



CL-328 SERIES

**MULTIFUNCTION
LOOP CALIBRATOR**

Operators Manual



An OMEGA Technologies Company

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FEATURES

- **DUAL LIQUID CRYSTAL DISPLAY**
Simultaneous Source and Read
- **LABORATORY ACCURATE**
 $\pm(0.012\% \text{ of Reading} + 0.008\% \text{ of Full Scale Reading})$
Accurate to $\pm 0.004 \text{ mA}$ from 4 to 20 mA
- **USER SETTABLE "QUIK-CHEK®s"**
Set any Span & Zero
- **FULL FIVE DIGIT DISPLAYS**
Source up to 24.000 mA, 20.000 V or 999.90 mV
Read up to 52.000 mA, 99.990 V or 999.90 mV
- **SCALEABLE DISPLAY**
Set in engineering units
- **SPEED SENSITIVE DIGIPOT**
Fast setting to any desired value
- **"AUTO-CHEK"™ OUTPUTS**
Automatically outputs in 2, 3, 5 or 10 steps
- **ISOLATED SOURCE AND READ**
Isolated to 500VDC
Fuseless protection to 120 V AC/DC

GENERAL INFORMATION

YOUR NEW CALIBRATOR

Simultaneously source and read any combination of process milliamp and voltage signals. OMEGA's CL328 combines all the functionality of a milliamp and a voltage calibrator! This dual function calibrator continuously displays the output and input signals. The top half of the display indicates the output setting while the lower half of the display shows the signal being measured.

Calibrate state of the art equipment such as smart transmitters and indicators to $4\frac{1}{2}$ or more digits using the Model CL328. Full 5 digit resolution lets you check any brand of process control equipment. Your calibrations are correct with accuracy surpassing 0.02% of reading.

Use the scaleable display to match the readings on the Model CL328 to that of the equipment being calibrated. For example, if your 4 to 20 mA recorder scale is 0.0 to 300.0 gallons/hour you can set the 934 to display 0.0 for 4 mA and 300.0 for 20 mA. No more need to use your calculator or "cheat sheet" to come up with the correct milliamp values.

Six "AA" alkaline batteries provide more than 20 hours sourcing 20 mA continuously . . . more than 3 months of typical use. From the time the low battery indicator first comes on you have hours of power remaining to get you through a shift without interruption. The CL328 comes configured to automatically power down after 30 minutes of inactivity to save battery life.

Calibrate loop converters and isolators by simultaneously providing the input signal and measuring the output of the converter or isolator. Internal optoisolators withstand up to 500 VDC between the source and read leads. Calibrate and checkout all your process milliamp and voltage instruments with the "benchtop accurate" Model CL328.

GENERAL INFORMATION

MILLIAMP CALIBRATION

Use at any point in your 4 to 20 milliamp loop. Source milliamps directly into your receivers with loop loads up to 1200 Ohms. Simulate 2-Wire Transmitters for checkout of field wiring and total loop testing. Power and measure 2-Wire or 4-Wire transmitters on the bench before installation. Read Transmitter & Controller outputs up to 52.00 mA. Display directly in milliamps, percent of 4 to 20 mA, percent of DP Flow or engineering units to match the scale of your process.

VOLTAGE CALIBRATION

Calibrate and checkout all your DC Voltage instrumentation. Source up to 999.90 millivolts to simulate sensors and up to 20.000 Volts to check your process signal inputs. Measure voltages from -99.990 to +99.990 VDC to check your power supplies and the outputs from any process voltage equipment.

Calibrate any 1 to 5 Volt device in a live 4 to 20 milliamp loop without disconnecting any wires. The Model CL328 will automatically source or sink 0 to >16 milliamps to clamp the test voltage in all source ranges. Output impedance is less than 0.2 Ohm to let you calibrate voltage instruments in milliamp loops without removing the input load resistors.

QUIK-CHEK & AUTO-CHEK

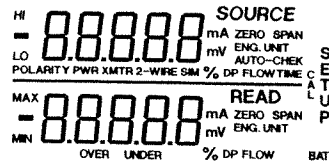
Instantly recall three output settings in each range with the handy QUIK-CHEK switch. All output settings are remembered for each function, even with the power off.

Use the AUTO-CHEK to continuously switch the Model CL328's output from Zero to Span in 2, 3, 5 or 10 equal steps at intervals of 5 to 900 seconds. Leave behind the panel and do your calibration from the front...or simulate your 2-Wire transmitter and calibrate every device in the loop.

OPERATING INSTRUCTIONS

GENERAL

TURN-ON



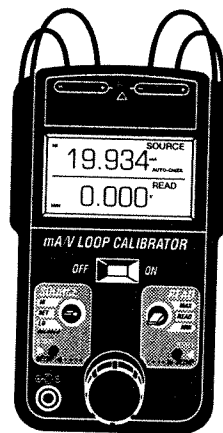
Each time the Model CL328 is turned on, the LCD will display all segments for about 1 second. It then displays the most recently selected Source & Read Settings.

- 1) Move the power switch to **ON**. All segments on the LCD are turned on during self test.
- 2) The upper half of the LCD will indicate if **SOURCE** is enabled while the lower half will indicate if **READ** is enabled.

SOURCE - The three **QUIK-CHEK** outputs will be the same as previously stored. Each time a different function is selected, the three **QUIK-CHEK** outputs for that function will be recalled.

READ - The CL328 is ready to measure the same signal as the last time it was turned on and is automatically updating the **MAX** & **MIN** readings for recall from the **READ** toggle switch.

CONNECTIONS

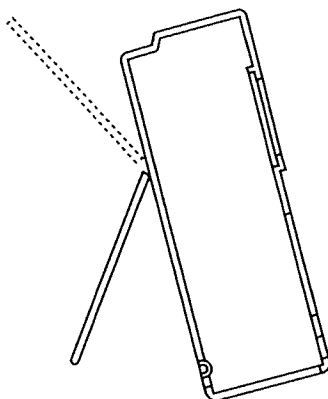


The Model CL328 has built-in test leads with alligator clips for attachment to instruments or sensors with terminal blocks or flying leads. *To prevent accidentally overloading the instrument being tested, it is important to correctly set up the outputs before connecting the Model CL328 to any instruments to be calibrated.*

OPERATING INSTRUCTIONS

GENERAL

FIELD & BENCH USE



The Model CL328 comes with a carrying case and a built-in tilt stand/hanger. The CL328 is held securely in the case by VELCRO® for use with the carrying case open. The carrying case also has a snap-on belt loop which can also be looped around a pipe or rail.

The tilt stand is easily raised by pulling the stand until it locks into place. The stand can also be reversed for use as a hanger to suspend the Model CL328.

RESTORE DEFAULT SETTINGS

The Model CL328 may be restored to the factory default setting. This will reset the HI and LO "QUIK-CHEK" memories according to the table below and the SET memory to midrange between HI and LO. The output and input are set to the mA range.

QUIK-CHEK DEFAULTS

RANGE	HI	LO
<i>mA</i>	20.000	4.000
%4-20mA	100.00	0.00
%DP	100.0	0.0
mV	100.00	0.00
V	5.000	1.000

- 1) Press and hold both the *STORE* & *RESET* push-buttons while turning the Model CL328 on.
- 2) Keep pressing the push-buttons until the display flashes once (10 seconds) then release.
- 3) All segments on the LCD will remain displayed until the Model CL328 has been reset

Note: Some ranges and functions are enabled by DIP switches (see pages 6 & 7 for factory settings).

AUTOCAL

To maintain accuracy the Model CL328 periodically recalibrates its measuring circuitry against internal references. While this is occurring the word CAL will appear on the LCD display for less than 2 seconds.

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OPERATING INSTRUCTIONS

ENABLING ADDITIONAL RANGES & FUNCTIONS

The Model CL328 has two additional ranges for displaying % DP Flow and Engineering Units. Additional functions are AUTO-CHEK (automatic stepping of outputs) and AUTO-OFF.

These ranges & functions are enabled by configuring DIP Switches (see next page). After the functions are enabled they are available as selections during setup (see OPERATING INSTRUCTIONS, SOURCE or READ).

AUTO-OFF

The Model CL328 can be set up to turn itself off after 30 minutes of inactivity. The internal timer is reset to 30 minutes each time the digital pot is turned or a pushbutton is pressed.

% DP FLOW

Check out the signal generated by DP (differential pressure) flow transmitters, square root extractors or other signals using a square law. Select %DP Flow for all milliamp functions.

AUTO-CHEK

The Model CL328 can be set up to automatically step the output with your choice of 2, 3, 5 or 10 steps from Zero to Full Scale.

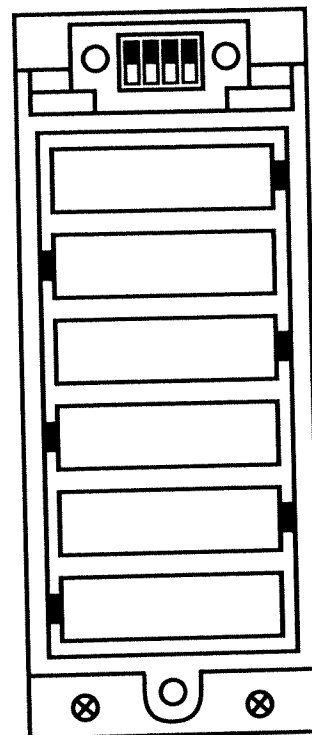
ENGINEERING UNITS

Scale the display on the CL328 to match the display of the instrument being calibrated. For example if you have a digital indicator showing 0.0 to 1000.0 Gallons/Hour from a flowmeter with 4 - 20 mA output you can scale the output of the CL328 to display 0.0 at 4 mA and 1000.0 at 20 mA.

OPERATING INSTRUCTIONS

ENABLING ADDITIONAL RANGES & FUNCTIONS

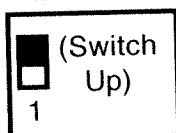
The DIP switches are located in the battery compartment. Turn the Model CL328 off and loosen the three slotted screws and remove the battery cover.



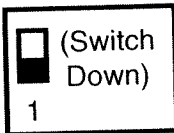
AUTO-OFF

Switches between continuous operation and automatic turn off after 30 minutes of inactivity

AUTO-OFF
Enabled*



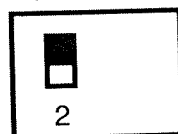
Continuous
Operation



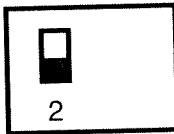
AUTO-CHEK

Switches between enabling and disabling AUTO-CHEK option for source functions

AUTO-CHEK
Enabled*



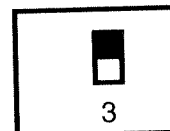
AUTO-CHEK
Disabled



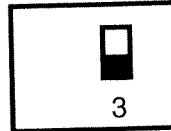
PERCENT DP FLOW

Switches between enabling and disabling Percent DP Flow range option for the milliamper functions

Percent DP
Flow Enabled*



Percent DP
Flow Disabled



ENGINEERING UNITS

Switches between enabling and disabling Engineering Units range option for all functions

Engineering
Units Enabled*



Engineering
Units Disabled*



*Factory default settings

OPERATING INSTRUCTIONS

RANGES

The selected range is displayed on the LCD by the annunciators listed below.

MILLIAMPS - mA

Choose mA to display directly in milliamps. Display in SOURCE and READ functions from 0.000 to 24.000 mA. In READ you can also measure up to 52.00 mA.

PERCENT OF 4 - 20 MILLIAMPS - mA %

Choose mA % to display in percent of span for 4 - 20 mA loops. Use with chart recorders or current trips that display in %.

<i>0.00%</i>	<i>4.000 mA</i>
<i>25.00%</i>	<i>8.000 mA</i>
<i>50.00%</i>	<i>12.000 mA</i>
<i>75.00%</i>	<i>16.000 mA</i>
<i>100.00%</i>	<i>20.000 mA</i>

$$\text{Percent} = (\text{mA} - 4) / 0.16 \quad \text{mA} = (\text{Percent} / 6.25) + 4$$

PERCENT DIFFERENTIAL PRESSURE - % DP

Choose % DP to display in percent of the square law for 4 - 20 mA loops. Also use to calibrate square root extractors and other square law mA inputs.

<i>0.0%</i>	<i>4.000 mA</i>
<i>25.0%</i>	<i>5.000 mA</i>
<i>50.0%</i>	<i>8.000 mA</i>
<i>75.0%</i>	<i>13.000 mA</i>
<i>100.0%</i>	<i>20.000 mA</i>

$$\%DP = (\sqrt{\text{mA} - 4}) \times 25 \quad \text{mA} = (\%DP / 25)^2 + 4$$

VOLTAGE - V

Choose V to display directly in DC Volts. Use for 0 to 1 Volt, 1 to 5 Volt or 0 to 10 Volt signals. SOURCE from 0.000 to 20.000 VDC. In READ the CL328 autoranges between -999.90 to +999.90 millivolts and -99.990 to +99.990 VDC.

OPERATING INSTRUCTIONS

RANGES

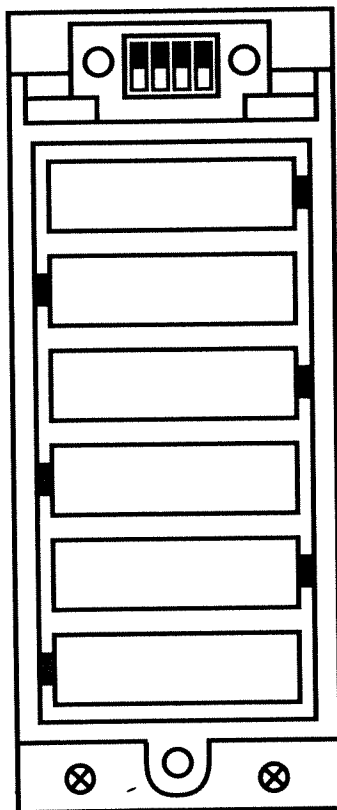
MILLIVOLTS - mV

Choose mV to display directly in millivolts DC. Use 0 to 100 millivolts to check recorder or analyzer inputs. SOURCE from 0.00 to 999.90 mVDC. In READ the CL328 autoranges between -999.90 to +999.90 millivolts and -99.990 to +99.990 VDC.

ENGINEERING UNITS - ENG. UNIT

Choose ENG. UNIT to match the display of the instrument being calibrated (see page 10 for instructions). Any span in mA, mV or V in Source or Read can be scaled to display a maximum of between -90000 to +90000 with 0 to three digits to the right of the decimal point.

CHANGING BATTERIES



Low battery is indicated by BAT on the LCD Display. Approximately 4 Hours of operation remain before the LCD goes blank and the Model CL328 shuts itself down. Turn the CL328 off, loosen the three captive screws securing the battery compartment cover. The six "AA" batteries are easily removed and replaced (alkaline supplied and recommended). Replace the battery compartment cover, tighten the screws and turn on when ready to use.

OPERATING INSTRUCTIONS

USING ENGINEERING UNITS

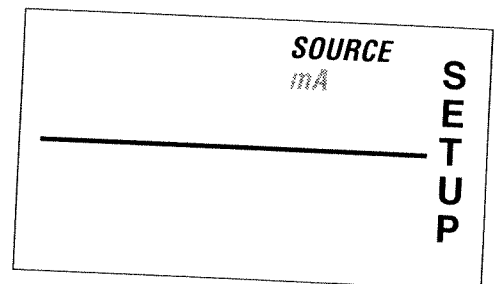
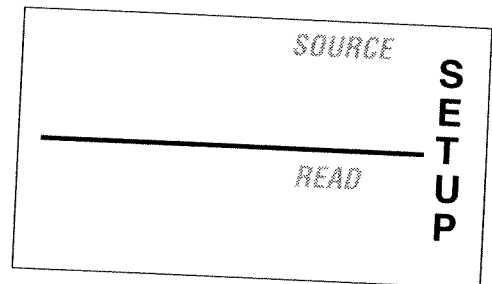
Scale the display of the Model CL328 to match the display of the instrument being checked. Any span in mA, mV or V in Source or Read can be scaled to display between a maximum of -90000 to +90000 with zero to three digits to the right of the decimal.

The previously stored Engineering units can be recalled by using the following procedure without turning the knob.

The display can be scaled to calibrate a reverse acting controller ($4 \text{ mA} = 100.0$ and $20 \text{ mA} = 0.0$) or to check an indicator reading negative numbers ($0 \text{ mA} = -500.00$ and $20 \text{ mA} = +500.00$).

Hint: Source in Engineering units and fundamental units at the same time. Setup Source for one unit and Read for the other unit. Connect the Source and the Read wires together (in series for mA, in parallel for mV and V).

- 1) Press & hold both the **STORE** & **RESET** push-buttons for 1 second to enter the SETUP mode. The word **SETUP** will appear in the LCD and the words **SOURCE** and **READ** will alternately flash (shown as gray). Release both push-buttons.
- 2) Press the **STORE** push-button to select **SOURCE** or the **RESET** push-button to select **READ**. The words **SETUP** and **SOURCE** or **READ** will remain on the LCD and the previously selected function will flash.

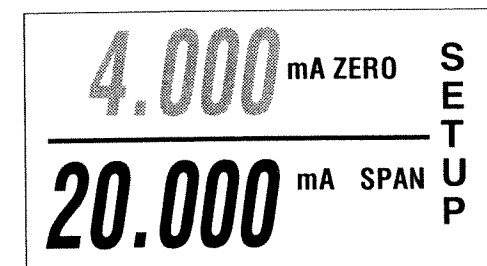
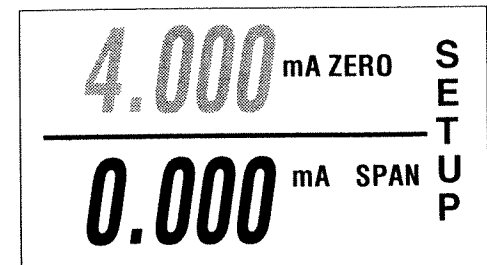
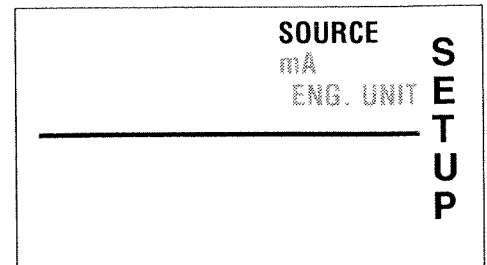


Diagrams show setting mA Source for 4 to 20mA scaled to 0.00 to 500.00 liters/hour.

OPERATING INSTRUCTIONS

USING ENGINEERING UNITS

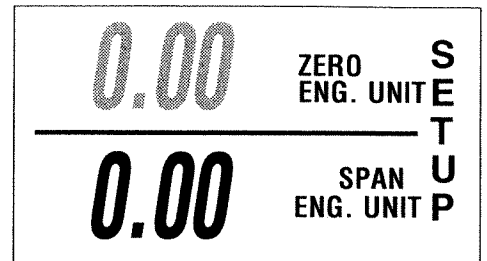
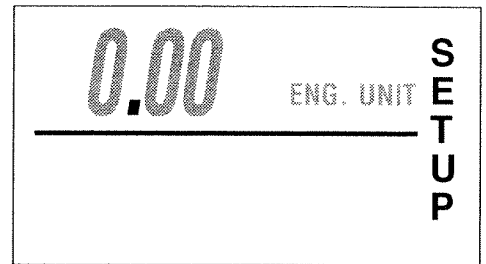
- 3) Turn the knob (Digital pot) to scroll through the available functions. Each enabled function will flash on the LCD. "ENG. UNIT" will appear as a choice for each SOURCE or READ function. Press the *STORE* or *RESET* push-button to proceed.
- 4) The word ZERO will appear in the top half of the LCD prompting you to enter the lowest value for the range in mA, V or mV that will be sourced or read. Turn the knob until the lowest value of your chosen range flashes in the top half of the LCD. Press the *STORE* or *RESET* push-button to continue.
- 5) The word SPAN will appear in the bottom half of the LCD prompting you to enter the highest value for the range in mA, V or mV that will be sourced or read. Turn the knob until the highest value of your chosen range flashes in the bottom half of the LCD. Press the *STORE* or *RESET* push-button to continue.



OPERATING INSTRUCTIONS

USING ENGINEERING UNITS

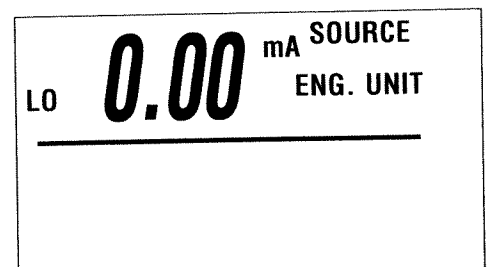
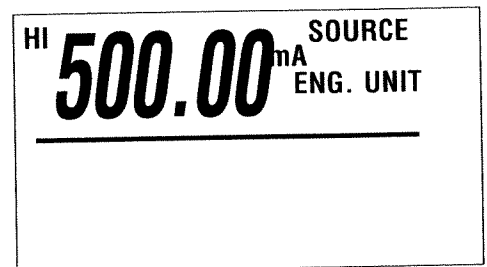
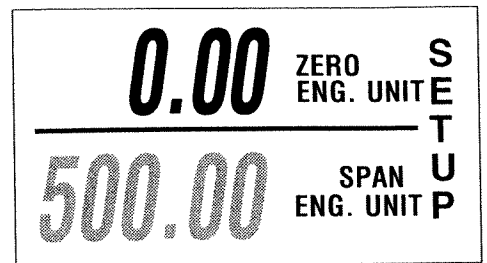
- 6) You are now prompted by flashing zeros to enter the decimal point position for the engineering units you have chosen. Turn the knob until the decimal point appears in the location to match the resolution of the display on the instrument you will be calibrating (from zero to three digits to the right of the decimal point). Press the *STORE* or *RESET* push-button to continue.
- 7) The word ZERO and ENG. UNIT will appear in the top half of the LCD prompting you to enter the lowest value for the range in the units to match the display of the instrument being calibrated. Turn the knob until the lowest value of your chosen range flashes in the top half of the LCD. Press the *STORE* or *RESET* push-button to continue.



OPERATING INSTRUCTIONS

USING ENGINEERING UNITS

- 8) The word SPAN and ENG. UNIT will appear in the bottom half of the LCD prompting you to enter the highest value for the range in the units to match the display of the instrument being calibrated. Turn the knob until the highest value of your chosen range flashes in the bottom half of the LCD. Press the *STORE* or *RESET* push-button to continue.
- 9) The Model CL328 will now begin operating with the ranges and Engineering Units you have selected. If Engineering Units have been chosen for any Source function the HI & LO QUIK-CHEKs will automatically be updated with the units you have chosen. Refer to the sections for READ or SOURCE FUNCTIONS for further instructions.



OPERATING INSTRUCTIONS

SOURCE MODE

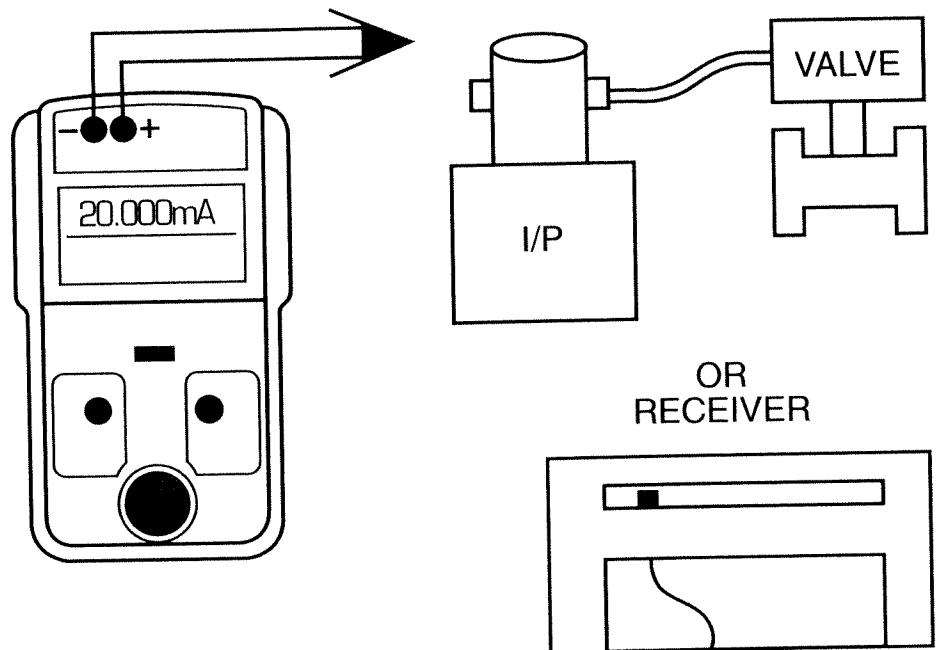
SOURCE

- 1) Move the POWER switch to *ON*
- 2) Press & hold both the *STORE* & *RESET* push-buttons for 1 second to enter the SETUP mode. The word SETUP will appear in the LCD and the words SOURCE and READ will alternately flash. Release both push-buttons.
- 3) Press the *STORE* push-button. The words SETUP and SOURCE will remain on the LCD and the previously selected function will repeatedly flash.
- 4) Turn the knob (Digital-Pot) to scroll through the available functions. Each enabled function will flash on the LCD (See ENABLING RANGES & FUNCTIONS, page 6).
- 5) Press the *STORE* push-button to select the function. If AUTO-CHEK has been enabled you can choose to have the CL328 automatically step the output (See AUTO-CHEK, page 24). If AUTO CHEK is not enabled or selected the CL328 will immediately output the prior value for that function. If OFF is selected the SOURCE function will be deactivated and the top half of the LCD will be blank.
- 6) Adjust the knob to the desired output value or QUIK-CHEK with previously stored outputs (see STORING QUIK-CHEK OUTPUTS, page 16).
- 7) Connect the Model CL328 to the input terminals of the instrument or meter to be calibrated.

OPERATING INSTRUCTIONS

SOURCE MODE

Whenever SOURCE mode is selected the word SOURCE will appear on the LCD display. To change the output value, turn the speed sensitive digital pot. Turning the knob slowly will cause a gradual change in the output. A faster rate of change will occur when the knob is turned faster. This function operates in all three output positions (HI, SET & LO).



OPERATING INSTRUCTIONS

SOURCE MODE

STORING QUIK-CHEK OUTPUTS

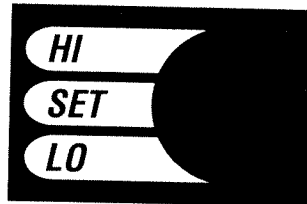


- 1) Switch to HI or LO
- 2) Turn the knob to desired value
- 3) Press the *STORE* push-button

The LCD will flash once to show that the value was saved

If a value is in the SET position and you want that value stored in HI or LO, press and hold the *STORE* push-button while moving the switch to HI or LO. The display will flash once to indicate the value has been stored. Then release the *STORE* push-button.

RECALLING QUIK-CHEK OUTPUTS



Any time you need a stored value just flip the QUIK-CHEK switch. Any value for the selected range may be stored in HI & LO. The Model CL328 remembers the HI, LO and SET values for all ranges (32 memories) with the power on or off. Each time a different range is selected, the last three QUIK-CHEK values for that type will be recalled.

OPERATING INSTRUCTIONS

SOURCE FUNCTIONS

The SOURCE functions generate or control the desired signal. Multiple scales are available for each function. Engineering Units & % DP Flow must be enabled before they are available for selection.

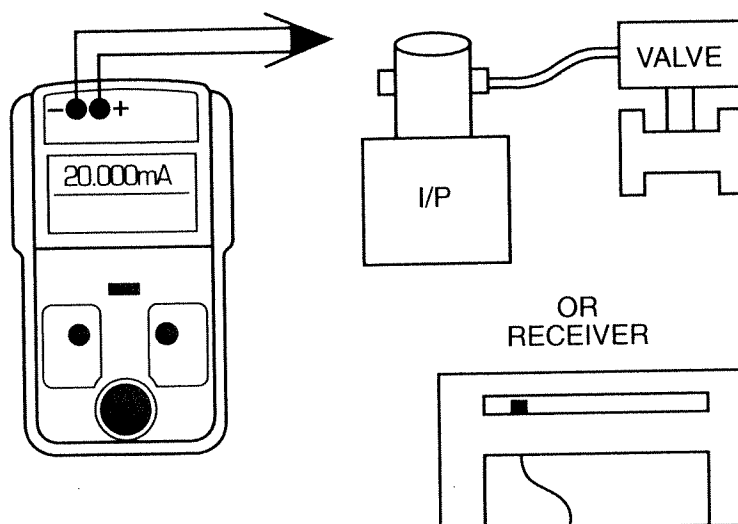
CALIBRATE MILLIAMP INPUTS

mA, mA %, mA ENG. UNIT, mA % DP FLOW

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.

- 1) Disconnect one or both input wires from the device to be calibrated
- 2) Connect the red *SOURCE* lead of the calibrator to the plus (+) input of the device and the black *SOURCE* lead to the minus (-)

Output current is continuously adjustable with the "QUIK-CHEK" switch in the *SET* position. Zero & Span (or any other values) are available by using the *LO* and *HI* "QUIK-CHEKs".



OPERATING INSTRUCTIONS

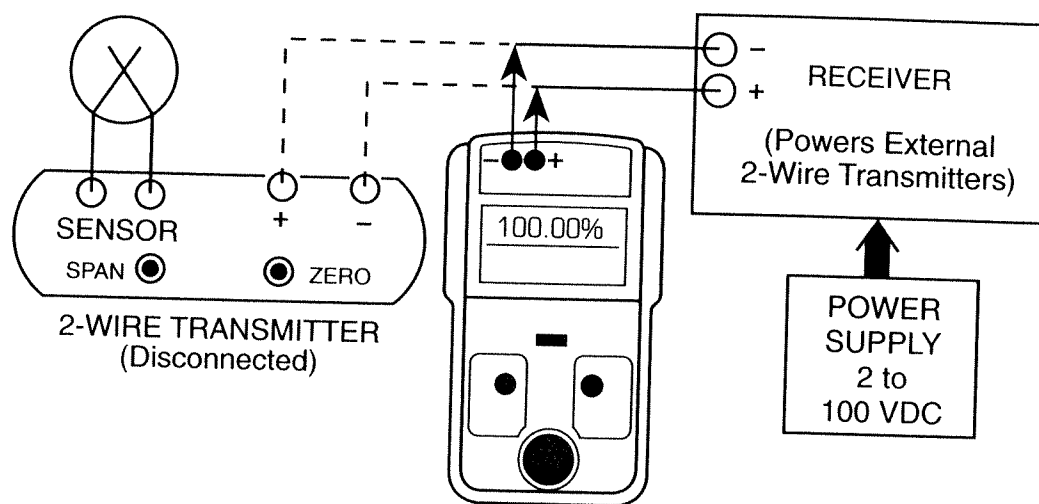
SIMULATE 2-WIRE TRANSMITTERS

2-WIRE SIM mA, 2-WIRE SIM %, 2-WIRE SIM ENG. UNIT, 2-WIRE SIM % DP FLOW

Choose this function to simulate a 2-Wire Transmitter output from 3.000 to 24.000 milliamps. Operates in loops with power supply voltages from 2 to 45 VDC.

- 1) Disconnect existing 2-Wire Transmitter from the loop
- 2) Connect the red *SOURCE* lead of the calibrator to the plus (+) input of the field connections and the black *SOURCE* lead to the minus (-)

The simulated output of the 2-Wire Transmitter is continuously adjustable from 3.000 to 24.000 mA with the "QUIK-CHEK" switch in the *SET* position. Zero & Span (or any other values) are available by using the LO and HI "QUIK-CHEKs".



OPERATING INSTRUCTIONS

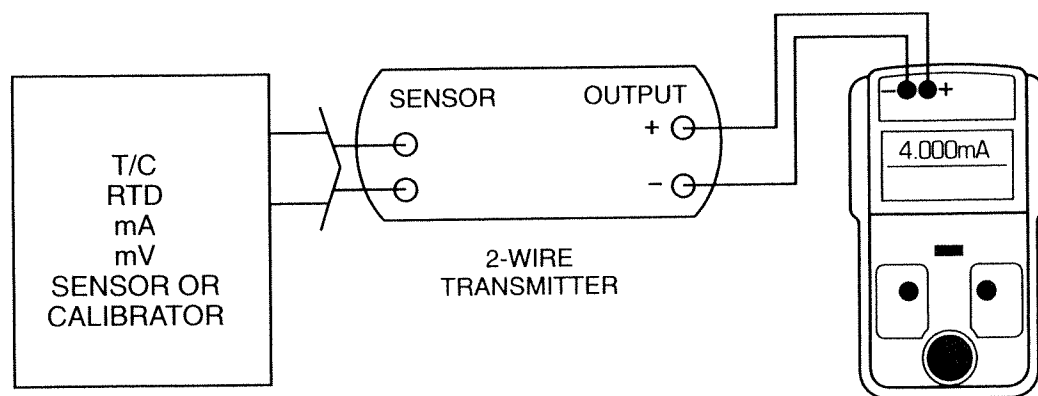
POWER & MEASURE 2-WIRE TRANSMITTERS

PWR XMTR mA, PWR XMTR %, PWR XMTR ENG. UNIT, PWR XMTR, % DP FLOW

Choose this function to simultaneously supply power to a 2-Wire transmitter while displaying the 4-20 mA output of the transmitter.

- 1) Disconnect one or both input wires from the 2-Wire Transmitter to be calibrated
- 2) Connect the red *SOURCE* lead of the calibrator to the plus (+) input of the device and the black *SOURCE* lead to the minus (-)
- 3) Connect an appropriate sensor or calibrator to the input of the 2-Wire Transmitter

The Model CL328 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 CL328. Calibrate the Transmitter in the usual manner and disconnect the Model CL328.



OPERATING INSTRUCTIONS

CALIBRATE VOLTAGE INPUTS

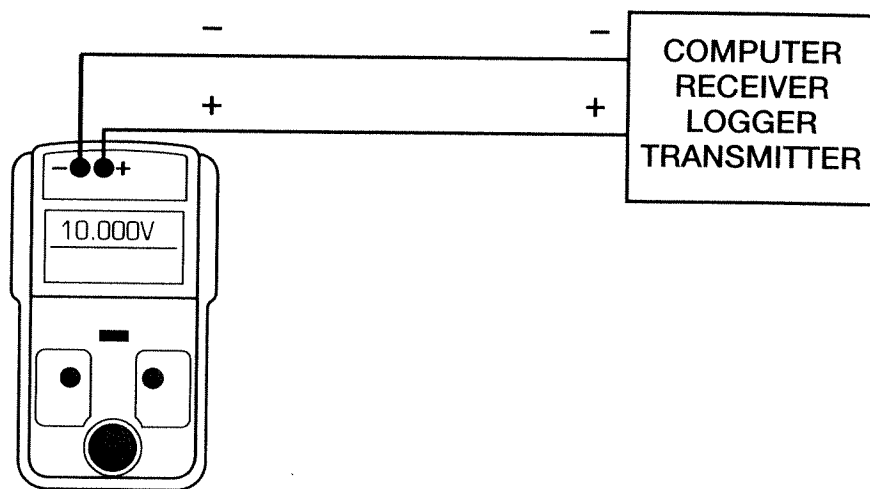
V, V ENG. UNIT

mV, mV ENG. UNIT

Choose this function to provide an output from 0.00 mV to 999.90 mV and from 0.000 to 20.000 VDC. Source current is a nominal 25 mA to provide the driving power to your voltage receivers.

- 1) Disconnect one or both input wires from the device to be calibrated
- 2) Connect the red *SOURCE* lead of the calibrator to the plus (+) input of the device and the black *SOURCE* lead to the minus (-)

Output voltage is continuously adjustable with the "QUIK-CHEK" switch in the *SET* position. Zero & Span (or any other values) are available by using the LO and HI "QUIK-CHEKs".



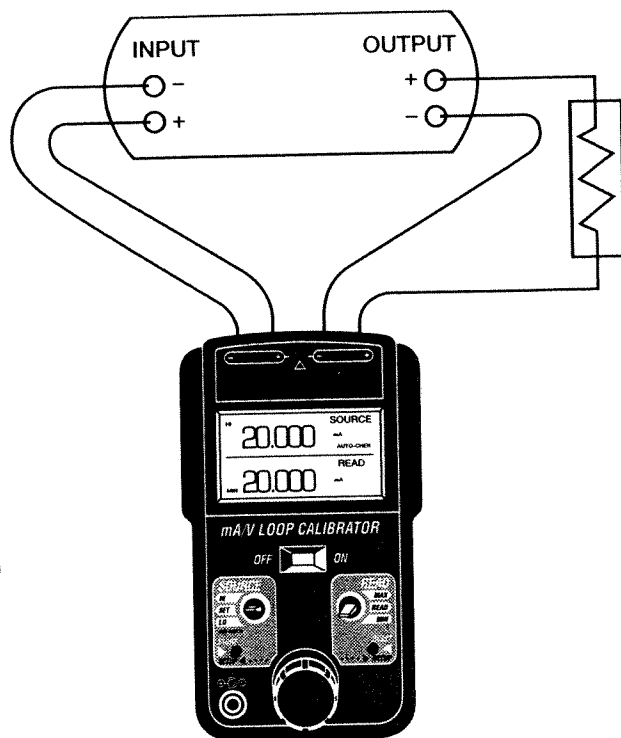
OPERATING INSTRUCTIONS

CALIBRATING LOOP CONVERTERS & I/I ISOLATORS

Calibrate your 4-20 milliamp and voltage loop converters and I/I isolators without any additional test equipment or power supplies.

- 1) Setup the Model CL328 to select both the correct SOURCE and READ functions and ranges to match the instrument being calibrated.
- 2) Connect the Model CL328 SOURCE and READ leads to the input and output connections of the instrument being calibrated

Some loop isolators require a resistor placed in series with the output of the isolator of either 250 Ohms or a value equivalent to the resistance of the loop. Check the manual for your isolator for specific instructions.



OPERATING INSTRUCTIONS

CHECK 1-5 VOLT INPUTS WITHOUT DISCONNECTING WIRES

Most 1-5 Volt receivers in 4-20mA loops have a 250 Ohm resistor across the input of the receiver. This resistor may be mounted internally or externally. The Model CL328 is connected directly across the input of the 1-5 Volt receiver without disconnecting any field wiring. This saves a great deal of time when a large number of voltage receivers, such as chart recorders or computer systems require calibration.

Output voltage is continuously adjustable with the "QUIK-CHEK" switch in the *SET* position. Zero & Span (or any other values) are available by using the LO and HI "QUIK-CHEKs". The LO & HI "QUIK-CHEK"s are usually set to 1.000 and 5.000 V to quickly calibrate Zero & Span.

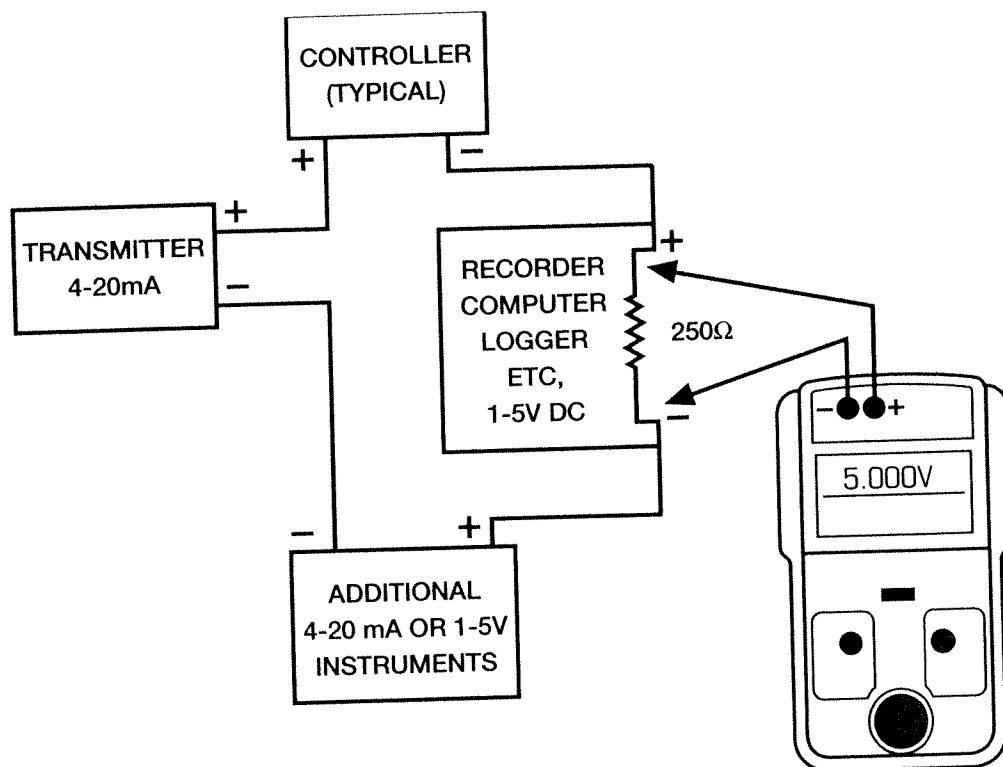
Make certain that changing the signal input will not disturb the process or cause unexpected alarms when checking on-line instruments. It is important to remember the Model CL328 drives *only* the device to which it is connected. It has no effect on other devices in the 4 to 20 mA loop. The Model CL328 will clamp the selected value in the mV and V Ranges to the maximum sink current of >16 mA.

OPERATING INSTRUCTIONS

V, V ENG. UNIT
mV, mV ENG. UNIT

Choose this function to calibrate any 1 to 5 Volt device in a 4 to 20 mA loop without breaking the loop or turning off the signal current.

- 1) Disconnect one or both input wires from the device to be calibrated.
- 2) Connect the red *SOURCE* lead of the calibrator to the plus (+) input of the device and the black *SOURCE* lead to the minus (-). Any associated 250 Ohm resistor must not be disconnected.



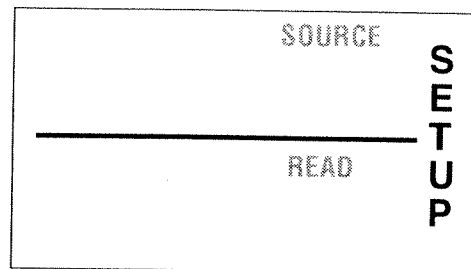
OPERATING INSTRUCTIONS

USING AUTO-CHEK

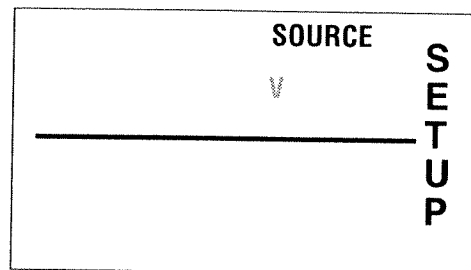
Use the AUTO-CHEK to continuously switch the Model CL328's output from Zero to Span (stored in the HI and LO QUIK-CHEKs) in 2, 3, 5 or 10 equal steps at an interval of between 5 and 900 seconds per step. Set your calibrator at one point in the field and calibrate every device in the loop.

1) Store the required Span & Zero into the HI & LO QUIK-CHEK positions (refer to **STORING QUIK-CHEK OUTPUTS**, page 16).

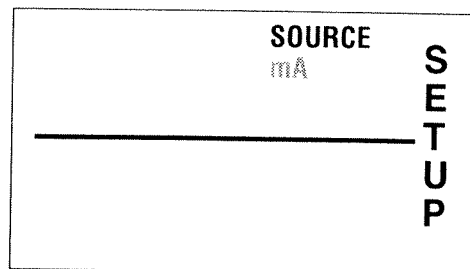
2) Press & hold both push-buttons (*STORE* & *RESET*) for 1 second to enter the **SETUP** mode. The word **SETUP** will appear in the LCD and the words **SOURCE** and **READ** will flash (shown as gray).



3) Press the *STORE* push-button. The words **SETUP** and **SOURCE** will remain on the LCD and the previously selected function will flash.



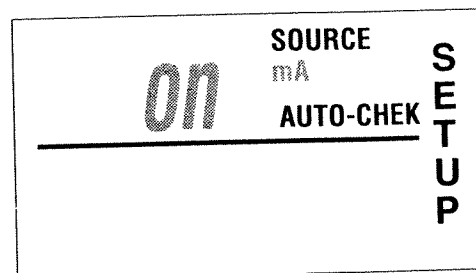
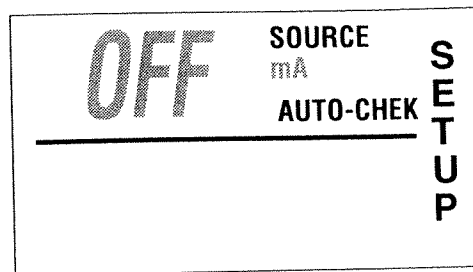
4) Turn the knob (digital pot) to scroll through the available functions. Each enabled function will flash on the LCD.



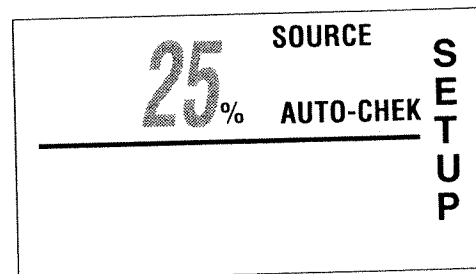
OPERATING INSTRUCTIONS

USING AUTO-CHEK

- 5) Press the *STORE* push-button to select the function. AUTO-CHEK will appear on the display along with the words **on** or **OFF**. Rotate the knob until the word **on** appears on the display. If AUTO-CHEK has not been enabled the word AUTO-CHEK will not appear - see ENABLING RANGES & FUNCTIONS, page 6. Press the *STORE* push-button to continue.



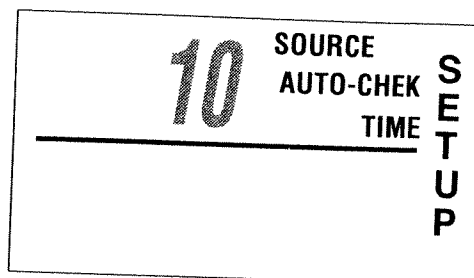
- 6) The word AUTO CHEK and % appear on the LCD prompting you to enter the percent of span change between steps. Turn the knob until the correct percentage appears on the LCD. For 2 steps choose 100%, 3 steps choose 50%, 5 steps choose 25% and for 10 steps choose 10%. Press the *STORE* push-button to continue.



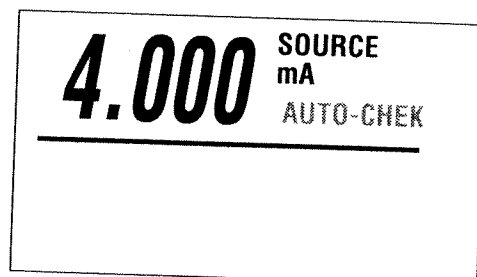
OPERATING INSTRUCTIONS

USING AUTO-CHEK

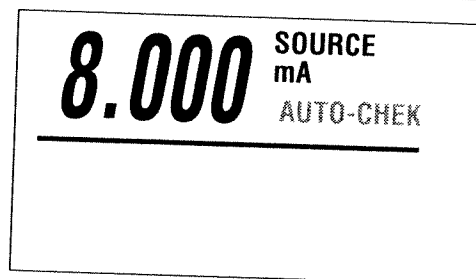
7) The words AUTO CHEK and TIME appear on the LCD prompting you to enter the number of seconds between steps. Turn the knob until the correct number of seconds per step (from 5 to 900) appears on the LCD. Press the *STORE* push-button to continue.



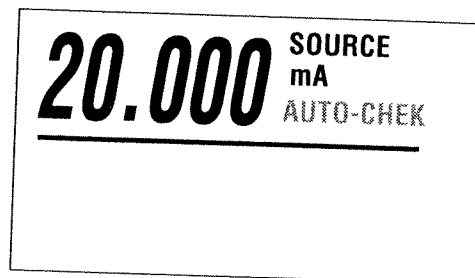
8) Move the QUIK-CHEK switch to *SET*. Press the *STORE* push-button to turn the AUTO-CHEK on.



The word AUTO-CHEK will flash while AUTO-CHEK is active. The output pauses at each step for the number of seconds selected then proceeds to the next higher step.



When the top step is reached (the value stored in the HI QUIK-CHEK) the AUTO-CHEK reverses direction and the output proceeds to the next lower step. This cycle repeats continuously until it is deactivated.



OPERATING INSTRUCTIONS

USING AUTO-CHEK

You can deactivate the AUTO-CHEK function at any time by pressing the *STORE* push-button while the QUIK-CHEK switch is at *SET* or by moving the QUIK-CHEK switch to *HI* or *LO*. AUTO-CHEK will stop flashing to indicate that it is deactivated. *SET* will indicate the the most recent step value.

HI **20.000** SOURCE
mA
AUTO-CHEK

While AUTO-CHEK is deactivated the QUIK-CHEK values stored in *HI* and *LO* can be recalled to adjust the Span and Zero of the device being calibrated. Or store new values by switching to *HI* and *LO*, turning the digital pot and pressing the *STORE* pushbutton.

HI **24.000** SOURCE
mA
AUTO-CHEK

To reactivate AUTO-CHEK press the *STORE* push-button while the QUIK-CHEK switch is at *SET*. When AUTO-CHEK is reactivated it restarts the cycle from the lowest output (stored in the *LO* QUIK-CHEK).

4.000 SOURCE
mA
AUTO-CHEK

OPERATING INSTRUCTIONS

READ MODE

READ

- 1) Move the POWER switch to *ON*
- 2) Press & hold both the *STORE* & *RESET* push-buttons for 1 second to enter the SETUP mode. The word *SETUP* will appear in the LCD and the words *SOURCE* and *READ* will alternately flash. Release both push-buttons.
- 3) Press the *RESET* push-button. The words *SETUP* and *READ* will remain on the LCD and the previously selected function will flash.
- 4) Turn the knob (Digital pot) to scroll through the available functions. Each enabled function will flash on the LCD (See *ENABLING RANGES & FUNCTIONS* under *OPERATING INSTRUCTIONS, GENERAL*).
- 3) Press the *RESET* push-button to select the function. If *OFF* is selected the *READ* function will be deactivated and the bottom half of the LCD will be blank.
- 4) Connect the Model CL328 to the input terminals of the instrument or meter to be calibrated.
- 5) Display the present reading, Maximum or Minimum

Whenever *READ* is selected the word *READ* will appear on the LCD display. The display will update the present reading twice per second.

OPERATING INSTRUCTIONS

READ MODE

MIN/MAX



To read the Maximum or Minimum INPUT since READ mode was entered, simply switch to *MAX* or *MIN*. The value will appear on the LCD along with the word MAX or MIN. The MAX/MIN values are automatically updated and may be viewed at any time without disturbing the other values.

RESTARTING MIN/MAX

Pressing the *RESET* push-button will cause the CL328 to store the present reading into the MIN and MAX memories. Upon releasing the *RESET* push-button the Model CL328 will resume reading the input and update the MAX & MIN values as the measured signal changes.

OUT OF RANGE SIGNALS



Signals above or below those available for the currently selected range will be indicated by OVER and UNDER on the display.

OPERATING INSTRUCTIONS

READ FUNCTIONS

The READ functions measures the desired signal. Multiple scales are available for each function. Engineering Units & % DP Flow must be enabled before they are available for selection.

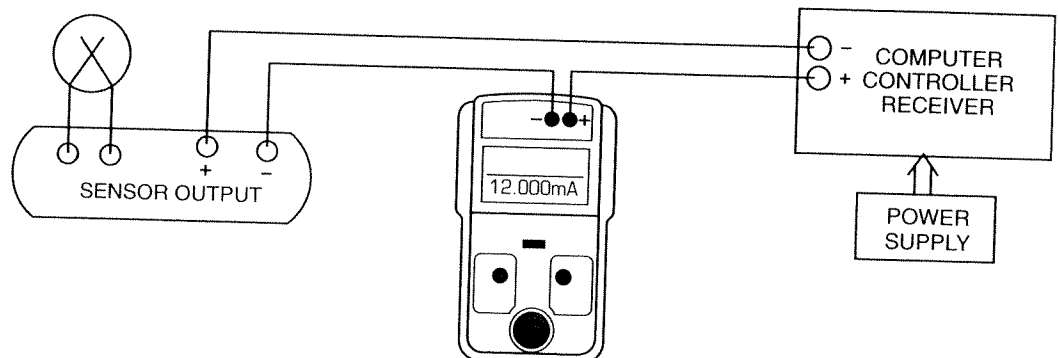
READ MILLIAMP OUTPUTS

mA, mA %, mA ENG. UNIT, mA % DP FLOW

Choose this function to measure from -52.00 to +52.00 milliamps. For calibrating controller output and checking process loop currents the input is autoranged to higher resolution from -24.000 to +24.000 milliamps.

- 1) Open the current loop at any convenient point along the signal path
- 2) Connect the red *READ* (+) lead of the calibrator to the more positive point of the break and the black *READ* (-) to the more negative

Display the present reading, Maximum or Minimum by moving the toggle switch from READ to MAX or MIN. If the Model 934 is connected in the wrong polarity, the display will indicate negative current. Simply reverse the leads for correct indication.



OPERATING INSTRUCTIONS

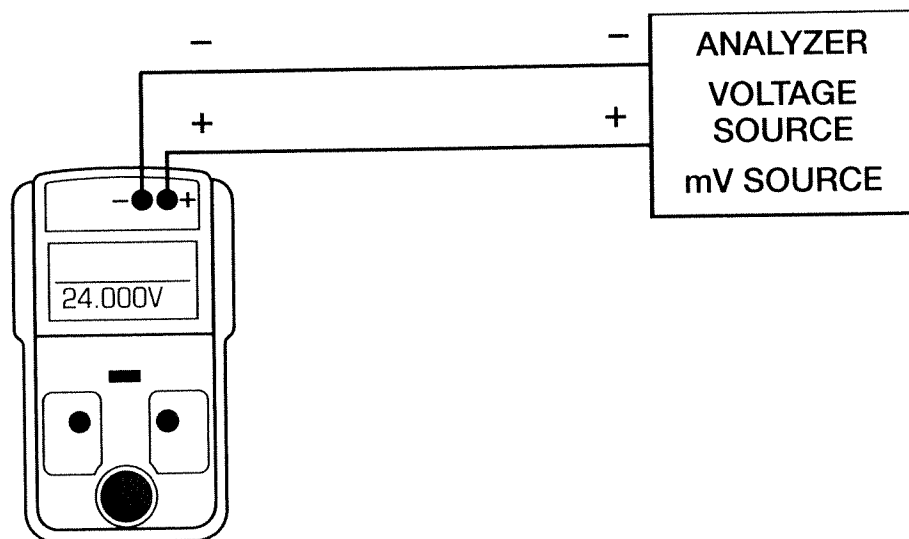
READ VOLTAGE OUTPUTS

V, mV, V ENG. UNIT

Choose this function to measure from -99.990 to + 99.990 Volts. For checking sensor outputs and other low level signals the input is autoranged to display from -999.90 to +999.90 millivolts.

- 1) Connect the red *READ (+)* lead and the black *READ* lead (-) of the calibrator across the voltage to be measured.

Loop power supplies, signal voltages at receivers, batteries, transmitter voltage drops and any other voltages may be measured. Signals above or below those available for the currently selected range will be indicated by OVER and UNDER on the display.



SPECIFICATIONS

(Unless otherwise indicated, specifications are in $\pm\%$ of Reading @ 23°C)

GENERAL

ACCURACY: $\pm(0.012\%$ of Reading + 0.008% of Full Scale Reading)

Accuracy of scaled ranges (% of 4 to 20 mA, %DP Flow, Engineering units) are based on the value of the fundamental units (mA, V or mV).

WARM UP TIME: 10 seconds to specified accuracy, 2 minutes to maximum accuracy

TEMPERATURE EFFECT: $\pm 0.008\%/^{\circ}\text{C}$ based on $23^{\circ}\text{C} \pm 25^{\circ}\text{C}$

ISOLATION: 500 VDC between SOURCE & READ leads

Accuracies of the Source and Read ranges are independent. When Source and Read are connected together the accuracies are additive.

BATTERIES: Six "AA", (R6) batteries (Alkaline supplied and recommended)

BATTERY LIFE:

MILLIAMP SOURCE & 2-WIRE MODES: Nominal 33 hours at 12 mA, 20 hours at 20 mA into 250 Ohm load

OTHER FUNCTIONS: Nominal 40 hours

AC ADAPTORS: Optional, nominal 115 or 230 VAC, 50/60 Hz

LOW BATTERY INDICATION: "BAT" indication on the display at approximately 4 hours left

OVERVOLTAGE PROTECTION: Protected to 120 Volts AC or DC in all ranges without fuses for 30 seconds

OUTPUT NOISE: ≤ 1 LSD at frequencies less than 10 Hz

NORMAL MODE REJECTION RATIO: 50 dB @ 50/60Hz

COMMON MODE REJECTION RATIO: Not applicable for battery operation. 120 dB @ 50/60 Hz with AC Adaptor

OPERATING TEMPERATURE RANGE:

-5 to +130°F (-20 to +55°C)

STORAGE TEMPERATURE RANGE:

-13 to +130°F (-25 to +55°C)

RELATIVE HUMIDITY: 10 to 90%, non-condensing for 24 hours from 0 to 35°C

OVERALL SIZE: $6\frac{11}{16} \times 4 \times 2\frac{15}{16}$ inches (170 x 102 x 75 mm)

WEIGHT: 1lb, 9oz (0.709 kg)

SPECIFICATIONS

MILLIAMP SOURCE

RANGES:

0.000 to 24.000 mA

-25.00 to 125.00% of 4 to 20 mA

-50.0 to 111.8% of % DP Flow

Scaled Engineering Units (from -90000 to +90000 counts with up to three digits to the right of the decimal point)

ACCURACY: $\pm(0.012\% \text{ of Reading} + 0.008\% \text{ of } 24.000 \text{ mA})$

TYPICAL DRIVE CAPABILITY: 1200 Ohms @ 20.000 mA

POWER TO DRIVE RECEIVER: nominal 24 VDC

COMPLIANCE VOLTAGE:

0 to 285 Ohm load: 10V nominal

285 to 1200 Ohm load: 24V nominal

OVERLOAD PROTECTION: Current limited to 25 mA

POWER & MEASURE 2-WIRE TRANSMITTERS

RANGES & ACCURACY: Same as for MILLIAMP
SOURCE above

OUTPUT CURRENT: up to 24.000 mA

TYPICAL DRIVE CAPABILITY: 1200 Ohms @ 20 mA

POWER TO EXTERNAL 2-WIRE TRANSMITTER:
nominal 24 VDC

OVERLOAD PROTECTION: Current limited to 25 mA

Specifications subject to change without notice

SPECIFICATIONS

2-WIRE TRANSMITTER SIMULATOR

RANGES:

3.000 to 24.000 mA

-6.25 to 125.00% of 4 to 20 mA

-25.0 to 111.8% of % DP Flow

Scaled Engineering Units (from -90000 to +90000 counts with up to three digits to the right of the decimal point)

ACCURACY: $\pm(0.012\% \text{ of Reading} + 0.008\% \text{ of } 24.000 \text{ mA})$

LOOP VOLTAGE LIMITS:

Minimum, 3 VDC; Maximum 45 VDC

OVERLOAD PROTECTION: Current limited to 25 mA

MILLIAMP READ

RANGES:

-52.00 to -24.00¹

-24.000 to +24.000 mA²

24.00 to 52.00 mA¹

-25.00 to 125.00% of 4 to 20 mA

-50.0 to 111.8% of % DP Flow

Scaled Engineering Units (from -90000 to +90000 counts with up to three digits to the right of the decimal point)

¹**ACCURACY:** $\pm(0.012\% \text{ of Reading} + 0.008\% \text{ of } 52.00 \text{ mA})$

²**ACCURACY:** $\pm(0.012\% \text{ of Reading} + 0.008\% \text{ of } 24.000 \text{ mA})$

INPUT IMPEDANCE: 25 Ohms

VOLTAGE BURDEN:

0.2 V at 4 mA, 0.6 V at 20 mA, 1.4 V at 50 mA

MEASURING ACROSS A DIODE: Add $\pm 0.2\%$ to specification from 0 to 20 mA (Diode 1N 914 or equivalent)

SPECIFICATIONS

VOLTAGE SOURCE

RANGES:

0.00 to 999.90 mVDC¹

0.000 to 20.000 VDC²

Scaled Engineering Units (from -90000 to +90000 counts
with up to three digits to the right of the decimal point)

¹**ACCURACY:** $\pm(0.012\% \text{ of Reading} + 0.008\% \text{ of } 999.90 \text{ mV})$

²**ACCURACY:** $\pm(0.012\% \text{ of Reading} + 0.008\% \text{ of } 20.000 \text{ V})$

SOURCE CURRENT: > 24 mA

SINK CURRENT: >16 mA from 1 to 5 VDC

OUTPUT IMPEDANCE: < 0.2 Ohm

LOAD RESISTANCE: > 3 Ohms

SHORT CIRCUIT DURATION: Infinite

OVERLOAD PROTECTION: Current limited to 50 mA nominal

VOLTAGE READ

RANGES:

-99.990 to -0.999 VDC¹

-999.90 to 999.90 mVDC²

0.999 to 99.990 VDC¹

Scaled Engineering Units (from -90000 to +90000 counts
with up to three digits to the right of the decimal point)

¹**ACCURACY:** $\pm(0.012\% \text{ of Reading} + 0.008\% \text{ of } 99.900 \text{ V})$

²**ACCURACY:** $\pm(0.012\% \text{ of Reading} + 0.008\% \text{ of } 999.90 \text{ mV})$

INPUT RESISTANCE: 2 Meg Ohm nominal

SOURCE RESISTANCE EFFECT: 0.01% error per 200 Ohms

MAXIMUM VOLTAGE LIMIT: 120 Volts DC to 100 Hz AC

SPECIFICATIONS

MODEL CL328 RANGES AND ACCURACIES

Source mA & Simulate 2-Wire Transmitter¹

mA OUTPUT	LOW LIMIT	HIGH LIMIT	ACROSS ² 100 OHM	LOW ² LIMIT	HIGH ² LIMIT
24.000mA	23.995	24.005	(2.4000V	2.3995	2.4005)
20.000	19.996	20.004	(2.0000	1.9996	2.0004)
12.000	11.997	12.003	(1.2000	1.1997	1.2003)
4.000	3.998	4.002	(0.4000	0.3998	0.4002)
0.000	-0.002	0.002	(0.0000	-0.0002	0.0002)

Source % 4-20 mA & Simulate 2-Wire Transmitter¹

%4-20mA OUTPUT	LOW LIMIT	HIGH LIMIT	ACROSS ² 100 OHM	LOW ² LIMIT	HIGH ² LIMIT
125.00%	23.995	24.005	(2.4000V	2.3995	2.4005)
100.00	19.996	20.004	(2.0000	1.9996	2.0004)
50.00	11.997	12.003	(1.2000	1.1997	1.2003)
0.00	3.998	4.002	(0.4000	0.3998	0.4002)
-25.00	-0.002	0.002	(0.0000	-0.0002	0.0002)

Source % DP Flow & Simulate 2-Wire Transmitter

%FLOW OUTPUT	LOW LIMIT	HIGH LIMIT	ACROSS ² 100 OHM	LOW ² LIMIT	HIGH ² LIMIT
100.00%DP	19.996	20.004	(2.0000V	1.9996	2.0004)
50.00	7.997	8.003	(0.8000	0.7997	0.8003)
0.00	3.998	4.002	(0.4000	0.3998	0.4002)

Power & Measure 2- Wire Transmitters

mA OUTPUT	LOW LIMIT	HIGH LIMIT	ACROSS ² 100 OHM	LOW ² LIMIT	HIGH ² LIMIT
24.000mA	23.995	24.005	(2.4000V	2.3995	2.4005)
20.000	19.996	20.004	(2.0000	1.9996	2.0004)
12.000	11.997	12.003	(1.2000	1.1997	1.2003)
4.000	3.998	4.002	(0.4000	0.3998	0.4002)
0.000	-0.002	0.002	(0.0000	-0.0002	0.0002)

SPECIFICATIONS

MODEL CL328 RANGES AND ACCURACIES

Source Volts			Read mA ³			
VOLT	LOW	HIGH	mA	LOW	HIGH	
OUTPUT LIMIT	LIMIT	LIMIT	INPUT LIMIT	LIMIT	LIMIT	
20.000V	19.996	20.004	52.00mA	51.99	52.01	
10.000	9.997	10.003	30.00	29.99	30.01	
5.000	4.998	5.002	24.000	23.995	24.005	
1.000	0.998	1.002	20.000	19.996	20.004	
0.000	-0.002	0.002	12.000	11.997	12.003	
			4.000	3.998	4.002	
			0.000	-0.002	0.002	
Source Millivolts			Read % 4-20 mA			
mV	LOW	HIGH	mA	%4-20mA	LOW	HIGH
OUTPUT LIMIT	LIMIT	LIMIT	INPUT	INPUT	LIMIT	LIMIT
999.90mV	999.70	1000.10	24.000mA	125.00%	124.97	125.03
500.00	499.86	500.14	20.000	100.00	99.97	100.03
100.00	99.91	100.09	12.000	50.00	49.98	50.02
10.00	9.92	10.08	4.000	0.00	-0.02	0.02
0.00	-0.08	0.08	0.000	-25.00	-25.01	-24.99
Read Volts ³			Read % DP Flow			
VOLT	LOW	HIGH	mA	%FLOW	LOW	HIGH
INPUT LIMIT	LIMIT	LIMIT	INPUT	INPUT	LIMIT	LIMIT
99.990V	99.970	100.010	20.000mA	100.0%DP	100.0	100.0
50.000	49.986	50.014	8.000	50.0	50.0	50.0
20.000	19.990	20.010	4.000	0.0	-1.2	1.2
10.000	9.991	10.009				
5.000	4.991	5.009				
1.000	0.992	1.008				
Read Millivolts ³			<div>¹Simulate 2-Wire Transmitter range is from 3.000 to 24.000 mA</div> <div>²100 Ohm resistor is used in the calibration procedure (See page 38)</div> <div>³LOW & HIGH LIMITS are identical for negative readings</div>			
mV	LOW	HIGH				
INPUT LIMIT	LIMIT	LIMIT				
999.90mV	999.70	1000.10				
500.00	499.86	500.14				
100.00	99.91	100.09				
10.00	9.92	10.08				
0.00	-0.08	0.08				

CALIBRATION PROCEDURE

SUGGESTED EQUIPMENT

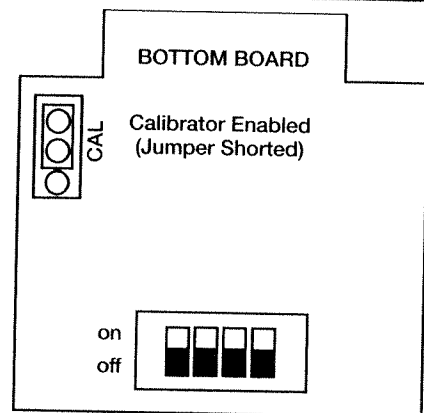
- 1) Digital voltmeter with accuracy of $\pm 0.003\%$ of reading at 2V and $\pm 0.005\%$ of reading at 100V
Important: The required accuracy is usually found only on meters with $7\frac{1}{2}$ or more digits
- 2) 100 Ohm laboratory standard resistor with accuracy of $\pm 0.003\%$
- 3) Adjustable DC Voltage source, 0 to 95.000 VDC with resolution of 0.001 V and 0.01 mV
- 4) Adjustable DC current source, 0 to 24.000 mA with resolution of 0.001 mA.

An $8\frac{1}{2}$ Digit Multimeter with DC current accuracy of ± 30 PPM may be substituted for items 1 & 2 to calibrate the mA ranges

Recommended calibration adjustments in this procedure have been calculated to $\frac{1}{2}$ of specification. See pages 36 & 37 for a table of published specifications which may be used to obtain "As Received" & "Adjusted" Test Data points.

ENABLING CALIBRATION

Allow one hour for the Model CL328 to stabilize to the ambient temperature of the calibration room. Remove the battery cover and the 4 black phillips head screws. While holding the CL328 face down in one hand carefully separate the top and bottom of the housing. Place the unit into calibration mode by placing the jumper located on the bottom board into the CAL position.



During calibration the top half of the CL328's LCD display prompts you with the input or output value being calibrated. The bottom half indicates the measurement computed by the Model CL328. When a pushbutton is pressed to store a calibration reading the value in the top half of the LCD flashes once. Please pause for 10 seconds before proceeding for the CL328 to compute the new calibration values.

CALIBRATION PROCEDURE

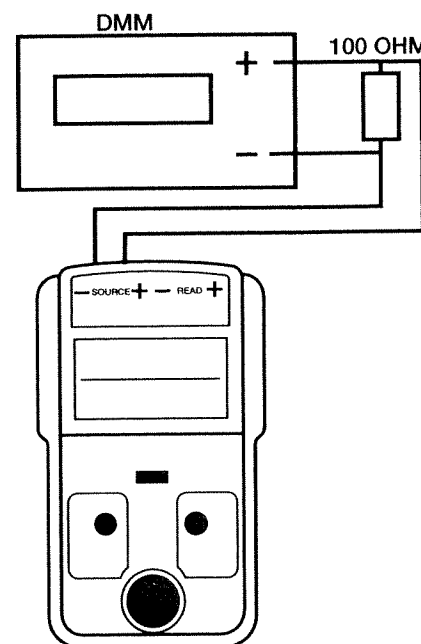
SOURCE MODE ADJUSTMENT

To change the output of the Model CL328 during the calibration of the SOURCE functions both coarse and fine adjustments are used. Place the *READ* toggle switch in the MAX position for coarse adjustment and move the *READ* toggle switch to the READ position for fine adjustment.

mA

- 1) Connect the Source leads in series with the 100 Ohm resistor. Connect the DVM parallel with the 100 Ohm resistor (See below).
- 2) Turn the unit on and wait for the unit to go into calibration mode (SOURCE and READ flashing).
- 3) Press the *STORE* pushbutton to select Source Mode.
- 4) Turn the Digital Pot (yellow knob) until mA is displayed and press the *STORE* pushbutton.
- 5) Dial the output with the READ toggle switch in the MAX position (coarse adjust) until the DVM displays approximately 0.0 V. Move the READ toggle switch to READ (fine adjust) until the DVM reads $0.0000V \pm 0.000096V$ and press the *STORE* pushbutton.
- 6) Dial the output (using the same coarse and fine adjustments) until the DVM reads $2.4000V \pm 0.00024V$ and press the *STORE* pushbutton.
- 7) Turn the unit off.

If calibrating with an 8^{1/2} digit multimeter directly in milliamps the calibration points are 0.000 mA $\pm 0.00096mA$ and 24.000 mA $\pm 0.0024mA$

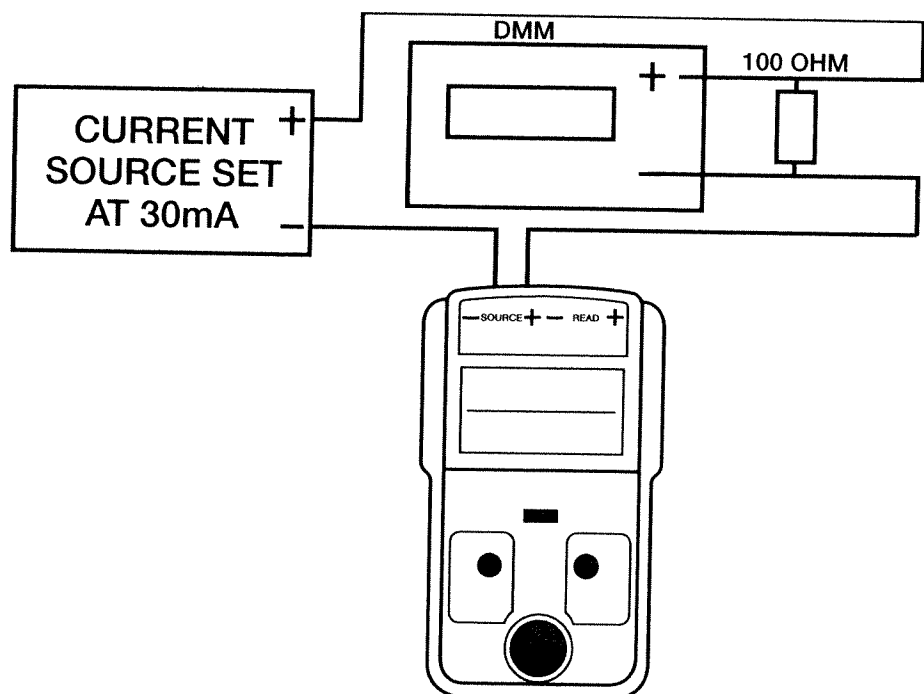


CALIBRATION PROCEDURE

SOURCE MODE ADJUSTMENT

2-Wire Sim

- 1) Connect the Source leads in series with the voltage source set to 24 VDC and the 100 Ohm resistor. Connect the DVM parallel with the 100 Ohm resistor (See below).
- 2) Turn the unit on and wait for the unit to go into calibration mode (SOURCE and READ flashing).
- 3) Press the *STORE* pushbutton to select Source Mode.
- 4) Turn the knob until 2-WIRE SIM is displayed and press the *STORE* pushbutton.
- 5) Disconnect the positive output lead from the 100 Ohm resistor and wait until the display reads 0.00 and press the *STORE* pushbutton.
- 6) Re-connect the positive output lead to the 100 Ohm resistor and dial the output until the DVM reads $2.4000V \pm 0.00024V$ and press the *STORE* pushbutton.
- 7) Turn the unit off.



CALIBRATION PROCEDURE

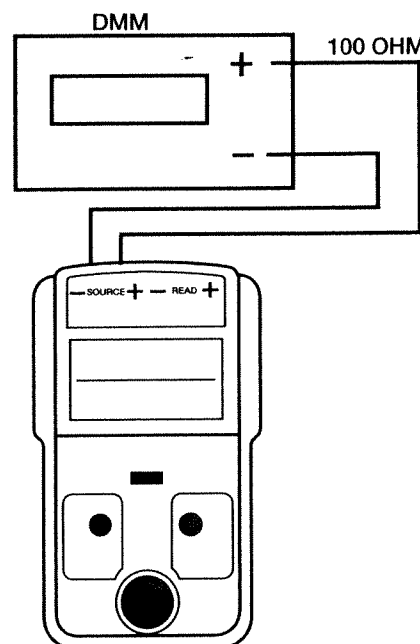
SOURCE MODE ADJUSTMENT

mV

- 1) Connect the Source leads to the DVM (See below).
- 2) Turn the unit on and wait for the unit to go into calibration mode (SOURCE and READ flashing).
- 3) Press the *STORE* pushbutton to select Source Mode.
- 4) Turn the knob until mV is displayed and press the *STORE* pushbutton.
- 5) Dial the output until the DVM reads $0.000\text{mV} \pm 0.040\text{mV}$ and press the *STORE* pushbutton.
- 6) Dial the output until the DVM reads $999.900\text{mV} \pm 0.100\text{mV}$ and press the *STORE* pushbutton.
- 7) Turn the unit off.

V

- 1) Leave the Source leads connected as in the mV calibration
- 2) Turn the unit on and wait for the unit to go into calibration mode (SOURCE and READ flashing).
- 3) Press the *STORE* pushbutton to select Source Mode.
- 4) Turn the knob until V is displayed and press the *STORE* pushbutton.
- 5) Dial the output until the DVM reads $0.0000\text{V} \pm 0.0008\text{V}$ and press the *STORE* pushbutton.
- 6) Dial the output until the DVM reads $20.0000\text{V} \pm 0.002\text{V}$ and press the *STORE* pushbutton.
- 7) Turn the unit off.
- 8) Disconnect the source leads from the DVM.

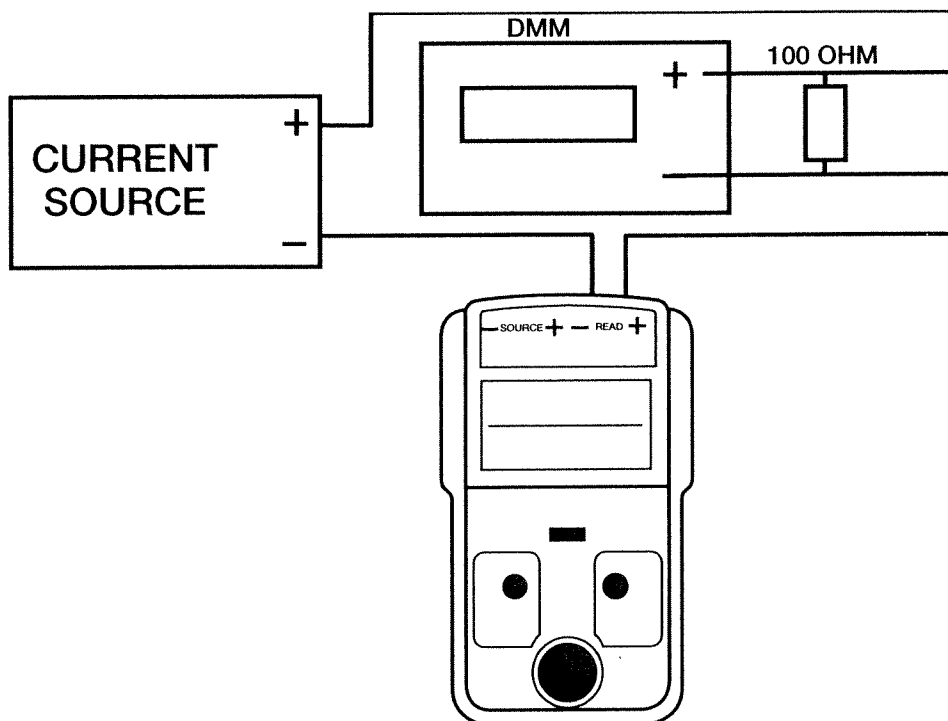


CALIBRATION PROCEDURE

READ MODE ADJUSTMENT

mA

- 1) Connect the Read leads to a current source in series with a 100 Ohm resistor. Monitor the current by placing a DVM across the 100 Ohm resistor (See below).
- 2) Turn the unit on and wait for the unit to go into calibration mode (SOURCE and READ flashing).
- 3) Press the *RESET* pushbutton to select Read mode.
- 4) Dial the unit so mA is displayed and press the *RESET* pushbutton.
- 5) Set the current source to 0.000mA so that the DVM reads $0.0000V \pm 0.000096V$ and press the Read store pushbutton.
- 6) Set the current source to 24.000mA so that the DVM reads $2.4000V \pm 0.00024V$ and press the *RESET* pushbutton.
- 7) Turn the unit off.



CALIBRATION PROCEDURE

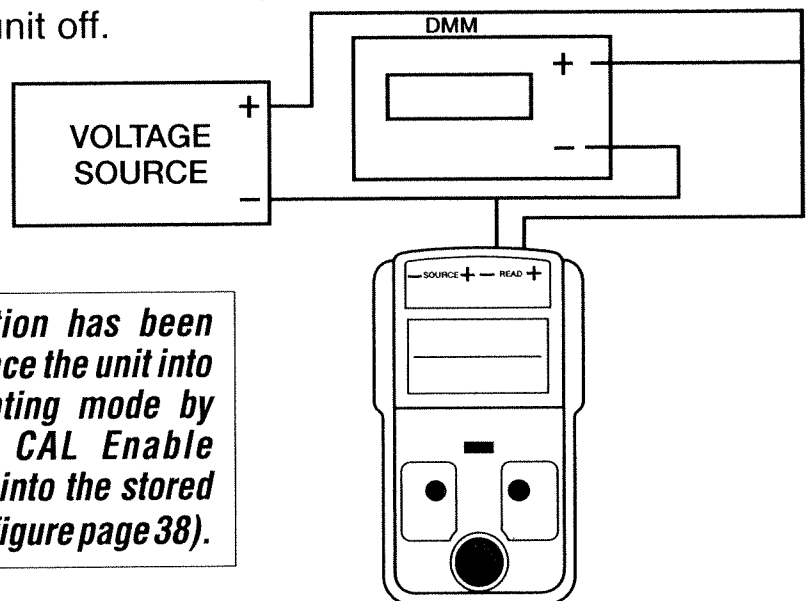
READ MODE ADJUSTMENT

mV

- 1) Connect the Read leads to a voltage source and place the DVM across the voltage source (See below).
- 2) Turn the unit on and wait for the unit to go into calibration mode (SOURCE and READ flashing).
- 3) Press the *RESET* pushbutton to select Read mode.
- 4) Dial the unit so mV is displayed press the *RESET* pushbutton.
- 5) Set the voltage source to 0.00mV so that the DVM reads $0.000\text{mV} \pm 0.040\text{mV}$ and press the *RESET* pushbutton.
- 6) Set the voltage source to 999.90mV so that the DVM reads $999.90\text{mV} \pm 0.100\text{mV}$ and press the *RESET* pushbutton.
- 7) Turn the unit off.

V

- 1) Leave the Read leads connected as in the mV calibration
- 2) Turn the unit on and wait for the unit to go into calibration mode (SOURCE and READ flashing).
- 3) Press the *RESET* pushbutton to select Read mode.
- 4) Dial the unit so V is displayed and press the *RESET* pushbutton to select V.
- 5) Set the voltage source to 0.000V so that the DVM reads $0.0000\text{V} \pm 0.004\text{V}$ and press the *RESET* pushbutton.
- 6) Set the voltage source to 95.000V so that the DVM reads $95.0000\text{V} \pm 0.0097\text{V}$ and press the *RESET* pushbutton.
- 7) Turn the unit off.



After calibration has been completed place the unit into normal operating mode by placing the CAL Enable jumper back into the stored position (See figure page 38).

WARRANTY

OMEGA ENGINEERING, INC. warrants this unit to be free of any defects in materials and workmanship for a period of 37 months from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal three (3) year product warranty to cover handling and shipping time. This ensures that OMEGA'S customers receive maximum coverage on each product.

If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA'S Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. OMEGA'S WARRANTY does not apply to defects resulting from action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture, vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA'S control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of various products. However, OMEGA neither assumes responsibility for any omission or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only the parts manufactured by it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive and total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

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■ TEMPERATURE

Thermocouple, RTD & Thermistor Probes & Assemblies
Connector Systems & Panels
Wire: Thermocouple, RTD and And Thermistor
Calibrators and Ice Point References
Recorders, Controllers and Process Monitors
Data Aquisition Modules and Data Loggers
Computer Sensor Interface

■ PRESSURE/STRAIN

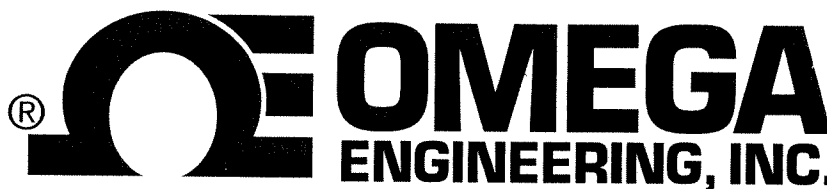
Transducers
Strain Gauges
Load Cells
Pressure Gauges
Instrumentation

■ FLOW

Rotameters
Flowmeter Systems
Air Velocity Indicators
Turbine/Paddlewheel Systems
Vortex Meters and Flow Computers

■ pH

Electrodes
Benchtop/Laboratory
Meters
Controllers
Calibrators/Simulators
Transmitters



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