mV increments.



Read mV/V

Choose this function to measure from -13.000 to 80.000 millivolts.

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 **mV** is automatically setup for the **RANGE**.

Connect the red input lead (+) of the PIE 422Plus 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 with "OVER RANGE" on the display.

The PIE 422Plus 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.

Operating Instructions

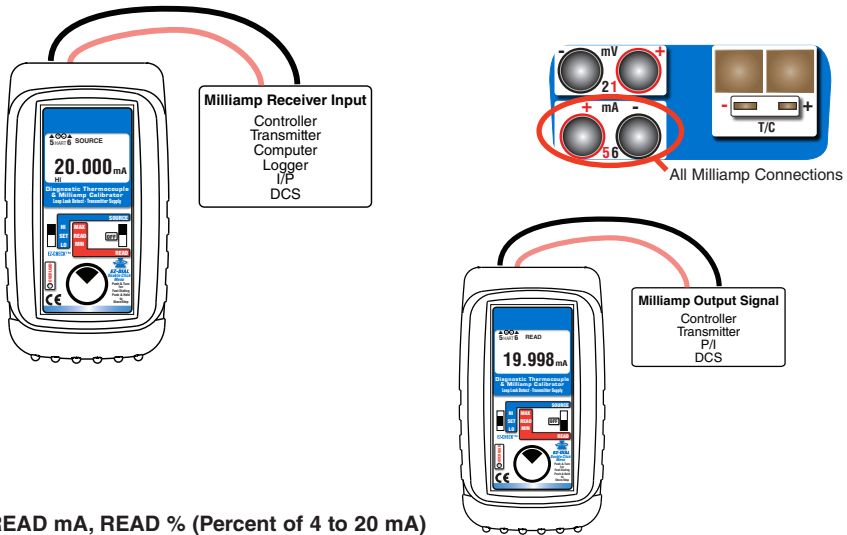
mA SOURCE/ % SOURCE (Percent of 4 to 20 mA)

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 422Plus 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.



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 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 422Plus 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" on the display and the red OVERLOAD LED lit.

The PIE 422Plus 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.

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Operating Instructions

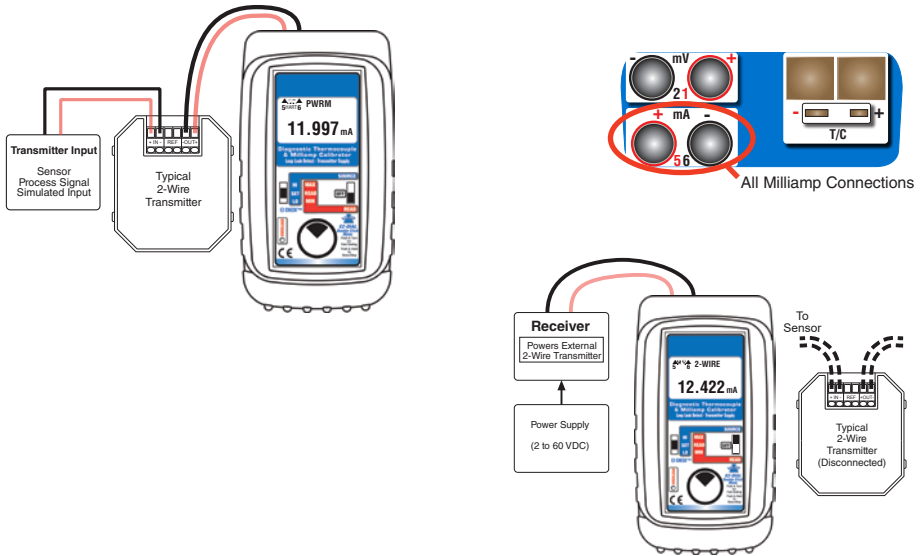
Power/Measure mA, Power/Measure % (Percent of 4 to 20 mA)

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 422Plus to the plus (+) input of the device and the black source lead to the minus (-).

The PIE 422Plus 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 422Plus. Calibrate the transmitter in the usual manner and disconnect the PIE 422Plus. Signals above 24 mA are current limited by protection circuitry with "OVERRANGE" on the display and the red OVERLOAD LED lit.



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 2 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 422Plus 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.

Operating Instructions

Calibrate a 2-Wire Thermocouple Transmitter by sourcing the input while monitoring the output.

Move the power switch ② to SOURCE and Double click the ③ DIAL KNOB and the MAIN menu for the function in use will appear for 15 seconds:

Turn the ③ DIAL KNOB to move to **FUNCTION**. Press the ③ DIAL KNOB until **T/C** is displayed. Turn the knob to scroll through the settings and press the knob to make your selection. Select **T/C** for the **FUNCTION**, **°F** or **°C** for the **UNITS**, **T/C Type** (J, K, E, T, R, S, B, N, L (J-DIN), U (T-DIN), G, C, D or P (Platinel II)) and internal **COLD JUNC ON** or **OFF** (ON is the default).

MAIN	
> EXIT (1/4)	
FUNCTION	T/C
UNITS	°C
T/C TYPE	K
COLD JUNC	ON

Turn the ③ DIAL KNOB to move to the third menu page so the word **mA DISPLAY** appears at the top of the menu.

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 **MODE** setting.

mA DISPLAY	
> EXIT (3/4)	
MODE	OFF READ PWRM READ% PWRM%
HART 250Ω	OFF ON
LEAK DETECT	OFF ON

MODE - pressing the knob will cycle through READ, PWRM, READ% ,PWRM% and OFF.

READ turns on the mA display and indicates current passing through the loop proportional to the input of the transmitter which is controlled by the output of the 422Plus. Choose **READ%** if you would like the mA display in percent of 4-20 milliamps.

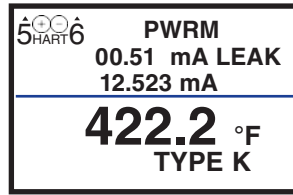
PWRM is POWER MEASURE which uses the internal loop supply of the 422Plus to power up the transmitter while indicating the current passing through the loop proportional to the input of transmitter which is controlled by the output of the 422Plus. Choose **PWRM%** if you would like the mA display in percent of 4-20 milliamps.

If **PWRM** or **PWRM%** is selected an additional menu selection of **LEAK DETECT** will appear. When **LEAK DETECT** is turned on the 422Plus will display **LEAK** and the amount of current that is uncontrolled in the loop. This may be due to a faulty transmitter, corrosion causing a bridge to ground or moisture present at some connection point. When **LEAK DETECT** tests a loop with leakage the loop mA signal will be affected. Note: Loop Leakage Detection is disabled during automatic stepping & ramping.

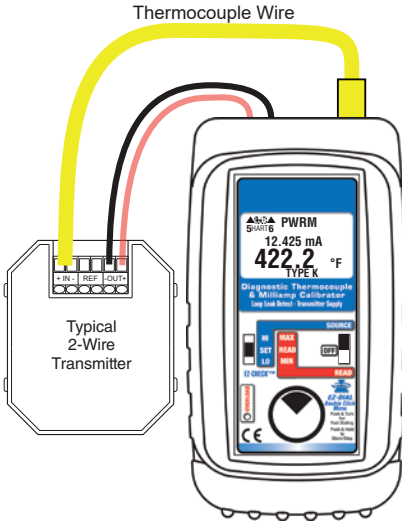
HART 250Ω - turn on the 250Ω resistor if you are powering up a HART transmitter. This provides the loop load required for HART communication.

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

Operating Instructions



(Enlarged Display)



Operating Instructions

Using Ground Leak Detection

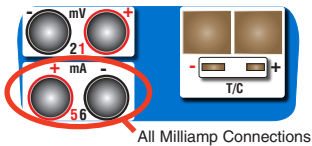
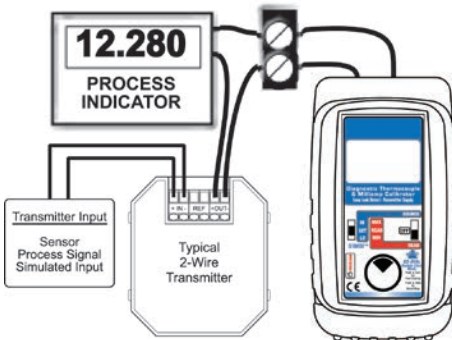
mA OUT, % OUT (Percent of 4 to 20 mA)

Find current leaks in loops caused by ground faults, moisture or corrosion. The 422Plus 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 menu to the right 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 422Plus to the plus (+) input of the device and the black source lead from the mA (-) to the minus (-).

mA DIAGNOSTIC
> EXIT (2/3)
LEAK DETECT OFF ON

The PIE 422Plus 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 422Plus along with an indication of leakage current at the top of the display. If there is an uncontrolled loop caused by a transmitter with upscale burnout and a sensor that is burned out or missing, or a short in the loop wiring, the 422Plus will display "OVER RANGE". Note: Loop Leakage Detection is disabled during automatic stepping & ramping.



Typical Error Conditions

5 HART 6 PWRM LEAK
00.51 mA
12.506 mA

The PIE 422Plus 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.

5 HART 6 PWRM
OVER RANGE
mA

The PIE 422Plus 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. The red ERROR LED will also flash.

Note: Many loops with installed transmitters will normally indicate 0.01 to 0.02 mA leakage without significant control problem. Unstable readings may indicate loose connections or the presence of moisture.

Practical Instrument Electronics

PIE 422Plus Specifications

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

General	
Operating Temperature Range	-25 to 60 °C (-10 to 140 °F)
Relative Humidity Range	10 % ≤RH ≤90 % (0 to 35 °C), Non-condensing
	10 % ≤RH ≤ 70 % (35 to 60 °C), Non-condensing
Temperature Drift	± 0.01% of span outside of 23°C ±10 °C (73°C ±18 °F)
Size	5.63 x 3.00 x 1.60 in, 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	25 Hours Thermocouple, 8 Hours milliamp
Isolation: Voltage	60V rms between all milliamp functions/Read V DC and Source V DC/Thermocouple
Normal Mode Rejection	50/60 Hz, 50 dB
Common Mode Rejection	50/60 Hz, 120 dB
Optional NiMh Rechargeable battery kit	Charger, four NiMh batteries [Part # 020-0103]
Low Battery	Low battery indication with nominal 1 hour of operation left
Protection against misconnection	Over-voltage protection to 60V dc (rated for 30 seconds)
Display	High contrast graphic liquid crystal display. LED backlighting for use in low lit areas.

Read mA	
Ranges and Resolution	0.000 to 24.000 mA or -25.00 to 125.00% of 4-20 mA
Accuracy	≤ ± (0.02 % of Reading + 0.003 mA)
Voltage burden	≤ 2V at 24 mA
Overload/Current limit protection	25 mA nominal

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
Accuracy	≤ ± (0.02 % of Reading + 0.003 mA)
Loop compliance voltage	≥ 24 DCV @ 20.00mA
Loop drive capability	1200 Ω at 20 mA for 15 hours nominal; 950 Ω with Hart Resistor or leak detection running

mA 2-Wire Transmitter Simulation	
Accuracy	Same as Source/Power & Measure
Voltage burden	≤ 2V at 20 mA
Overload/Current limit protection	24 mA nominal
Loop voltage limits	2 to 60VDC (fuse-less protected from reverse polarity connections)

PIE 422Plus Specifications

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

Source Thermocouple

Accuracy	$\pm(0.008\% \text{ of Reading} + 0.006 \text{ mV})$
Cold Junction Compensation	$\pm 0.09^\circ\text{F} (\pm 0.05^\circ\text{C})$ - Thermistor traceable to NIST for 11 years
Millivolt Range	-13.000 to 80.000 mV
Output Impedance	< 0.3 Ohms
Source Current	> 20 mA (drives 80 mV into 10 Ohms)
Noise	≤ 4 microvolts p-p for frequencies of 10 Hz or below

Read Thermocouple

Accuracy	$\pm(0.008\% \text{ of Reading} + 0.006 \text{ mV})$
Cold Junction Compensation	$\pm 0.09^\circ\text{F} (\pm 0.05^\circ\text{C})$ - Thermistor traceable to NIST for 11 years
Millivolt Range	-13.000 to 80.000 mV
Input Impedance	> 10 Megohms
Open Thermocouple Threshold Pulse	10,000 Ohms nominal < 10 microamp pulse for 400 milliseconds
Normal Mode Rejection	50/60 Hz, 50 dB
Common Mode Rejection	50/60 Hz, 120 dB

Thermocouple Ranges & Accuracies




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

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

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

Thermocouple Ranges & Accuracies

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

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

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