L40

UNIVERSAL ANALOG INPUT DIGITAL PANEL METER

OWNERS MANUAL

CE RoHS

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1. ORDERING GUIDE

Configure a model number in the format below, where ordered items are separated by commas:

Example: L40, JS, CP, RL1, RL2, CASE1

Set jumpers for 4-20 mA input. Scale display so that 4 mA =0, 20 mA = 500.0

☐ **L40**…….**Digital panel meter** for 65 user-selectable analog signal types and ranges. Includes power from 18-265 Vac/dc. Shipped with factory default settings for 0-400 Vac input, display 0-400.

☐ **FS**……. ... **Jumper setting & front panel programming.** Done by vendor as a service. Specify the signal type and range. For DC, AC, process and resistance signals which require scaling, specify min input, min reading, and max input, max reading. For temperature, specify 1° or 0.1° resolution and °C or °F. For NTC thermistors, specify R25 and beta.

☐ **Slot 1 Option Board.** Shipped installed in meter. Select maximum of 1 board.

A1 ..... Single 8A relay for Slot 1

M1 ..... Isolated, scalable 4-20 mA output

S1..... Isolated RS485 output, Modbus RTU

☐ **Slot 2 Option Board.** Shipped installed in meter. Requires Slot 1 option board to be present.

A2 ..... Single 8A relay for Slot 2

Add-on Options & Accessories

☐ **NL** ..... Front panel with button pads but no Laurel logo.

☐ **BL** ..... Front panel without button pads or Laurel logo.

☐ **IPC** ..... Splash-proof front panel cover.

☐ **BOX1** ..... NEMA-4 wall-mount enclosure.

☐ **BOX2** ..... BOX1 plus IPC.

☐ **CASE1** .... Benchtop case for one 1/8 DIN meter.

☐ **CASE2** .... Benchtop case for two 1/8 DIN meters.

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2. TABLE OF CONTENTS

3. PRODUCT INTRODUCTION

Model L40 is a low-cost, universal analog input meter which offers 65 user-selectable analog input types and ranges. User-selectable input types are DC voltage and current, true AC RMS voltage and current, process signals (4-20 mA, 0-10V), thermocouple (10 types, °C or °F), RTD (6 types, °C or °F), NTC and PTC thermistors, resistance (0-10k or 0-100k ohms), and a potentiometric input. The same meter handles all of these signal types with no need for a plug-in signal conditioner board. The meter's universal power supply accepts voltages from 18V to 265V, AC or DC, so that power can be from AC in any country or from 24 Vdc industrial supplies. A 5V or 15V excitation output is user-selectable. The meter conforms to the popular 1/8 DIN size standard and features four 14.2 mm (0.56") red LED digits. The display is user scalable for all input types other than temperature.

The base L40, as shipped by Laurel, is set up so that a 0-400 Vac input reads 0-400. To change that default range, pry off the meter faceplate, push out the electronics, and move one or two jumpers depending on the range, as explained in this manual. Make software selections using front panel keys after reassembling the meter. If you want Laurel or your distributor to set the jumpers and do the programming, order the FS option.

Selectable software features add flexibility to this low cost meter. Programmable features include five levels of display brightness, min and max capture, dual scaling selectable by an external control input, a deadband around 0 for AC measurements, a moving average digital filter, a "count by" function, hysteresis for alarm operation, a user-configurable fast access menu, and selectable password protection.

Optional output boards can be plugged in at any time and provide additional flexibility:

- **A first option slot** accepts one of three available plug-in boards. These are a single 8A relay board, an isolated active or passive 4-20 mA analog output board, and an isolated Modbus RTU compatible RS485 serial data output board.
- **A second option slot** accepts an 8A relay board, which plugs into a first slot option board if installed. For example, this allows an L40 to have and analog output and a relay output, or to have two relay outputs.

Advanced standard features include:

- Front panel UP key configurable for fast access to alarm setpoints.
- Eco mode to reduce power consumption.
- Simplified scaling configuration.
- External contact closure control input with programmable function.
- Five user-selectable display brightness levels.

4. RECEIVING & UNPACKING

Your meter was carefully tested and inspected prior to shipment. Should the meter be damaged in shipment, notify the freight carrier immediately. In the event the meter is not operable, contact your seller and return the meter for repair or replacement. Please include a detailed description of the problem.

5. SAFETY CONSIDERATIONS

Warning: Your meter was tested to conform to the safety requirements of CE 61010-1. Use of the meter in a manner other than specified may impair the safety of the device and subject the user to a hazard. Visually inspect the unit for signs of damage. If the unit is damaged, do not attempt to operate.

Cautions:

- The instrument must be connected to a disconnect switch or a branch-circuit breaker, which must be in a suitable location
- The instrument can be powered by 18-265 Vac/dc. Verify that the voltage to be applied is within this range. This instrument has no On/Off switch. It will be in operation as soon as power is connected.
- This instrument is rated for signals as high as 400 Vac. Signal lines for such high voltages represent a safety hazard and should only be installed by a properly trained technician.
- Do not make signal connections or signal wiring changes while power is applied to the meter or while high voltages are applied to signal lines. Always remove power from the meter or signal lines before handling.
- To prevent electrical or fire hazard, do not expose the meter to excessive moisture. Do not operate the instrument in the presence of flammable gases or fumes.
- This meter is designed to be mounted in a metal panel or a bench or wall mount style case. The spacing around the meter and the ventilation must be sufficient to maintain the ambient temperature at less than 50°C.
- Verify panel cutout dimensions, and mount according to instructions.

Symbols used


Caution (refer to accompanying documents)


Caution, risk of electric shock.


Equipment protected throughout by double insulation or reinforced insulation.

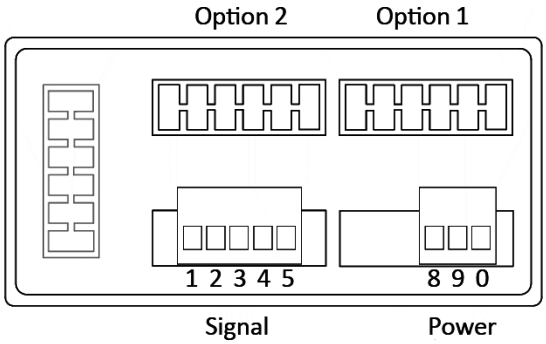

Earth (ground) terminal.


Both direct and alternating current.

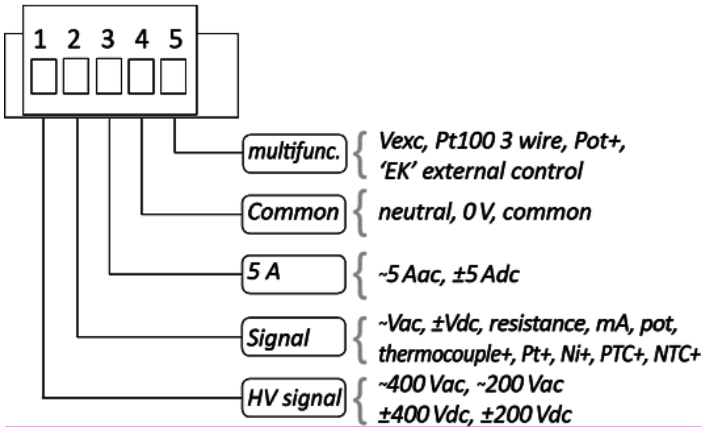
Operating environment:

The meter is Class II (double insulated) equipment designed for Pollution degree 2.

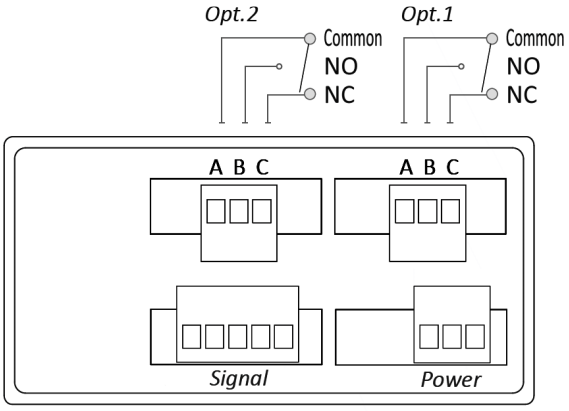
6. CONNECTOR WIRING OVERVIEW



Instrument Rear view

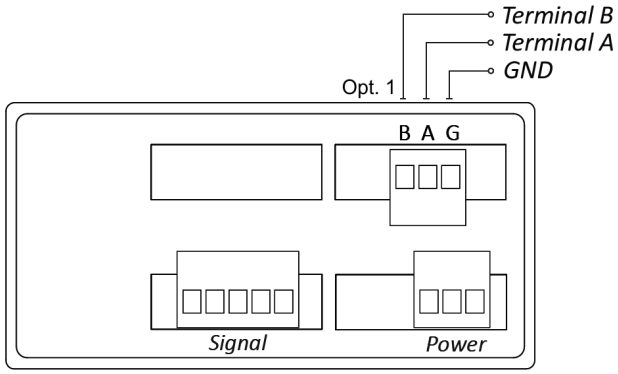


Signal Connections

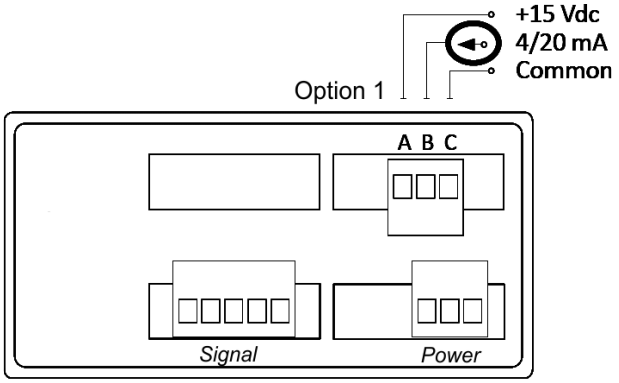


Terminal A	*Common*
Terminal B	*NO - Normally open*
Terminal C	*NC - Normally closed*

Relay Connections (optional)

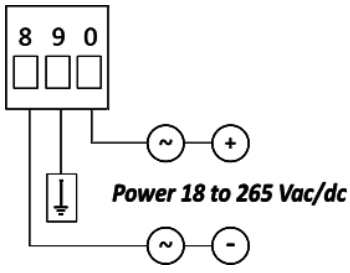


RS485 Connections (optional)



Terminal A	***Vexc +15 Vdc***
Terminal B	***Signal in mA***
Terminal C	***Common***

Analog Output Connections (optional)



UL 61010-1 requires a 250 mA slow-blow fuse for power > 50 Vac/dc, or a 400 mA slow-blow fuse for power < 50 Vac/dc.

Power Connections

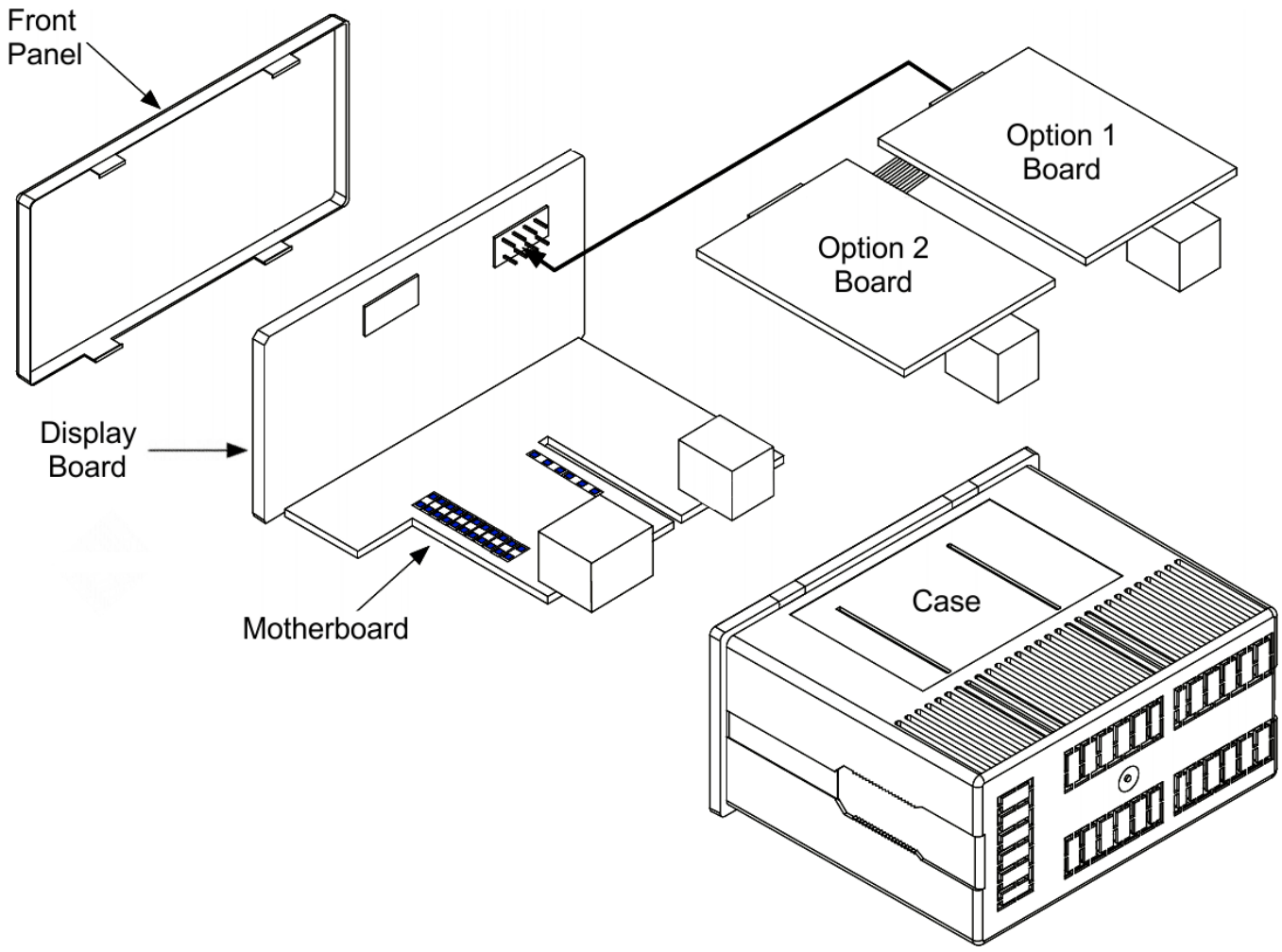
7. Factory Default Settings

Unless the JS customer jumper setting option or the CS jumper setting and programming option has been ordered, out-of-the-box L40 units are set up with the following factory default settings:

Range ..... 400 Vac
Scaling and decimal point: ..... 0 to 400 Vac = 0 to 400
Alarms 1 & 2:
Type ..... Alarm as maximum
  Setpoint 1000
  Hysteresis ..... 0 counts
External control ..... Off
Fast access ..... All off
Tools:
  Option 1 ..... Off
  Step 1
  Average 0
  Reading offset 0
  Scaling ..... 0 to 400
  Eco mode ..... Off
  Temperature resolution 1º
  Degrees ..... ºC
  RTD alpha 385
  TC cold junction ..... Auto
  AC deadband 20
  Brightness level ..... 3 (out of 5)
  Password ..... Off
Option 1 configuration:
  Analog output ..... 0-100.0 = 4-20 mA
  RS485 Modbus RTU ..... 9600 bps, address 1, format 8n1
Jumpers:
  Jumpers S ..... Set for 400 Vac
  Jumper T ..... Set for EK external control

Implementing settings other than the above factory default setting requires opening the case, setting jumpers on the Main Board, and programming parameters using front panel keys, as explained in this manual.

8. Output & Control Module Overview



An Electronics Main Assembly is standard. It consists of a large horizontal Motherboard, which includes a Universal Power supply for 18-265 Vac/dc, and which performs signal conditioning and processing for all selectable signal types. Soldered to the Motherboard is a vertical Display Board, which holds the meter's LEDs and pushbuttons.

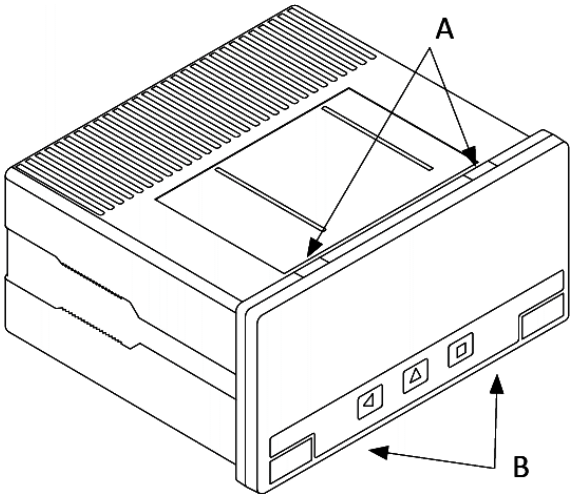
An Option 1 Board can plug into the Display Board. This can be a single 8A relay board, an isolated active or passive 4-20 mA analog output board, or an isolated Modbus compatible RS485 serial data output board.

An Option 2 Board can plug into the Option 1 Board if installed. This is another single 8A relay board. For example, use of this second board allows an L40 to have and analog output and a relay output, or to have two relay outputs.

9. Opening the Case and Setting Jumpers

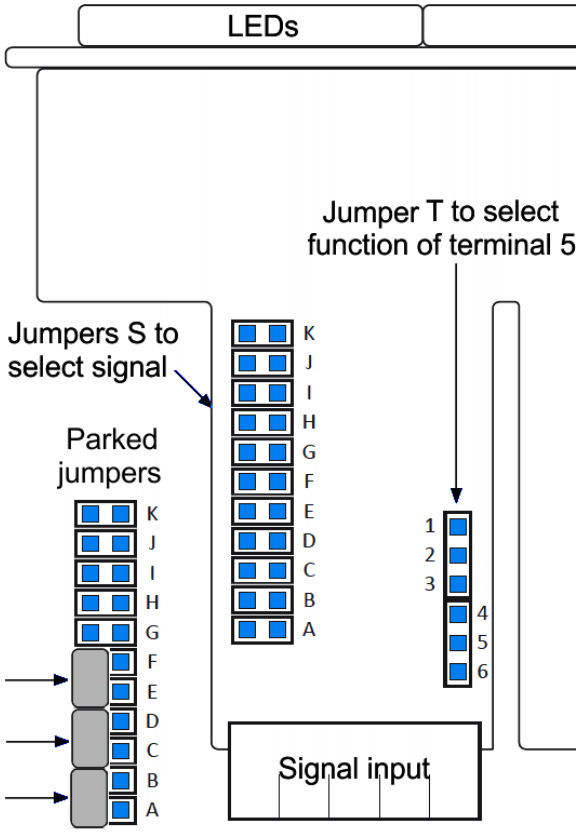
The case has to be opened and jumpers need to be placed to select signal types and ranges other than the factory default setting of 400 Vac.

To open the case, unplug all screw-clamp connectors. Use a flat-blade screwdriver to lift up and unsnap the two tabs A that hold the top of the front cover. Turn the case over and repeat for the two tabs B that hold the bottom of the front cover. The front cover will then come off.



Press on the large green connector in the middle bottom of the rear of the case to push out the electronics Main Assembly through the front of the case. Do this carefully, so that any options boards remain seated in their grooved slots in the plastic case. This will facilitate reseating of the Main Assembly.

Note that all boards fit into grooved slots molded into the case. These ensure perfect alignment for electrical connections. An Option 2 board plugs into an Option 1 board if present. For assembly, these two boards are first interconnected and then slid into their grooves.



The horizontal Motherboard has a jumper pin forest labeled S to select the signal type and one labeled T to select the function of multi-function input terminal 5. Refer to the illustration to the right and to the next page to place your jumpers. Also refer to the signal input sections of this manual.

Park any unused jumpers in the no-contact positions illustrated by arrows to the lower left.

Once jumpers have been set, reseat the Main Assembly and snap the front panel back on. You should hear a loud click as each tab is seated, and there should be no more gaps between the front cover and case. Re-attach the screw-clamp connectors when done.

Jumper Table

AC voltage & current	Jumpers S	Jumper T
400 Vac	G I	4-5
200.0 Vac	I	
20.00 Vac	A I	
2.000 Vac	B I	
200.0 mAac	C I	
60.00 mAac	E I	
5.00 Aac	I	
20.00 mAac	D I	

DC voltage & current	Jumpers S'	Jumper T
±400 Vdc	G	4-5
±200.0 Vdc	---	
±20.00 Vdc	A	
±2.000 Vdc	B	
±200.0 mAdc	C	
±60.00 mAdc	E	
±5.00 Adc	---	
±20.00 mAdc	D	

Process signals	Jumpers S	Jumper T
4-20 mA	D	1-2 for 15V excitation output 4-5 for external control input
0-10 Vdc	A	
Potentiometer follower	A	2-3 for 5V excitation output

Resistance	Jumpers S	Jumper T
0-9.999 kΩ	F H K	4-5
0-99.99 kΩ	F K	

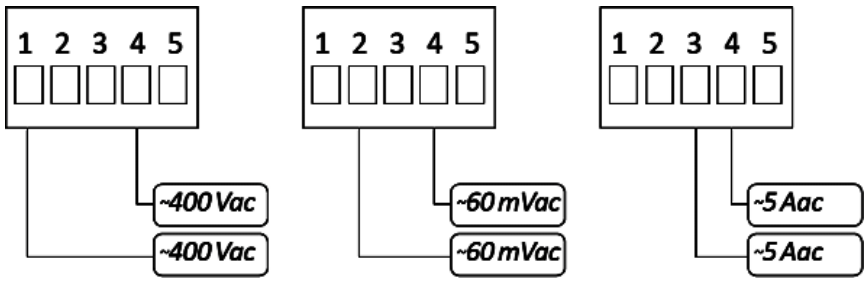
Thermocouple	Jumpers S	Jumper T
TC Types K J E N L C	E	4-5
TC Types R S B T	E J	

RTD	Jumpers S	Jumper T
Pt100 (3 wires)	F H J	5-6
Pt100 (2 wires), Ni100, Ni200	F H	4-5
Pt500, Pt1000, Ni1000	F	

Thermistor	Jumpers S	Jumper T
NTC Type	F K	4-5
PTC KTY 121	F	
PTC KTY 210, 220	F H K	

10. True RMS AC Voltage or Current Input

True RMS voltage and current ranges: The L40 computes true RMS. The meter's factory default signal range is 400 Vac. A total of 6 voltage ranges and 2 current ranges are jumper selectable. The 400 Vac range is suitable for 480 Vac 3-phase measurements, but can only be CE safety rated to 400 Vac due to a 3 mm creepage distance. The 200 Vac range is suitable for 24 or 48 Vac lines. The 60 and 200 mV ranges can be scaled for use with current shunts, which have a typical FS output of 50, 60 or 100 mV. The 5A current range can be used directly or be scaled with current transformers (CTs) to display currents up to 9999A.



Display scaling: AC voltage or current signals can be scaled to produce readings from -1999 to 9999 with any decimal point. The meter's first or second scaling method can be selected using the meter's external control input.

Deadband: AC voltages or currents below a deadband are displayed as 0. Deadband values are programmable from 0 to 100. The factory default value is 20. Increase this value to increase deadband, decrease it to decrease deadband.

Max signal: Accuracy is rated up to the top of each Vac or Aac range. Higher signals up to "Max signal" can safely be applied, but may be out of accuracy specifications. Signals higher than "Max signal" may cause permanent damage to the instrument.

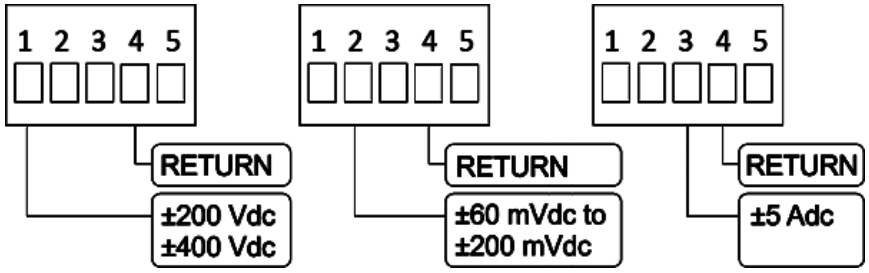
Response time to step signal: 300 ms regardless of selected range.

Vac ranges (Vrms)	FS default reading	Jumpers S	Jumper T	Accuracy (% of FS)	Max signal	Input resistance
400 Vac	400	G I	4-5	< 0.30%	800 Vac	12 MΩ
200 Vac	200.0	I		< 0.30%	800 Vac	12 MΩ
20 Vac	20.00	A I		< 0.30%	150 Vac	1 MΩ
2 Vac	2.00	B I		< 0.30%	100 Vac	100 kΩ
200 mVac	200.0	C I		< 0.30%	30 Vac	10 kΩ
60 mVac	60.0	E I		< 0.30%	3 Vac	1 MΩ

Aac ranges (Arms)	FS default reading	Jumpers S	Jumper T	Accuracy (% of FS)	Max signal	Input resistance
5 Aac	5.00	I	4-5	< 0.5%	7 A max 7 sec	20 mΩ
20 mAac	20.00	D I		< 0.5%	25 mAac	4.7 Ω

11. DC Voltage or Current Input

DC voltage and current ranges: A total of 6 voltage ranges and 2 current ranges are jumper selectable. Applications include the measurement of 12 or 24 Vdc battery voltages, and other DC sources up to 400 V. The 60 and 200 mV ranges are can be scaled for use with current shunts, which have a typical FS output of 50, 60 or 100 mV. The 20 mA and 20V ranges are ideal for use with process signals.



Display scaling: DC voltage or current signals can be scaled to produce readings from -1999 to 9999 with any decimal point. The meter's first or second scaling method can be selected using the meter's external control input. Scaling allows DC process signals to be converted to readings in engineering units.

Process signals: Use the ± 20 mAdc range with offset and scaling for 4-20 mA process signals. Use the ± 20 Vdc range with scaling for 0-10V process signals. See the next page for use with process signals. All DC signal ranges are bipolar for positive and negative signals.

Max signal: Accuracy is rated up to the top of each Vdc or Adc range. Higher signals up to "Max signal" can safely be applied, but may be out of accuracy specifications. Signals higher than "Max signal" may cause permanent damage to the instrument.

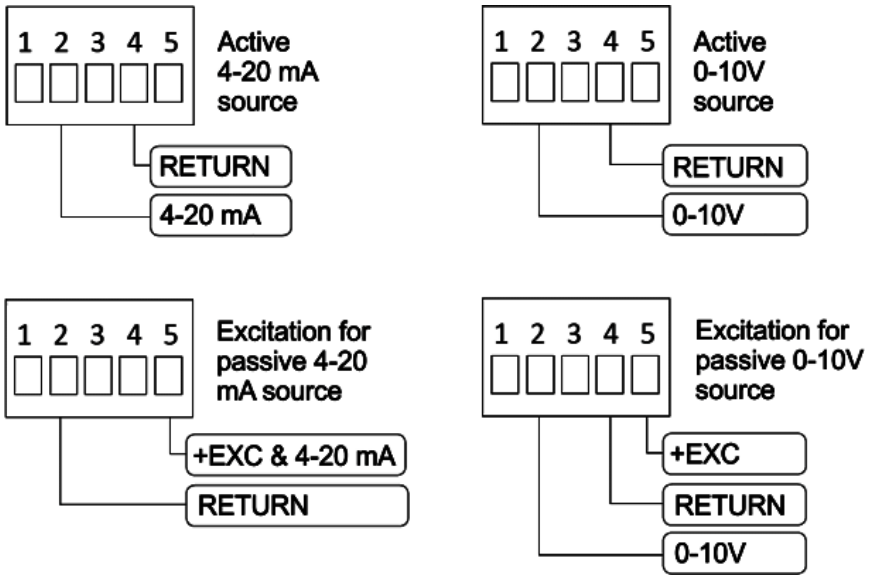
Response time to step signal: 300 ms regardless of selected range.

Vdc ranges	FS default reading	Jumpers S	Jumper T	Accuracy (% of FS)	Max signal	Input resistance
± 400 Vdc	400	G	4-5	< 0.20%	800 Vdc	12 MΩ
± 200 Vdc	200.0	---		< 0.20%	800 Vdc	12 MΩ
± 20 Vdc	20.00	A		< 0.20%	150 Vdc	1 MΩ
± 2 Vdc	2.00	B		< 0.20%	100 Vdc	100 kΩ
± 200 mVdc	200.0	C		< 0.20%	30 Vdc	10 kΩ
± 60 mVdc	60.0	E		< 0.25%	3 Vdc	1 MΩ

Adc ranges	FS default reading	Jumpers S	Jumper T	Accuracy (% of FS)	Max signal	Input resistance
± 5 Adc	5.00	- - -	4-5	< 0.25%	7 A max 7 sec	20 mΩ
± 20 mAdc	20.00	F	1-2 for Vexc 4-5 no Vexc.	< 0.15%	25 mAdc	4.7 Ω

12. Process Signal Input

Process Signals: Process signals as defined for the L40 are the 4-20 mA or 0-10V DC signals that are produced by transducers and transmitters for physical parameters such as pressure, level, temperature, etc. Such signals require scaling for display in engineering units.



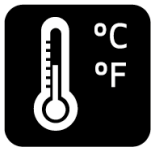
Display scaling: Process signals can be scaled to produce readings from -1999 to 9999 with any decimal point. The factory default scaling is 0-100.0%. In addition to a first scaling, a second scaling can be set up in software and be invoked by grounding multi-function terminal 5. This requires that Jumper T be set to 4-5 and that second scaling be enabled in software.

Excitation output: A 15 Vdc, 30 mA transducer excitation output is available at multi-function terminal 5. This requires that Jumper T be set to 1-2 as opposed to the normal 4-5. Please see the diagrams below for electrical connections.

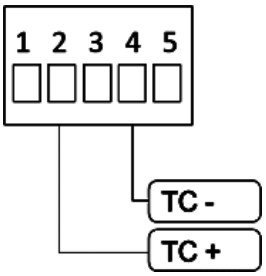
Response time to step signal: 300 ms

Signal range	Default scaling	Jumper S	Jumper T	Accuracy (% of FS)	Max signal	Input resistance
4-20 mA	0-100.0	D	4-5 or 1-2	< 0.15%	25 mA	4.7 Ω
0-10 Vdc	0-100.0	A	4-5 or 1-2	< 0.20%	25 Vdc	1 MΩ

13. Thermocouple Input



Ten thermocouple types: The L40 can be jumpered and programmed to read type K, J, E, N, L, R, S, B, T and C thermocouples for display of temperature in degrees C or F.



Cold junction compensation: Internal cold junction compensation is selected by default, but can be disabled from the configuration menu to allow external cold junction compensation.

Units and resolution: 1°C or 1°F as programmed.

Sensor break detection: Display of “h.ovr” or “h.udr” depending on the broken cable.

Response time to step signal: 300 ms

Long cable runs: Keep total resistance under 100 ohms. Use shielded cable to minimize electrical noise pickup.

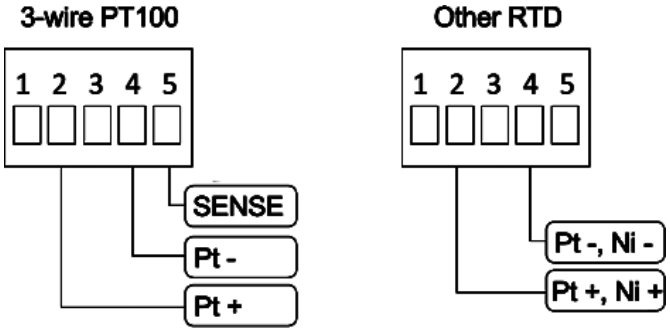
Accuracy: Read errors include measurement of the thermocouple’s emf voltage, conformity error (the difference between the meter reading and the temperature stated in NIST Monograph 125 for a specified thermocouple type), and the error in cold junction temperature measurement by the meter’s built-in solid state sensor. Add 3°C to the errors shown for temperatures below -50°C and above 1000°C. Not included are thermocouple wire errors caused by variations in commercial thermocouple alloys. There are variations from manufacturer to manufacturer, from batch to batch, and within batches.

TC Type	Range °C	Range °F	Accuracy	Jumpers S	Jumper T
Type K	-100 to 1350°C	-148 to 2462°F	< 3°C	E	4-5
Type J	-100 to 1200°C	-148 to 2192°F	< 3°C	E	
Type E	-100 to 1000°C	-148 to 1832°F	< 3°C	E	
Type N	-100 to 1300°C	-148 to 2372°F	< 3°C	E	
Type L	-100 to 900°C	-148 to 1652°F	< 3°C	E	
Type C	0 to 2300°C	32 to 4172°F	< 5°C	E	
Type R	0 to 1768°C	32 to 3214°F	< 3°C	E & J	
Type S	0 to 1768°C	32 to 3214°F	< 3°C	E & J	
Type B	700 to 1820°C	1292 to 3308°F	< 5°C	E & J	
Type T	-100 to 400°C	-148 to 752°F	< 3°C	E & J	

14. RTD Input (Pt and Ni Probes)

Pt and Ni Probes: The L40 can be jumpered and programmed to read Pt100, Pt500 or Pt1000 platinum RTD temperature probes, also Ni100, Ni200 or Ni1000 nickel RTD temperature probes, for display of temperature in degrees C or F.

Platinum RTD alpha: 0.00385 (IEC) or 0.00390 (ANSI) are user selectable.



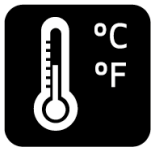
Provision for lead wire resistance: A 3-wire connection is jumper selectable with Pt100 RTDs to subtract lead wire resistance. If a 2-wire connection is used, the instrument allows a fixed number of counts to be subtracted from the resistance reading. This is done with the programmable “oPFFS” offset parameter.

Units and resolution: 1°C, 0.1°C, 1°F, or 0.1°F, as programmed.

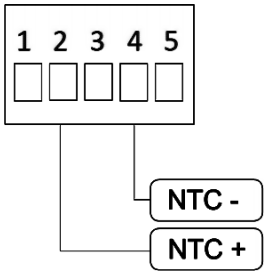
Sensor break detection: Display of “h.ovr” or “h.udr” depending on the broken cable.

RTD Type	Range °C	Range °F	Excitation Current	Accuracy	Jumpers S	Jumper T
Pt100 (3 wires)	-200 to 700°C	-328 to 1292°F	< 900 µA	< 1°C	F H J	5-6
Pt100 (2 wires)	-200 to 700°C	-328 to 1292°F	< 900 µA	< 1°C	F H	4-5
Pt500	-150 to 630°C	-238 to 1166°F	< 90 µA	< 1°C	F	
Pt100	-190 to 630°C	-310 to 1166°F	< 900 µA	< 1°C	F	
Ni100	-60 to 180°C	-76 to 356°F	< 900 µA	< 1°C	F H	
Ni200	-60 to 120°C	-76 to 248°F	< 900 µA	< 1°C	F H	
Ni100	-60 to 180°C	-76 to 356°F	< 900 µA	< 1°C	F	

15. NTC and PTC Thermistor Input



NTC Thermistor Probes: The L40 can be jumpered and programmed to read temperature from a wide range of NTC thermistor elements, which have a negative temperature coefficient (NTC) of resistance. Such elements have curved line relationship between temperature and resistance as defined by the Steinhart-Hart equation. Knowing the resistance R_{25} at 25°C (such as 10 kΩ) and a parameter named Beta allows the meter to display temperature for any measured resistance from 100 Ω to 100 kΩ.



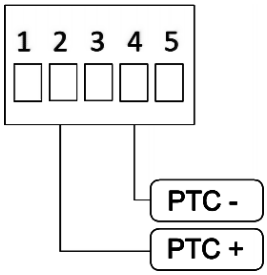
NTC probe types: To see if the L40 is compatible with specific NTC thermistor type, check the thermistor data sheet and note the parameters R_{25} and Beta. The instrument can be programmed for Beta values from 2000 to 5500 and accommodates resistances from 100 Ω to 100 kΩ.

Units and resolution: 1°C, 0.1°C, 1°F, or 0.1°F, as programmed.

Sensor break detection: Display of “h.ovr” or “h.udr” depending on the broken cable.

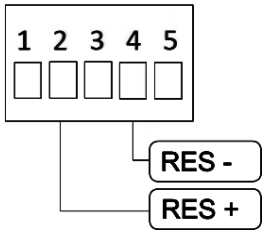
R_{25} Values	Beta Values	Resolution	Accuracy	Jumpers S	Jumper T
100 Ω to 100 kΩ	2000 to 5500	1° or 0.1°, °C or °F	< 1.5% of resistance	F & K	4-5

PTC Thermistor Probes: The L40 can be jumpered and programmed to read temperature from specific types of PTC thermistor elements, which have a positive temperature coefficient (PTC) of resistance. Please see the table below for the list of compatible PTC thermistor types.



PTC Family	Sensor Model	Range	Accuracy	Jumpers S	Jumper T
KTY 121	KTY81-121 KTY82-121	-55 to 150°C -67 to 302°F	< 1°C	F	4-5
KTY 210	KTY81-210 KTY82-210			F H K	
KTY 220	KTY81-210 KTY82-210			F H K	

16. Resistance Input



Resistance ranges: The L40 can be jumpered and programmed to read resistance in two ranges: from 0 to 10 kΩ and 0 to 100 kΩ.

Provision for lead wire resistance: A simple 2-connection is used from meter to the resistance under test. To compensate for errors caused by lead wire resistance, the instrument allows a fixed number of counts to be added or subtracted from the reading. This is done with the programmable "oPFFS" offset parameter.

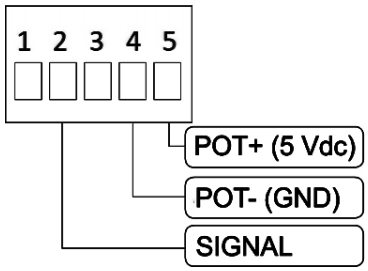
Scaling: The measured resistance can be scaled for readings from -1999 to 9999 with a selectable decimal point.

Response time to step signal: 300 ms

Sensor break detection: Display of "h.ovr" or "h.udr" depending on the broken cable.

Resistance range	Default scaling	Bias current	Accuracy	Jumpers S	Jumper T
0 to 5 kΩ	0 to 5.000	926 to 64 µA	< 0.5% FS	F H K	4-5
0 to 50 kΩ	0 to 50.000	86 to 20 µA	< 0.5% FS	F K	

17. Potentiometer Input



Potentiometric Signals: In potentiometric (or pot follower) applications, the L40 applies a 5 Vdc excitation voltage across a 3-wire potentiometer, and the signal to be measured is picked off by a wiper. The reading is in percent and is not affected by changes in excitation voltage. This technique is commonly used to measure linear or angular position.

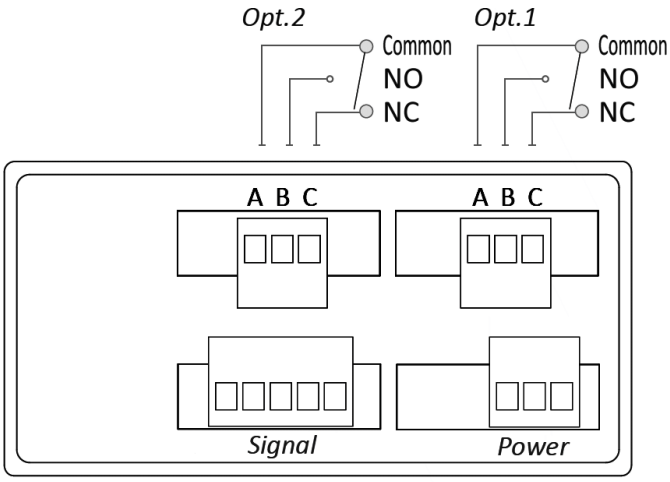
Display scaling: Potentiometric readings can be scaled to produce readings from -1999 to 9999 with any decimal point. The factory default scaling is 0-100.0%.

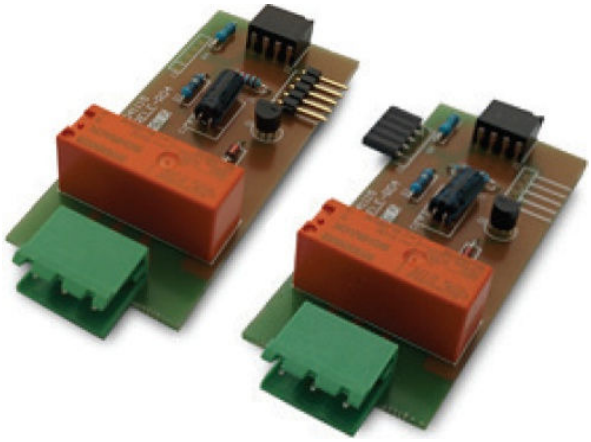
Excitation output: A +5V, 30 mA transducer excitation output is available at multi-function terminal 5. This requires that Jumper T be set to 1-2 as opposed to the normal 4-5.

Response time to step signal: 300 ms

Potentiometer range	Default scaling	Potentiometer resistance	Accuracy	Jumper S	Jumper T
0 to 100%	0 to 100.0	500Ω to 20 kΩ	< 0.5% FS	A	2-3

18. A1 and A2 Relay Output Options





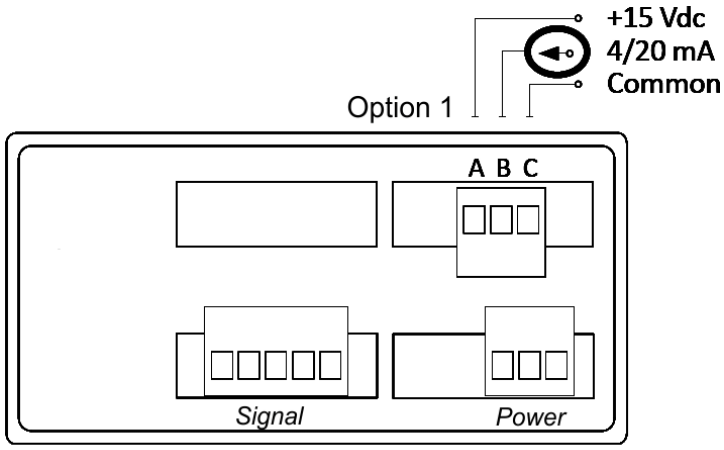
Terminal A *Common*
Terminal B *NO - Normally open*
Terminal C *NC - Normally closed*

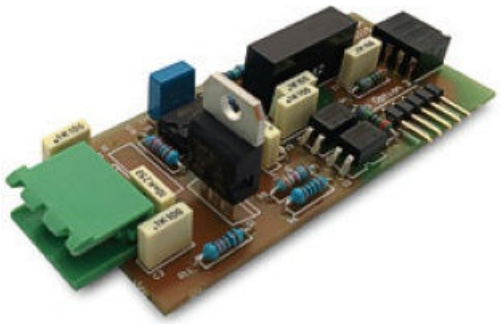
The optional A1 relay output module fits in Option Slot 1 and plugs into the display board. The A2 relay output module fits into Option Slot 2 and plugs into a Slot 1 option board, which must be present.

The A1 relay is controlled by alarm 1, and is configured from the Alarm 1 (Alr1) menu item. The A2 relay is controlled by alarm 2, and is configured from the Alarm 2 (Alr2) menu item. Each relay has 3 contacts (Common, Normally Closed, Normally Open) and accepts voltages up to 250V at 8A. The relay modules can be ordered installed or can be installed later. They do not require soldering or configuration.

Relay type ..... 3 contact relay (NC, NO, common)
Maximum voltage ..... 250 Vac continuous
Maximum current ..... 8A (resistive load)
Isolation ..... 2500 Vrms
Slots allowed ..... Slot 1 for RL1, Slot 2 for RL2

19. M1 Analog Output Option





Terminal A	*Vexc +15 Vdc*
Terminal B	*Signal in mA*
Terminal C	*Common*

The optional M1 module provides an isolated 4-20 mA analog output. It is installed in Option Slot 1 and plugs into the display board. The 4-20 mA signal is scalable with either a positive or negative slope, and is proportional to the reading of the instrument. A sourcing mode, where the modules powers the loop, or a passive sinking mode, where an external supply powers the loop, are selectable at the connector.

Output signal ..... 4-20 mA (active or passive)
Active sourcing mode ..... Connect terminal A (+15 Vdc) and B (mA), R_L < 350Ω
Passive sinking mode..... Connect terminal C (GND) and B (mA), R_L < 700Ω
Accuracy ..... < 0.5% FS
Isolation..... 1000 Vdc
Slot allowed..... Slot 1

Configuration and Calibration

1) If the M1 module came in the instrument, then it has already been factory calibrated as part of the instrument. Jump directly to 10) below.
2) If the M1 module is being installed for the first time, install it in Slot 1 and follow steps 3) through 9).
3) Locate the factory calibration sheet that came with the M1 module. This sheet shows the values for “cAL.y / 4mA” and “cAL.y / 20mA”.
4) From the Configuration menu, go to “tool \ out.1” and select “420” to inform the instrument that an M1 module is now installed.
5) The instrument will display “cAL.n” (do not calibrate). Press the Up ▲ key to change the display “cAL.y” (calibrate).

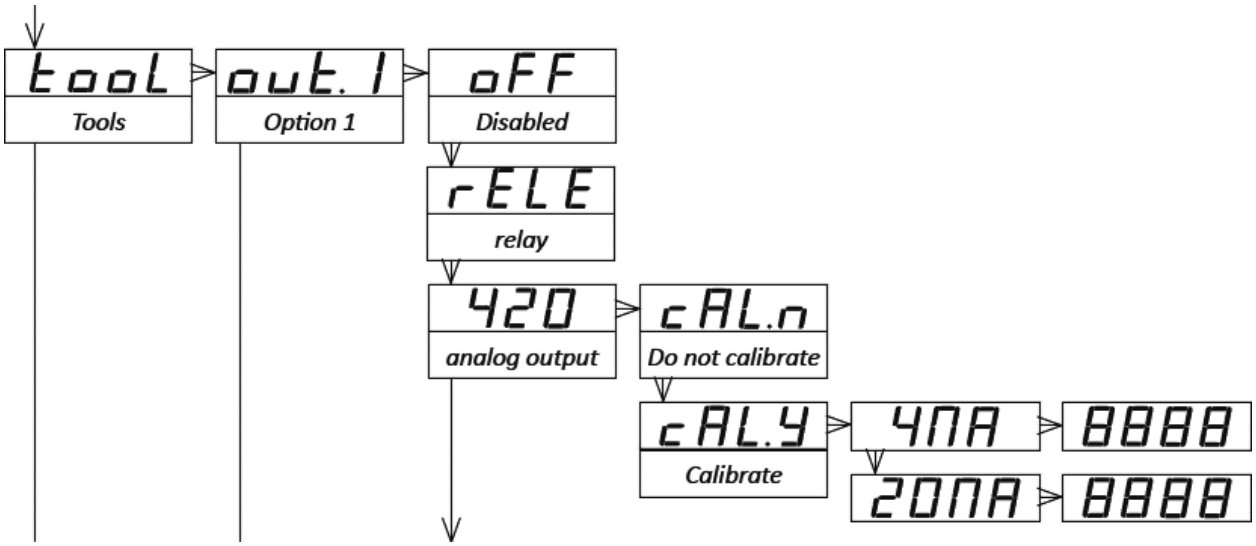
6) Select “4 mA”, and the display will show a number. Change that number to the one shown on the calibration sheet by using the Up ▲ key to increase or the Left ◀ key to decrease. Enter that value by pressing the ■ Square key.

7) Repeat for “20 mA”.

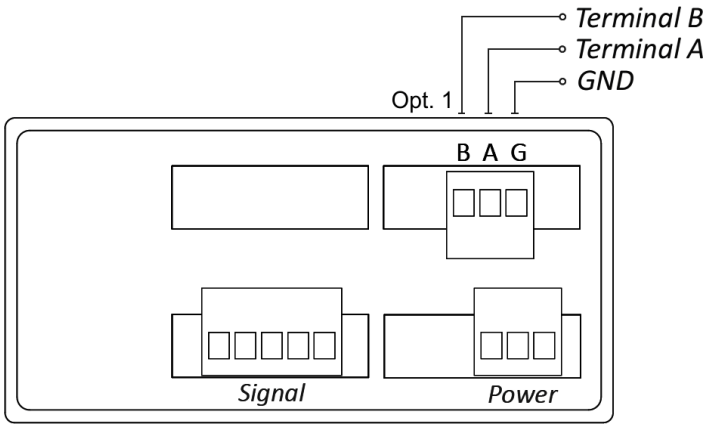
8) Press the Left ◀ key several times to exit the Configuration menu and cause the instrument to reboot with the new analog output calibration values.

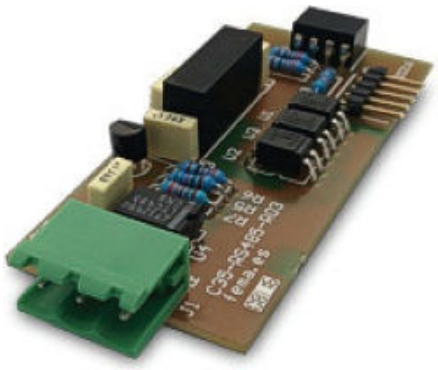
9) If you do not have the factory calibration sheet, use a milliammeter to measure the analog output. Access the parameters “cAL.y / 4mA” and “cAL.y / 20mA” to adjust the calibration values to obtain 4 mA and 20 mA.

10) Following calibration, enter the readings to be associated with the 4 mA and 20 mA analog outputs, as illustrated below.



20. S1 Serial Data Output Option





The optional S1 module provides an isolated Modbus RTU serial output. It is installed in Slot 1 and plugs directly into the display board. With only a single function (4 = read register), it is very easy to use.

Configuration is from the front panel through the configuration menu. The instrument must first be informed that there is an S1 module at Slot.1. This is done from configuration menu "Tool \ out.1". Then configure the bus parameters from configuration menu "out.1 \ 485".

The S1 module can be ordered installed in the L40 instrument or separately for later installation, as it does not require soldering or special configuration.

Bus type	RS485
Protocol	Modbus RTU
Baud rates	9600 bps, 4800 bps
Addresses	1 to 247
Formats	Configurable 8n1, 8e1, 8o1, 8n2
Functions	4 = read register
Registers	0 = reading value (16 bits) 1 = number of decimals (16 bits)
Errors	0 = function not supported 1 = register not accessible
Isolation	1000 Vdc
Slot allowed	Slot 1

21. Front Panel Menu Overview

1. CONFIGURATION MENU

The Configuration menu is used to set up the meter in software for specific applications. Note that both the jumpers and the software have to be set, since the meter's software does not sense jumper settings. Jumpers have to be set before programming. While the Configuration menu is active, relay states remain unchanged from their prior state, and the output of control modules is in an "error" state. When leaving the Configuration menu, the instrument applies a system reset, followed by a brief disconnect of alarm and control output modules.

- **Press the Square ■ key** for one second to enter the Configuration menu. Entry can be blocked by activating the "PASS" password function.
- **Press the Up ▲ key** to advance through the first column menu headings for selection, as shown in the next 6 pages.
- **Press the Square ■ key** to select a first column menu heading, which will present the second column menu headings for selection.
- **Press the Up ▲ key** to advance through the second column menu headings.
- **Press the Square ■ key** to select a second column menu heading, which will present the third column menu headings for selection.
- **Press the Up ▲ key** to advance through the third column menu headings.
- **Press the Square ■ key** to make your third column menu selection.
- **Press the Left ◀ key** to leave the selected menu item and eventually leave the Configuration menu, thereby saving your changes.

2. FAST ACCESS MENU

The Fast Access menu allows four often-used functions to be accessed by pressing a single key, the Up ▲ key. These functions are enabled for Fast Access using the Configuration Menu. Available Fast Access functions are viewing and changing Setpoint 1, viewing and changing Setpoint 2, viewing Max, and viewing Min. To reset Max and Min, cycle power on and off.

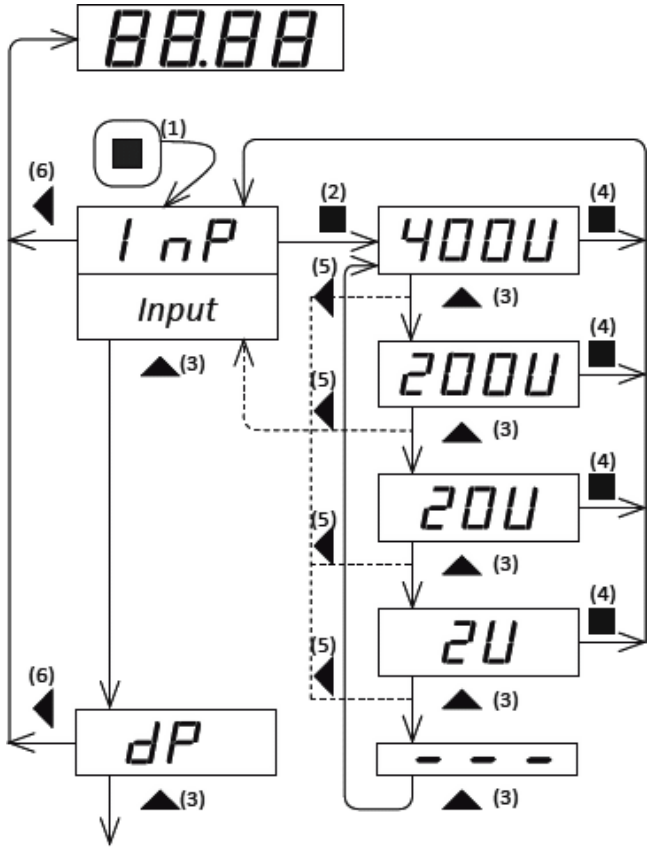
- **Press the Up ▲ key** to access enabled Fast Access menu items. This action is not blocked by the "PASS" password function. The Fast Access menu does not interfere with ongoing meter operation, and exiting it does not cause a system reset.

3. MENU ROLLBACK

After 30 seconds without user interaction, the instrument rolls back to its previous state, discarding any unsaved changes.

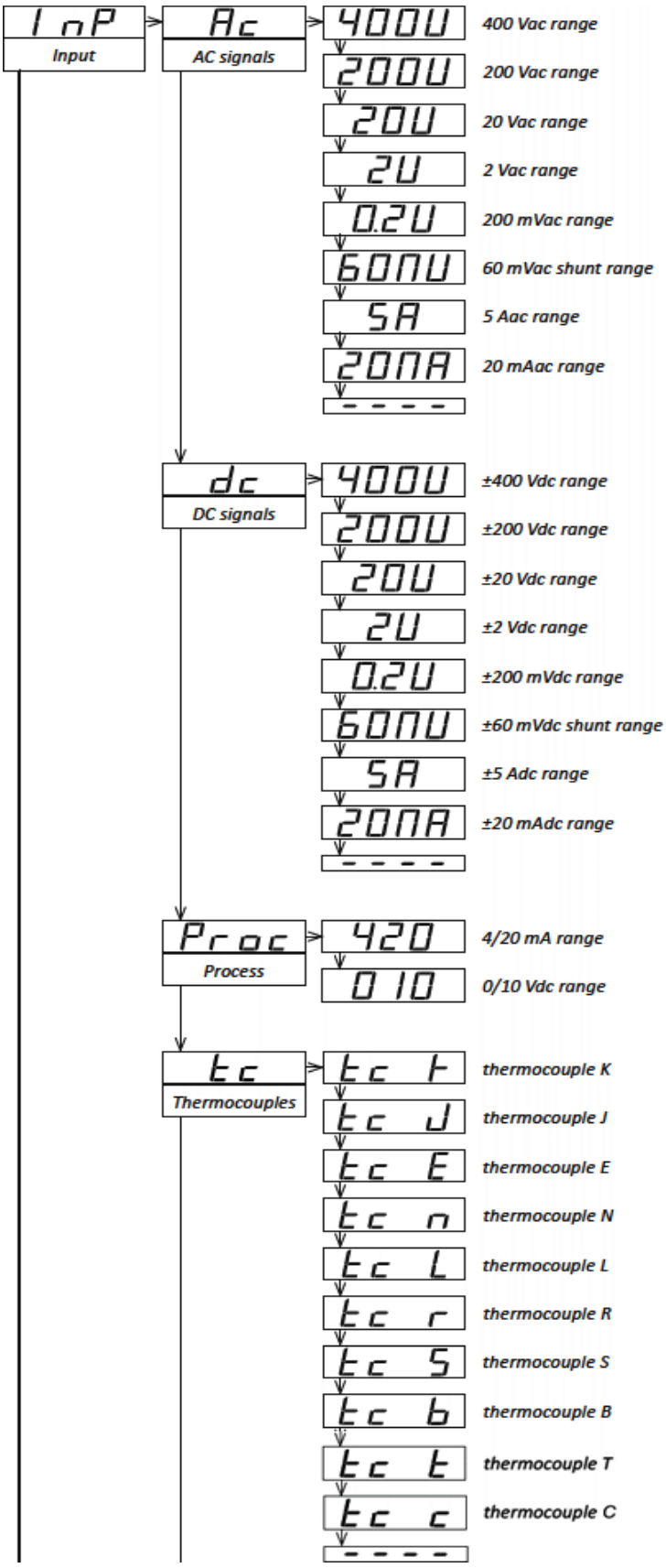
Configuration Menu navigation example

1. The Square ■ key enters the Configuration menu.
2. The Square ■ key enters into the “InP” option menu.
3. The Up ▲ key moves through the menu options.
4. The Square ■ key selects the desired range and returns to the “InP” menu.
5. The Left ◀ key leaves the current menu level and moves to the previous menu level.
6. The Left ◀ key leaves the Configuration menu. Changes are applied and saved at this moment.



Messages and errors	
'h.udr' *'h.oVr'*	Hardware underrange (**'h.udr'**) / overrange (**'h.ovr'**). Input signal is lower / higher than the minimum / maximum signal the instrument can detect.
'd.udr' *'d.oVr'*	display underrange (**'d.udr'**) / overrange (**'d.ovr'**). The instrument already displays the minimum / maximum value possible (9999 / -1999).
*'Err.0'**	at the **'scaling'** (**'ScAL'**) menu entry, the defined slope is higher than '5000' (slope almost vertical). Entered values are dismissed and default values are activated.
'Err.1'	incorrect password.

22. Configuration Menu Details

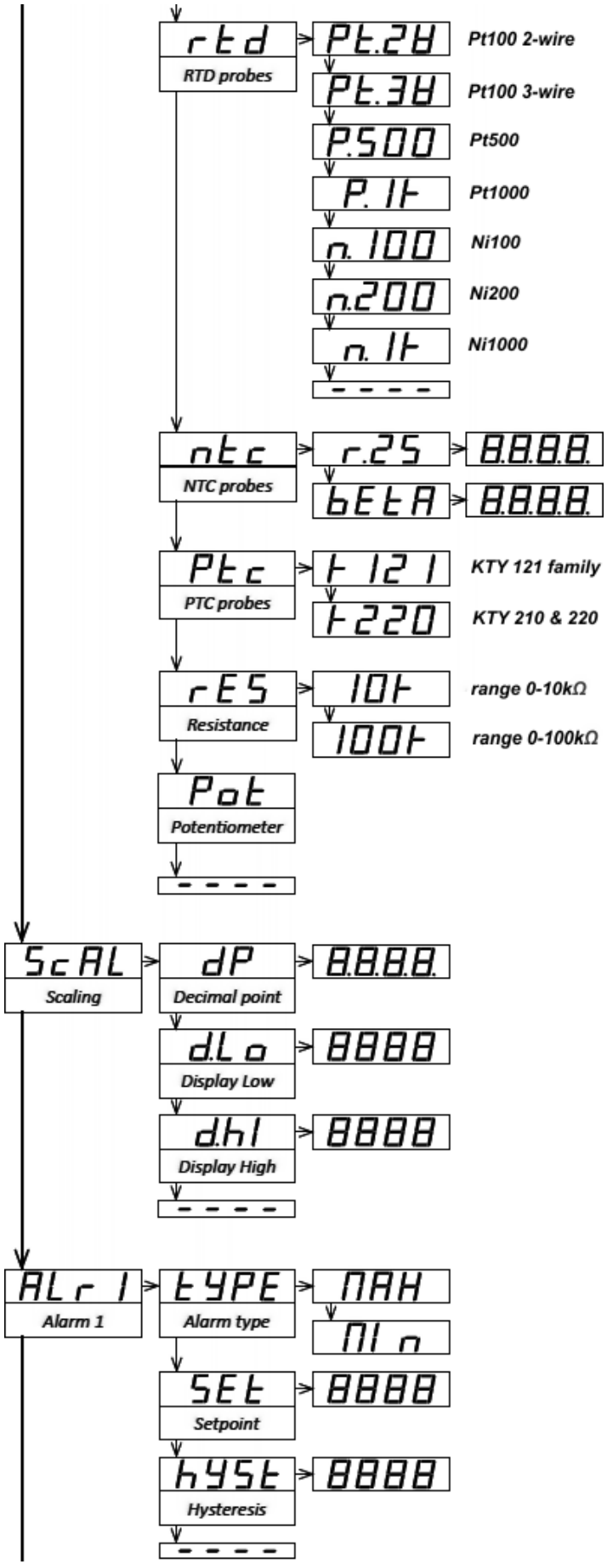


AC input (Ac). Select the full scale range. Choices are 400 Vac (factory default), 200 Vac, 20 Vac, 2 Vac, 200 mVac, 60 mVac, 5 Aac, and 20 mAac. AC measurement provides True RMS readings.

DC input (dc). Select the full scale range. Choices are ±400 Vdc, ±200 Vdc, ±20 Vdc, ±2 Vdc, ±200 mVdc, ±60 mVdc, ±5 Adc and ±20 mAdc. DC measurements are bipolar.

Process input (Proc). Select 4-20 mA or 0-10 Vdc. Excitation of 15V, 30 mA is selectable at connector to power transducers.

Thermocouple input (tc). Select the thermocouple type. Choices are K, J, E, N, L, R, S, B, T and C. The meter provides cold junction compensation.



RTD input (rtd). Select the RTD type. Use the programmable offset feature (oFFS) to subtract counts for lead resistance.

NTC input (ntc). NTC are thermistors with a negative temperature coefficient. Enter the resistance at 25°C and beta between 2000 and 5500, as shown on the NTC data sheet.

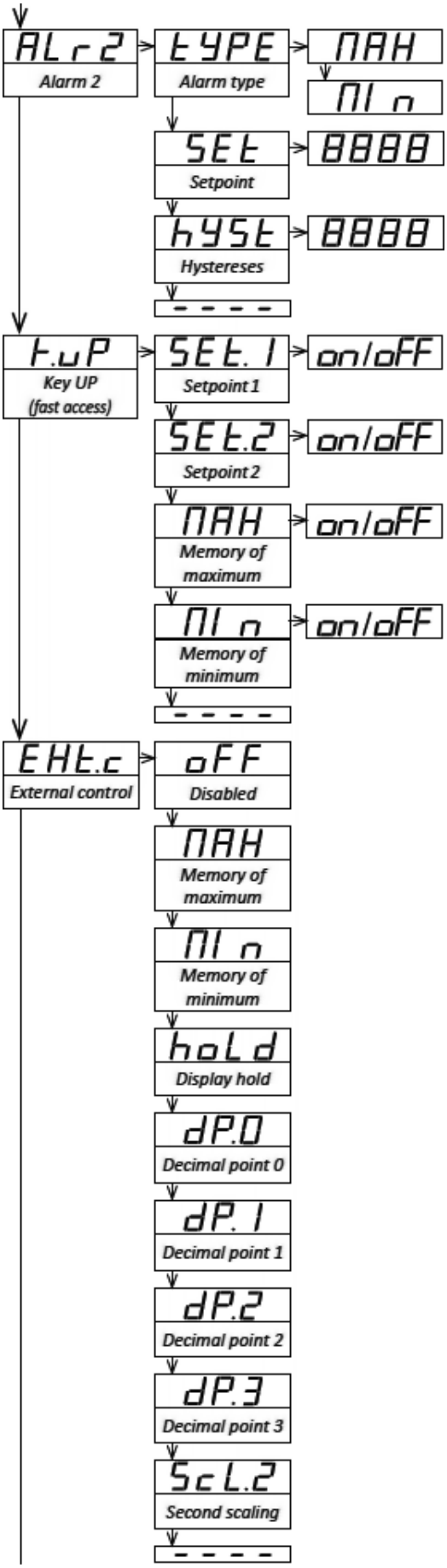
PTC input (Ptc). PTC are thermistors with a positive temperature coefficient. Select the PTC family: KTY 121 or KTY 210 / 220.

Resistance input (rES). Select the 0-10 kΩ or 0-100 kΩ range. Use the programmable offset feature (oFFS) to subtract counts for lead resistance.

Potentiometer input (Pot). Percent of full scale potentiometer resistance from 200Ω to 50 kΩ.

Scaling is applicable to AC, DC, process, resistance and potentiometer inputs, not to temperature. First select the position of the decimal point (dP) using the LE ◀ key. Then enter the desired low reading (d.Lo) for the low end signal (such as 4 mA) and the high end reading (d.hI) for the high end signal (such as 20 mA).

1 or 2 Alarms are individually configurable and are associated with 1 or 2 optional relays. Select the alarm type as MAX (nAH), which activate above the setpoint, or MIN (nI n), which activates below the setpoint. Enter the setpoint (SEt), which can also be entered using the Fast Access menu. Also enter hysteresis (hySt). A MAX alarm activates upon passing the setpoint and deactivates upon passing the setpoint less one hysteresis value. Use hysteresis to avoid relay chatter around the setpoint.



The Fast Access (K.up) menu allows specific functions to be accessed by pressing the Up ▲ key. Select “on” to select a function for fast access, “off” to deselect. Super-fast access is provided when only a single function has been selected. Pressing the Up ▲ key will then jump to that function.

Setpoint 1 (SEt.1) allows display and change of the setpoint for Alarm 1.

Setpoint 2 (SEt.2) allows display and change of the setpoint for Alarm 2.

Maximum (nAH) allows display of the maximum reading since last reset.

Minimum (nI n) allows display of the minimum reading since last reset.

To reset maximum and minimum, cycle power off and on, or leave the Configuration menu after a change has been entered.

The External control (EHt.c) menu defines the functions of the meter’s external control input when tied to ground. Selectable functions are:

oFF disables all external control functions.

nAH flashes maximum since last reset.

nI n flashes minimum since last reset.

hoLd holds and flashes last meter reading until external input is released.

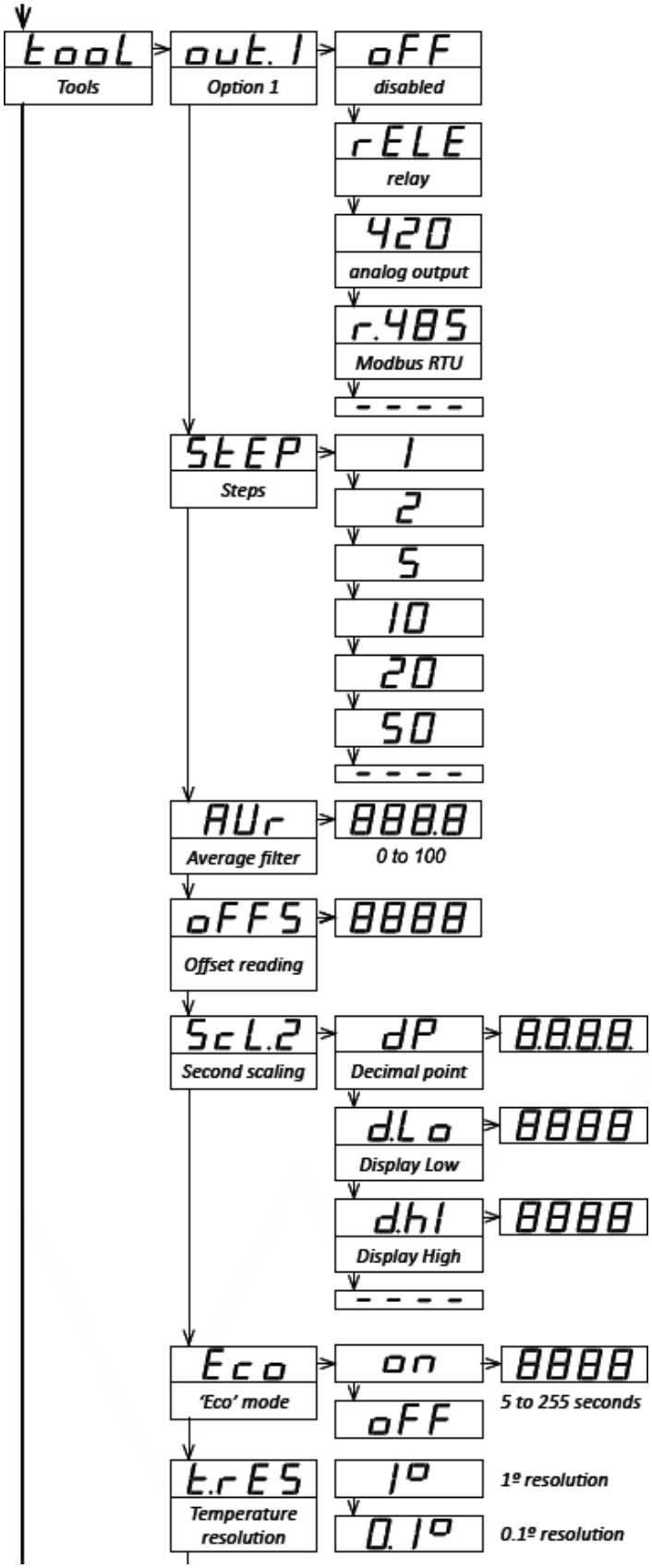
dP.0 removes decimal point until released.

dP.1 sets decimal point to xxx.x until released.

dP.2 sets decimal point to xx.xx until released.

dP.3 sets decimal point to x.xxx until released.

ScL.2 selects a second scaling method. Applicable to AC, DC, process, resistance and potentiometer signals. Programmable under Tools \ Second scaling.



The Tools (tooL) menu is used to configure the meter.

Option 1 (out.1) informs the meter of the option board installed in Slot 1. Selections are no board (oFF), relay (rELE), analog output (420), and RS485 (r.485).

Steps (StEP) allows selection of the step size in counts by which readings will change. Also called “count-by.” Choice are 1 (default), 2, 5, 10, 20, 50.

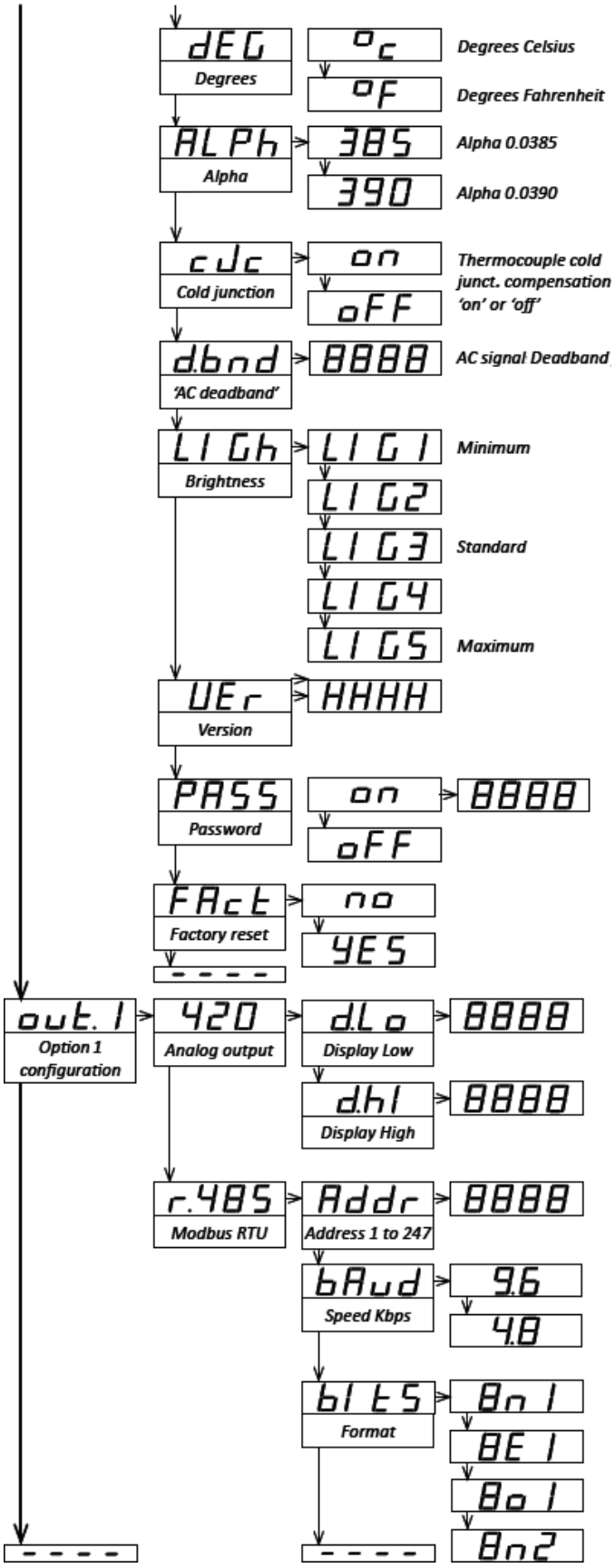
Average filter (AVr) allows entry of a value from 0 to 100 for a recursive digital filter. Enter 0 for no filter. Enter 100 for maximum filtering, which provides a stable reading in the presence of noise but decreases response time. Experiment to find your best value.

Offset reading (oFFS) allows entry of a reading offset in counts from -500 to 500. Used to compensate for lead resistance in 2-wire RTD and resistance measurements.

Second scaling (ScL.2) allows you to specify an alternate scaling method, which is invoked by grounding the external input to the meter. First select the position of the decimal point (dP) using the Left ◀ key. Then enter the desired low reading (d.Lo) for the low end signal (such as 4 mA) and the high end reading (d.hI) for the high end signal (such as 20 mA).

‘Eco’ mode (Eco) can be enabled to reduce power consumption. Enter a time from 5 to 255 seconds after which the display turns off, provided that the meter is not in the Configuration menu or Fast Access menu, no key is being pressed, and there is no active alarm. Pressing any front panel key or entering an alarm turns on the display again.

Temperature resolution (t.rES) allows selection of 1° or 0.1° for temperature.



Degrees (dEG) allows selection of °C or °F for temperature.

Alpha (ALPh) allows selection of 0.00385 (DIN alpha) or 0.00390 (ANSI alpha) for platinum RTD probes.

Cold Junction Compensation (cJc) allows internal thermocouple compensation to be turned on or off.

AC deadband (dbnd) allows entry of a number from 0 to 100 to display 0 for low AC signal inputs. Factory default is 20. Empirically find the number that works best for you.

Version (Ver) returns the firmware version of the instrument.

Password (PASS) allows entry of a 4-digit numerical password. This number will be requested for access to the Configuration menu. It is not requested for the Fast Access menu, for example to change setpoints.

Factory reset (FAct) reverts instrument programming to the default values listed at the front of this manual.

Option 1 configuration (out.1) allows programming of the output options in Slot 1, provided that these have been previously selected under the Tools menu.

Analog output (420) sets up the 4-20 mA analog output. Enter the Display Low (d.Lo) reading for 4 mA and Display High (h.hl) reading for 20 mA.

Modbus RTU (r.485) sets up the RS485 output. Enter the meter Address (Addr) from 1 to 247, speed Kbps (bAud) as 9.6 or 4.8, and Format (bitS) as 8n1, eE1, 8o1 or 8n2.

Relay modules are configured through the menu entries Alarm 1 (ALr1) and Alarm 2 (ALr2).

23. General Specifications

Meter Display

Numeric display ..... Four 7-segment, 14.2 mm (.56") high red LED digits
Indicators ..... Two LED lamps
Range ..... -1999 to 9999
Decimal point ..... Programmable X.X.X.X
Read rate ..... 3 readings/sec
Step response, 0% to 99% of signal ..... 300 msec

Signal Types & Ranges

Signal type & range selection ..... Via jumpers and front panel programming
AC voltage ..... 400 Vac, 200 Vac, 20 Vac, 2 Vac, 200 mVac, 60 mVac
AC current ..... 5 Aac, 20 mAac
DC voltage ..... ±400 Vdc, ±200 Vdc, ±20 Vdc, ±2 Vdc, ±200 mVdc, ±60 mVdc
DC current ..... 5 Adc, 20 mAdc
Process signal ..... 4-20 mA, 0-10V with +15Vdc, 30mA excitation
Thermocouple types ..... K, J, E, N, L, R, S, B, T, C
RTD types ..... Pt100 (2 and 3 wires), Pt500, Pt1000, Ni100, Ni200, Ni1000
Thermistor types, NTC ..... Resistance measurement from 100Ω to 100 kΩ
R_{25} values of 100 to 100000, beta values of 2000 to 5500
Thermistor types, PTC ..... Types KTY-121, KTY-210, KTY-220
Resistance ..... 0-9999 kΩ, 0-99.99 kΩ
Potentiometric input ..... 200Ω to 50 kΩ

Analog Output Option (AOT)

Output level ..... 4-20 mA, source or sink (selectable at connector)
Maximum load ..... 350Ω source, 700Ω sink
Scaling ..... Zero and full scale adjustable from -1999 to +9999 counts
Accuracy ..... < 0.5% of full scale
Update time ..... 400 ms
Isolation ..... 1000 Vdc

Relay Output Options (RL1 for Slot 1, RL2 for Slot 2)

Relay type ..... Single 3-contact relay (NC, NO, common)
Relay rating ..... 8A at 250 Vac
Isolation ..... 1000 Vdc

RS485 Output Option (RS485)

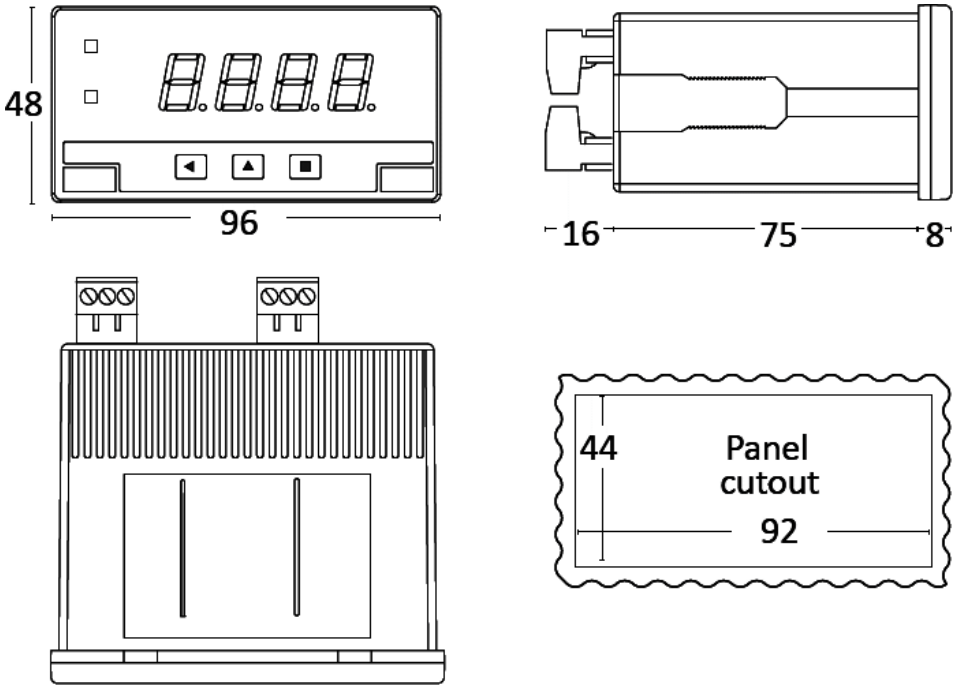
Protocol ..... Modbus RTU
Programmable addresses 1-247
Supported function code ..... 4 = “read the register”
Data rates ..... 9600 or 4800 baud
Update time ..... 400 ms
Isolation ..... 1000 Vdc

Power Requirement

Input voltage ..... 18 to 265 Vac or Vdc
Power consumption, normal operation ..... < 1.5W without options, < 2.5W with options
Power consumption, Eco mode ..... < 0.3W without options, < 1.5W with options

Mechanical

Bezel dimensions ..... 96 x 48 mm (1/8 DIN)
Panel cutout ..... 92 x 45 mm (1/8 DIN)
Depth behind panel, including connectors ..... 91 mm
Housing material ..... Black polycarbonate
Weight with options ..... 163 grams (5.7 oz)



Environmental

Operating temperature ..... 0 to 50°C (32 to 122°F)
Storage temperature ..... -20 to 70°C (-4 to 158°F)
Front panel protection ..... IP50 (standard), IP54 (NEMA-12) with optional gasket

Included Advanced Functions

Fast access ..... To setpoints, maximum and minimum
Functions selectable via external control input ..... Second scaling, Decimal point selection, Reading Hold, Maximum, Minimum
Eco mode ..... Reduced power consumption
Alarms ..... Setpoint, hysteresis, set as max or min type
Offset ..... Add fixed number of counts to reading
Filter ..... Moving average filter
Password ..... To block unauthorized access
Brightness control ..... 5 levels (default level is 3)

23. WARRANTY

Laurel Electronics Inc. warrants its products against defects in materials or workmanship for a period of one year from the date of purchase.

In the event of a defect during the warranty period, the defective unit may be returned to the seller, which may be Laurel or a Laurel distributor. The seller may then repair or replace the defective unit at its option. In the event of such a return, freight charges from the buyer shall be paid by the buyer, and freight charges from the seller shall be paid by the seller.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from:

1. Improper installation or miswiring.
2. Improper or inadequate maintenance.
3. Unauthorized modification or misuse.
4. Operation outside the environmental specifications.
5. Mishandling or abuse.

The warranty set forth above is exclusive, and no other warranty, whether written or oral, is expressed or implied. Laurel specifically disclaims implied warranties of merchantability and fitness for a particular purpose.

Any electronic product may fail or malfunction over time. To minimize risks associated with reliance on Laurel products, users are expected to provide adequate system-level design and operating safeguards. Laurel's products are intended for general purpose industrial or laboratory use. They are not intended nor certified for use in life-critical medical, nuclear, or aerospace applications, or for use in hazardous locations.

EXCLUSIVE REMEDIES

The remedies provided herein are Buyer's sole and exclusive remedies. In no event shall Laurel be liable for direct, indirect, incidental or consequential damages (including loss of profits) whether based on contract, tort, or any other legal theory.

