

Cla-Val X145 Loop-Powered Rate/Totalizer Instruction Manual



- 4-20 mA Input Loop-Powered
- Modern, Sleek and Practical Enclosure
- 5 Digits, 0.7" (17.8 mm) Upper Display
- 7 Alphanumeric Character, 0.4" (10.2 mm) Lower Display
- Through-Window Button Programming
- Password Protection
- 32-Point, Square Root, or Exponential Linearization
- Rate in Units per Second, Minute, Hour, or Day
- Open Collector Pulse or Alarm Output
- Loop-Powered or External DC-Powered Backlight Standard
- HART® Protocol Transparent
- 3.0 V Drop (6.0 V with Backlight)
- Plastic NEMA 4X, IP65 Enclosure
- Operates from -40 to 75°C

CLA-VAL

1701 Placentia Avenue • Costa Mesa, CA 92627

800-942-6326 • Fax: 949-548-5441 • Web Site: cla-val.com • E-mail: info@cla-val.com

CLA-VAL CANADA

4687 Christie Drive
Beamsville, Ontario
Canada L0R 1B4
Phone: 905-563-4963
Fax: 905-563-4040
E-mail sales@cla-val.ca

CLA-VAL EUROPE

Chemin des Mésanges 1
CH-1032 Romanel/
Lausanne, Switzerland
Phone: 41-21-643-15-55
Fax: 41-21-643-15-50
E-mail: cla-val@cla-val.ch

CLA-VAL UK

Dainton House, Goods Station Road
Tunbridge Wells
Kent TN1 2 DH England
Phone: 44-1892-514-400
Fax: 44-1892-543-423
E-mail: info@cla-val.co.uk

CLA-VAL FRANCE

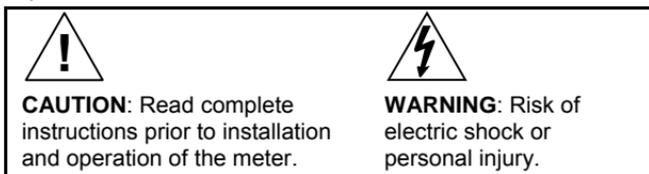
Porte du Grand Lyon 1
ZAC du Champ du Pérrier
France - 01700 Neyron
Phone: 33-4-72-25-92-93
Fax: 33-4-72-25-04-17
E-mail: cla-val@cla-val.fr

CLA-VAL PACIFIC

45 Kennaway Road
Woolston, Christchurch, 8023
New Zealand
Phone: 64-39644860
www.cla-valpacific.com
E-mail: info@cla-valpacific.com

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Warning

- This product is not recommended for life support applications or applications where malfunctioning could result in personal injury or property loss. Anyone using this product for such applications does so at his/her own risk. Cla-Val Co. shall not be held liable for damages resulting from such improper use.
- Failure to follow installation guidelines could result in death or serious injury. Make sure only qualified personnel perform the installation.

Limited Warranty

Cla-Val Co. warrants this product against defects in material or workmanship for the specified period under "Specifications" from the date of shipment from the factory. Cla-Val's liability under this limited warranty shall not exceed the purchase value, repair, or replacement of the defective unit.

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INTRODUCTION

The Cla-Val X145 is a plastic field mounted loop-powered rate/totalizer fully featured for demanding applications in the harshest environmental conditions. The meter derives all of its power from the 4-20 mA loop. It is programmed using the four through-window buttons, without removing the cover, and can be scaled with or without a calibration signal. The numeric rate display will read up to 99999 and the alphanumeric total/tag display will read up to 9999999. The alphanumeric display can also be programmed to show any combination of numbers and letters up to seven characters long for use as engineering units and/or the process identification tag. The backlight lets you see the display under any lighting condition and can be powered from either the 4-20 mA loop or from a separate DC power supply.

The enclosure has three threaded conduit holes, integrated pipe or wall mounting flanges, and allows for easy installation of tamper seals.

ORDERING INFORMATION

Model	Description
X145	Loop-Powered Rate/Totalizer with Backlight

Accessories

Model	Description
X145-PLUG	3/4" NPT Plastic Conduit Plug

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SPECIFICATIONS

Except where noted all specifications apply to operation at +25°C.

General

DISPLAY	Five digits	0.70" (17.8 mm) high, 7-segment, (-9999 to 99999)	automatic lead zero blanking.
	Seven characters (Total and/or Tag)	0.4" (10.2 mm) high, 14 segment. 7-digit Totalizer 9,999,999	
	Symbols	High, Low, & Set Alarm, Password Lock	
	Backlight	White	
DISPLAY UPDATE RATE	Ambient > -25°C: 2 Updates/Second Ambient < -25°C: 1 Update/5 Seconds		
OVERRANGE	Display flashes 99999		
UNDERRANGE	Display flashes -9999		
PROGRAMMING METHOD	Four through-window buttons when cover is installed. Four internal pushbuttons when cover is removed.		
NOISE FILTER	Programmable LQ, n, Ed, H I, or OFF		
RECALIBRATION	Recalibration is recommended at least every 12 months.		
MAX/MIN DISPLAY	Max/Min readings reached by the process are stored until reset by the user or until power to the meter is turned off.		
PASSWORD	Programmable password restricts modification of programmed settings.		
NON-VOLATILE MEMORY	All programmed settings and total reading are stored in non-volatile memory for a minimum of ten years if power is lost.		
NORMAL MODE REJECTION	64 dB at 50/60 Hz		
ENVIRONMENTAL	Operating temperature range: -40 to 75°C Storage temperature range: -40 to 75°C Relative humidity: 0 to 90% non-condensing		
CONNECTIONS	Screw terminals accept 12 to 22 AWG wire		
ENCLOSURE	NEMA 4X, IP65 plastic field enclosure. Color: grey. Three ¾" NPT threaded conduit openings. One ¾" NPT plastic conduit plug, with 1.29" wrenching flats and a screwdriver slot, is included.		
MOUNTING	May be mounted directly to conduit. Two slotted flanges for wall mounting or NPS 1½" to 2½" or DN 40 to 65 mm pipe mounting. See Mounting Dimensions on page 45.		
OVERALL DIMENSIONS	5.67" x 5.25" x 4.18" (W x H x D) (144 mm x 133 mm x 106 mm)		
WEIGHT	1.65 lbs (26.4 oz, 0.75 kg)		
WARRANTY	3 years parts and labor		

Input

ACCURACY	±0.03% of calibrated span ±1 count, square root & programmable exponent accuracy range: 10-100% of calibrated span.		
ADVANCED FUNCTION	Linear, square root, or programmable exponent		
MULTI-POINT LINEARIZATION	2 to 32 points		
PROGRAMMABLE EXPONENT	1.0001 to 2.9999		
LOW FLOW CUT-OFF	0-99999 (0 disables cutoff function)		
TEMPERATURE DRIFT	50 PPM/°C from -40 to 75°C ambient		
DECIMAL POINT	User selectable decimal point		
TOTALIZER	Calculates total based on rate, time base of second, minute, hour, or day, and field programmable multiplier; stored in non-volatile memory upon power loss.		
TOTALIZER RESET	User selectable via through-window buttons, time delay, external contact closure, or protected		
CALIBRATION RANGE	An <i>Error</i> message will appear if input 1 and input 2 signals are too close together.		
	Input Range	Minimum Span Input 1 & Input 2	
	4-20 mA	0.10 mA	
MAXIMUM VOLTAGE DROP	Without Backlight or with Externally-Powered (DC Powered) Backlight	With Loop-Powered Backlight	
	3.0 VDC @ 20 mA	6.0 VDC @ 20 mA	
EQUIVALENT RESISTANCE	150 Ω @ 20 mA	300 Ω @ 20 mA	
EXTERNALLY POWERED BACKLIGHT	Voltage Range:	Maximum Power	
	9-36 VDC	9 VDC	12 VDC
		24 VDC	36 VDC
		0.2 W	0.25 W
		0.5 W	0.75 W
INPUT OVERLOAD	Over current protection to 2 A max.		

Open Collector Output

RATING	Isolated open collector, 30 VDC @ 150 mA max.
ALARM OUTPUT	Assign to rate for high or low alarm trip point. Assign to total for total alarm trip point.
DEADBAND	0-100% FS, user selectable
ACKNOWLEDGE	Front panel ACK button resets output and screen indication.
PULSE OUTPUT K-FACTOR	K-factor programmable from 0.0001 to 99999. One pulse is generated for every total increment selected (e.g. K-factor value of 100 will generate one pulse every time the total is incremented by 100 units). If the pulse output exceeds the programmed output frequency, pulses are accumulated as pending and are not lost. Pulses will continue to output until the buffer is emptied or the total is reset from the front panel.
PULSE OUTPUT FREQUENCY	Programmable frequency: 2, 4, 8, 16, 32, 64, 128 Hz. Minimum pulse width: 3.9 ms @ 128 Hz Maximum pulse width: 250 ms @ 2 Hz Factory default pulse width: 31 ms @ 16 Hz

SAFETY INFORMATION



WARNINGS

- Read complete instructions prior to installation and operation of the meter.
- Installation and service should be performed only by trained service personnel. Service requiring replacement of internal components must be performed at the factory.
- Disconnect from supply before opening enclosure. Keep cover tight while circuits are alive.
- If the meter is installed in a high voltage environment and a fault or installation error occurs, high voltage may be present on any lead.

INSTALLATION



WARNING

Hazardous voltages may exist within enclosure. Installation and service should be performed only by trained service personnel.

Wiring connectors are accessed by opening the enclosure. To access electrical connectors, remove the 2 captive screws, then disconnect the ribbon cable from the display module and set the display module aside.

Unpacking

Remove the meter from box. Inspect the packaging and contents for damage. Report damages, if any, to the carrier.

If any part is missing or the meter malfunctions, please contact your supplier or the factory for assistance.

Conduit/Stopping Plug

The X145 is provided with three $\frac{3}{4}$ " NPT threaded conduit openings and one IP68 rated $\frac{3}{4}$ " NPT plastic conduit plug.

The conduit/stopping plug included has 1.29" wrenching flats and a screwdriver slot.

Mounting

The X145 has two slotted mounting flanges that may be used for pipe mounting or wall mounting. Alternatively, the unit may be supported by the conduit using the conduit holes provided.

Refer to *Mounting Dimensions*, page 45 for details.



WARNING

Do not attempt to loosen or remove flange bolts while the meter is in service.

Connections



WARNINGS

- Static electricity can damage sensitive components.
- Observe safe handling precautions for static-sensitive components.
- Use proper grounding procedures/codes.
- If the meter is installed in a high voltage environment and a fault or installation error occurs, high voltage may be present on any lead or terminal.

To access the connectors, remove the enclosure cover and unscrew the two captive screws that fasten the display module. Disconnect the ribbon cable and remove the display module. Signal connections are made to a four-terminal connector in the base of the enclosure.

Connections (continued)

SIGNAL +	4-20 mA signal input positive terminal connection
SIGNAL -	4-20 mA signal return/negative terminal connection when not using loop powered backlight.
BACKLIGHT +	+9-30 VDC when powering backlight from external supply.
BACKLIGHT -	4-20 mA signal return/negative terminal when using the installed loop powered backlight or ground/negative when powering backlight from external supply.
OUTPUT+	NPN open collector output positive.
OUTPUT-	NPN open collector output negative.
RESET +	Contact closure reset pullup to 3 VDC
RESET-	Contact closure reset ground/negative.

Refer to Figure 1 for terminal positions.



WARNING Observe all safety regulations. Electrical wiring should be performed in accordance with all agency requirements and applicable national, state, and local codes to prevent damage to the meter and ensure personnel safety.

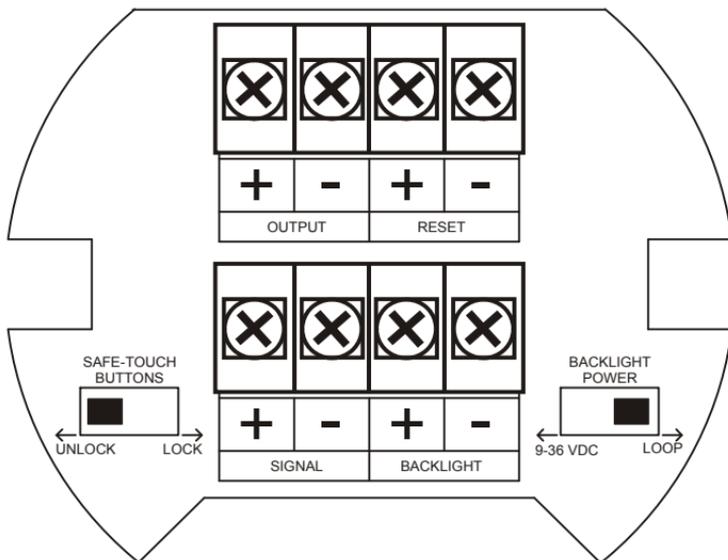


Figure 1. Connector Board

Input Signal & Backlight Connections

Signal and backlight connections are made to a four-terminal connector mounted in the base of the enclosure. For installations without backlight, only the two signal terminals are connected. The 4-20 mA input with no backlight has a maximum voltage drop of 3 V and is wired as shown in Figure 2. The loop-powered backlight configuration requires a total maximum voltage drop of 6 V. The backlight is recommended for dim lighting conditions and is enabled when wired as shown in Figure 3 or Figure 4.

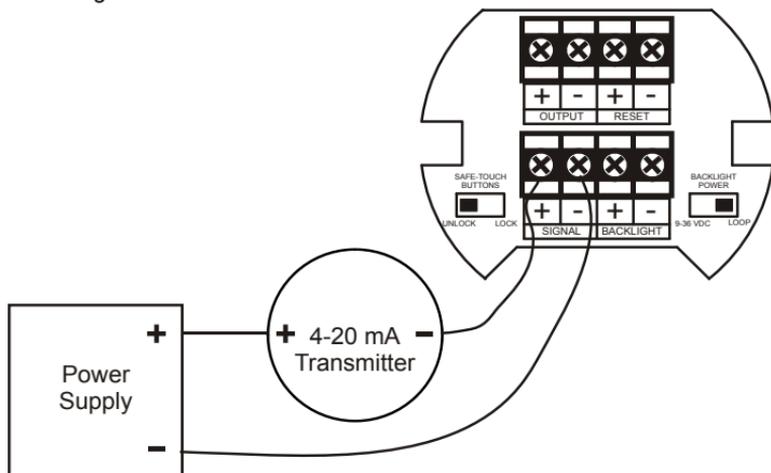


Figure 2. Input Connections without Backlight

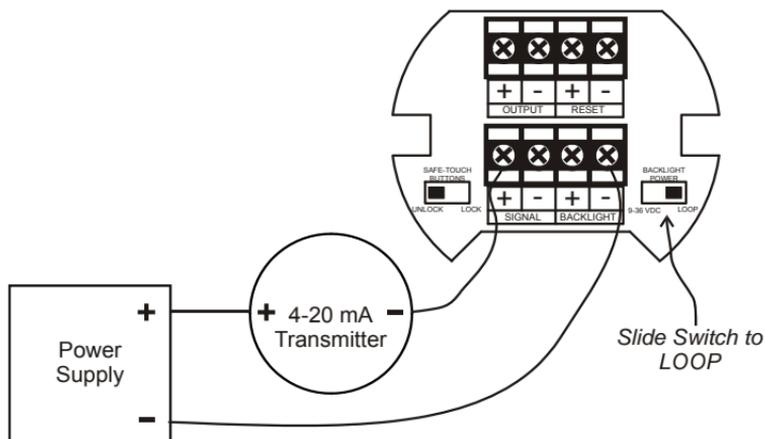


Figure 3. Input Connections with Loop-Powered Backlight

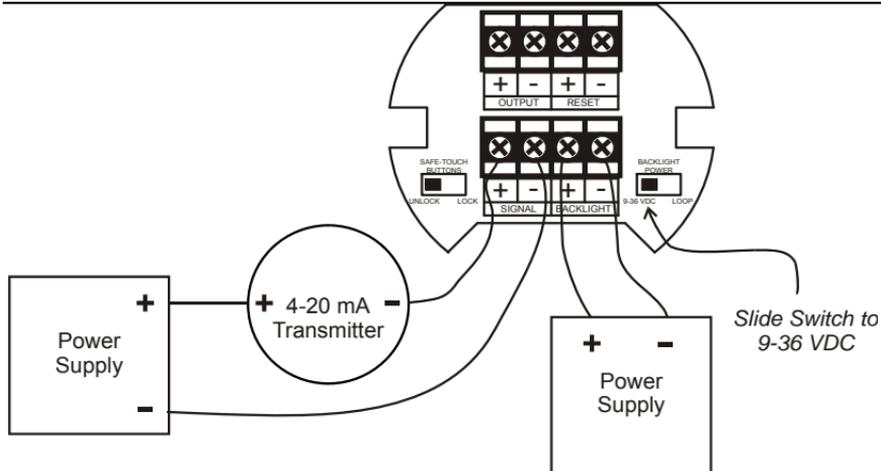


Figure 4. Input Connections with Externally-Powered Backlight

It is possible to use the same transmitter (signal loop) power supply for the externally powered backlight. The backlight circuit will draw 25 mA in addition to the loop circuit.

External Reset Connection

External reset connections are made to two terminals labeled Reset. Connect to a contact closure source such as a relay or a pushbutton as shown in Figure 5.

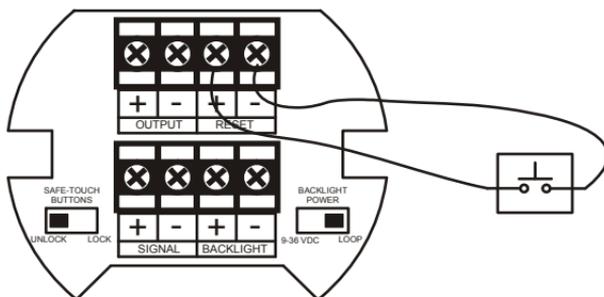


Figure 5. Reset Connections

Open Collector Output Connections

Output connections are made to two terminals labeled OUTPUT. Connect to an input device such as alarm indicator or pulse counter as shown in Figure 6, or drive a relay as shown in Figure 7.

To avoid damaging the X145's amplifying components, use care not to wire incorrectly or exceed output ratings. A diode, such as 1N4000 series, will provide protection from relay transients.

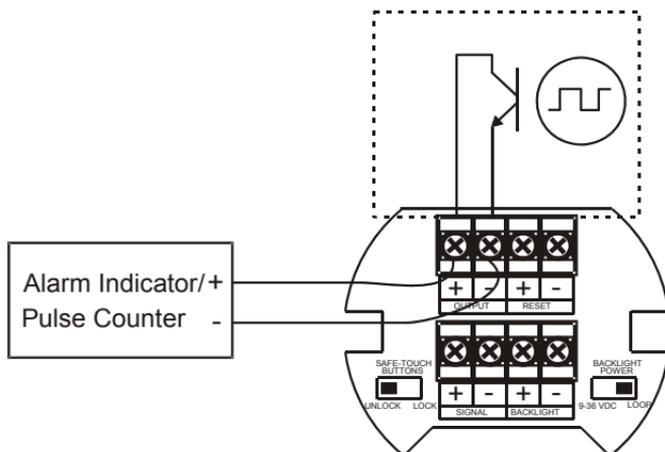


Figure 6. Connection to Device with Internal Pull-Up

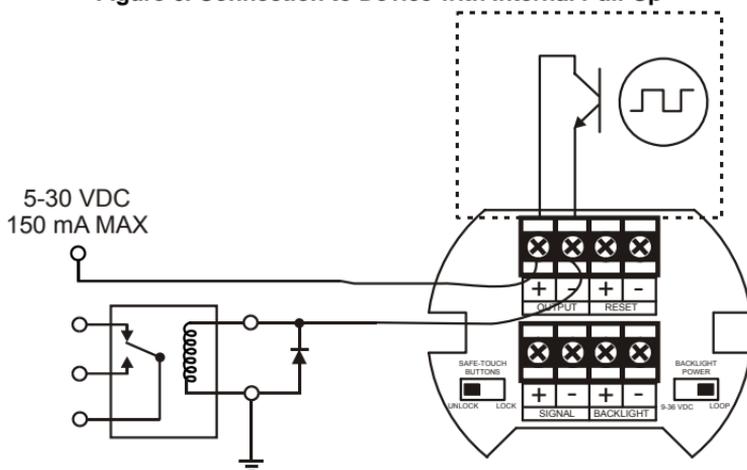


Figure 7. Output Connections

SETUP AND PROGRAMMING

There is **no need to recalibrate** the meter for milliamps when first received from the factory.

The meter is **factory calibrated** for milliamps prior to shipment. The calibration equipment is certified to NIST standards.

Overview

Setup and programming is done through the infrared through-window buttons, or using the mechanical buttons when uncovered. There are two slide switches located on the connector board. One is used to select backlight power (if equipped) and the other is to lock or unlock the through-window buttons.

Through-Window Buttons

The X145 is equipped with four sensors that operate as through-window buttons so that it can be programmed and operated without removing the cover. These buttons can be disabled for security by selecting the LOCK setting on the switch located on the connector board in the base of the enclosure. To actuate a button, press one finger to the window directly over the marked button area. When the cover is removed, the four mechanical buttons located next to the sensors are used. The sensors are disabled when a mechanical button is pressed and will automatically be re-enabled after 60 seconds of inactivity.

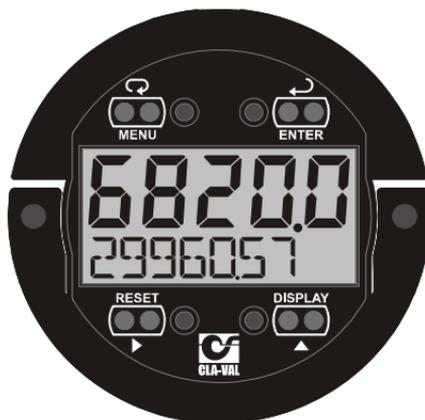
The through-window buttons are designed to filter normal levels of ambient interference and to protect against false triggering, however, it is recommended that the through-window buttons be disabled (slide switch to LOCK) if there is an infrared interference source in line-of-sight to the display.

Through-Window Button Tips:

- To remove cover with power applied (safe area only), or to clean the window, select `SEPV ICE` in the main menu before opening the cover. This will temporarily disable the through-window buttons for 60 seconds to prevent inadvertent use. Use the mechanical buttons while the meter is open.
- To the extent possible, install the display facing away from sunlight, windows, reflective objects and any sources of infrared interference.
- Keep the window clean.
- Tighten the cover securely.
- Use a password to prevent tampering.

After all connections have been completed and verified, apply power to the loop.

Buttons and Display



Button Symbol	Description	Symbol	Status
	Menu	HI	High Alarm Set
	Right arrow/Reset	LO	Low Alarm Set
	Up arrow/Max	SET	Total Alarm Set
	Enter		Password Enabled

- Press the **Menu** button to enter or exit the Programming Mode at any time.
- Press the **Right** arrow button to move to the next digit or decimal position during programming.
- Press the **Up** arrow button to scroll through the menus, decimal point, or to increment the value of a digit.
- Press the **Enter** button to access a menu or to accept a setting.
- Press and hold the **Menu** button for five seconds to access the *Advanced Features* of the meter.

Main Menu Display Functions & Messages

The meter displays various functions and messages during setup, programming, and operation. The following table shows the main menu functions and messages in the order they appear in the menu.

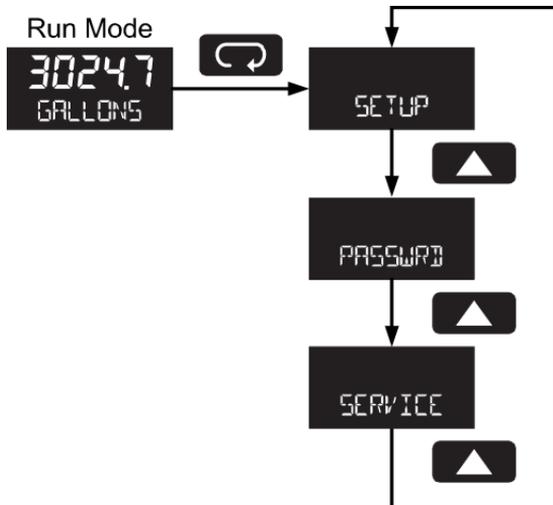
Display	Parameter	Action/Setting
SETUP	<i>Setup</i>	Enter <i>Setup</i> menu
dECPt	<i>Decimal point</i>	Enter <i>Decimal Point</i> menu
rRtE	<i>Rate decimal</i>	Set rate display decimal point
tOtAL	<i>Total decimal</i>	Set total display decimal point
Prog	<i>Program</i>	Enter the <i>Program</i> menu
SCALE	<i>Scale</i>	Enter the <i>Scale</i> menu
CAL	<i>Calibrate</i>	Enter the <i>Calibrate</i> menu
INPt 1	<i>Input 1</i>	Calibrate input 1 signal or program input 1 value
dSPt 1	<i>Display 1</i>	Program display 1 value
INPt 2	<i>Input 2</i>	Calibrate input 2 signal or program input 2 value
dSPt 2	<i>Display 2</i>	Program display 2 value
SPRn Error	<i>Span Error</i>	Error, calibration not successful, check signal
tBASE	<i>Time Base</i>	Enter the <i>Time Base</i> menu
SEc	<i>Second</i>	Units per <i>second</i>
MIN	<i>Minute</i>	Units per <i>minute</i>
hour	<i>Hour</i>	Units per <i>hour</i>
dAY	<i>Day</i>	Units per <i>day</i>
tOtCF	<i>Conversion Factor</i>	Enter the <i>Conversion Factor</i> menu
t rSt	<i>Total Reset</i>	Enter the <i>Total Reset</i> menu
Auto	<i>Automatic</i>	<i>Automatic Total Reset</i>
T DELAY	<i>Time Delay</i>	<i>Automatic Reset Time Delay</i>
MAN	<i>Manual</i>	<i>Manual Total Reset</i>
EnAbL	<i>Enable</i>	<i>Enable Manual reset</i>

Display	Parameter	Action/Setting
d5RbL	Disable	Disable Manual reset
TAG	Tag/Units	Enter the Tag/Units Menu
On	Tag On	Enable Tag/Units
OFF	Tag Off	Disable Tag/Units
TOGGLE	Tag Toggle	Toggle Tag and Total
PASSWORD	Password	Enter the Password menu
UNLOCKED	Unlocked	Program password to lock meter
LOCKED	Locked	Enter password to unlock meter
99999 -99999	Flashing display	Overrange condition Underrange condition
SERVICE	Service	Select before removing/installing cover for service or to clean the window

Main Menu

The main menu consists of the most commonly used functions: *Setup*, *Password*, and *Service*.

Press **Menu** button to enter Programming Mode then press the **Up Arrow** button to scroll through the main menu.



- Press **Menu**, at any time, to exit and return to Run Mode. Changes made to settings prior to pressing **Enter** are not saved.
- Changes to the settings are saved to memory only after pressing **Enter**.
- The display moves to the next menu every time a setting is accepted by pressing **Enter**.

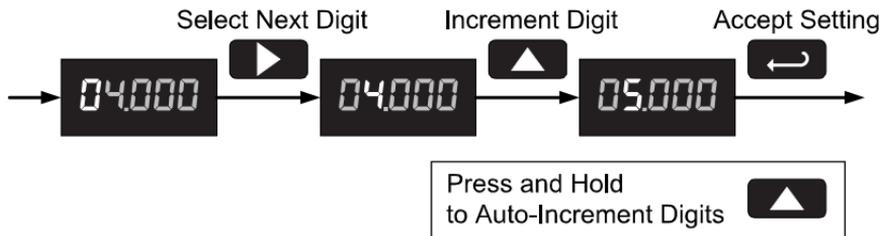
Setting Numeric Values

The numeric values are set using the **Right** and **Up** arrow buttons. Press **Right** arrow to select next digit and **Up** arrow to increment digit.

The digit being changed blinks.

Press the **Enter** button, at any time, to accept a setting or **Menu** button to exit without saving changes.

The decimal point is set using the **Right** or **Up** arrow button in the *Setup-decimal point* menu.

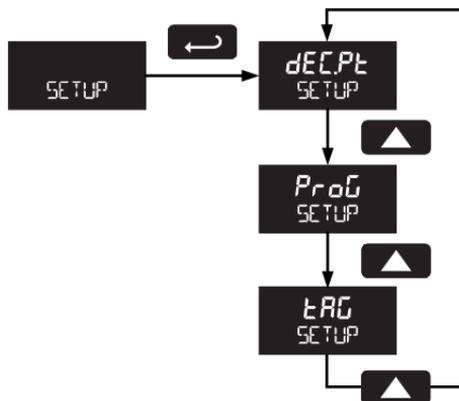


Setting Up the Meter (SETUP)

The *Setup* menu is used to select:

1. Rate and total decimal point position
2. Program menu
3. Rate and total tag display
4. Time base
5. Total conversion factor
6. Manual or automatic total reset function

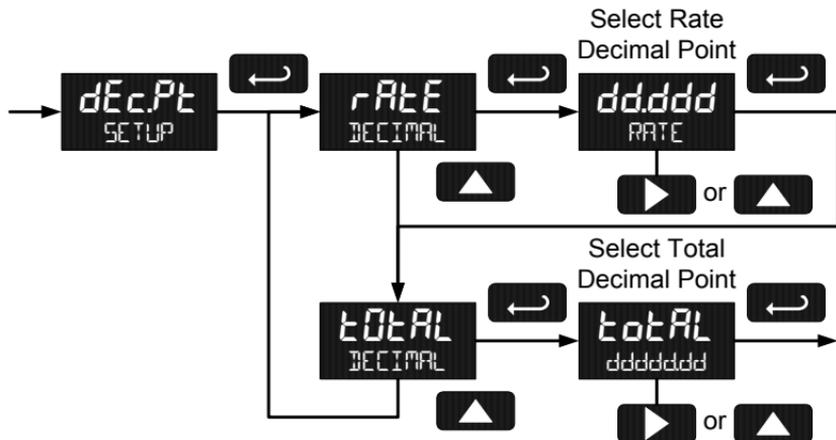
Press the **Enter** button to access any menu or press **Up** arrow button to scroll through choices. Press the **Menu** button to exit at any time.



Setting the Decimal Point (*dEcPt*)

Rate decimal point may be set with up to four decimal places or with no decimal point at all. Total decimal point may be set with up to six decimal places or with no decimal point at all. Rate decimal and total decimal are programmed individually.

Pressing the **Right** arrow moves the decimal point one place to the right until no decimal point is displayed. Pressing the **Up** arrow moves the decimal point one place to the left.



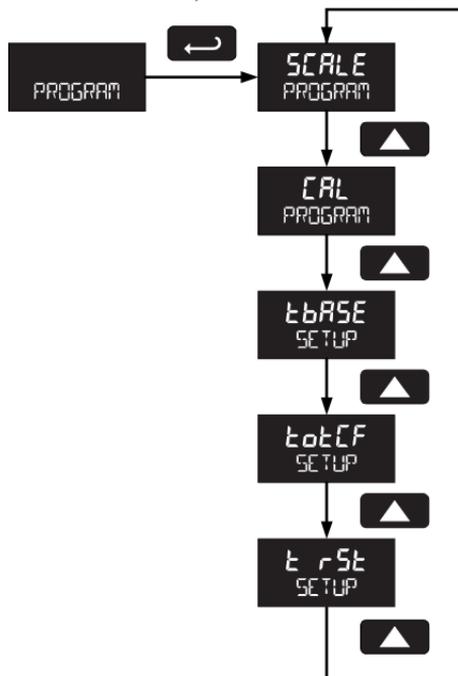
Programming the Meter (PrOg)

It is **very important** to read the following information, before proceeding to program the meter:

- There is **no need to recalibrate** the meter for milliamps when first received from the factory.
- The meter is **factory calibrated** for milliamps prior to shipment. The calibration equipment is certified to NIST standards.
- Use the *Scale* menu to enter the default 2-point scaling without a signal source - or
- Use the *Calibrate* menu to apply a signal from a calibrator or a flowmeter for the default 2-point scaling.

Note: *The Scale and Calibrate functions are exclusive of each other. The meter uses the last function programmed. Only one of these methods can be employed at a time. The Scale and Calibrate functions can use up to 32 points (default is 2). The number of points should be set in the Advanced Features menu under the Multi-Point Linearization (LnERR) menu selection prior to scaling and calibration of the meter, see page 37 for details.*

Additional parameters, not needed for most applications, are viewed and programmed with the *Advanced features* menu, see Advanced Features Menu page 33.



Scaling the Meter (SCALE)

The 4-20 mA input can be scaled to display the process in engineering units.

A signal source is not needed to scale the meter; simply program the inputs and corresponding display values.

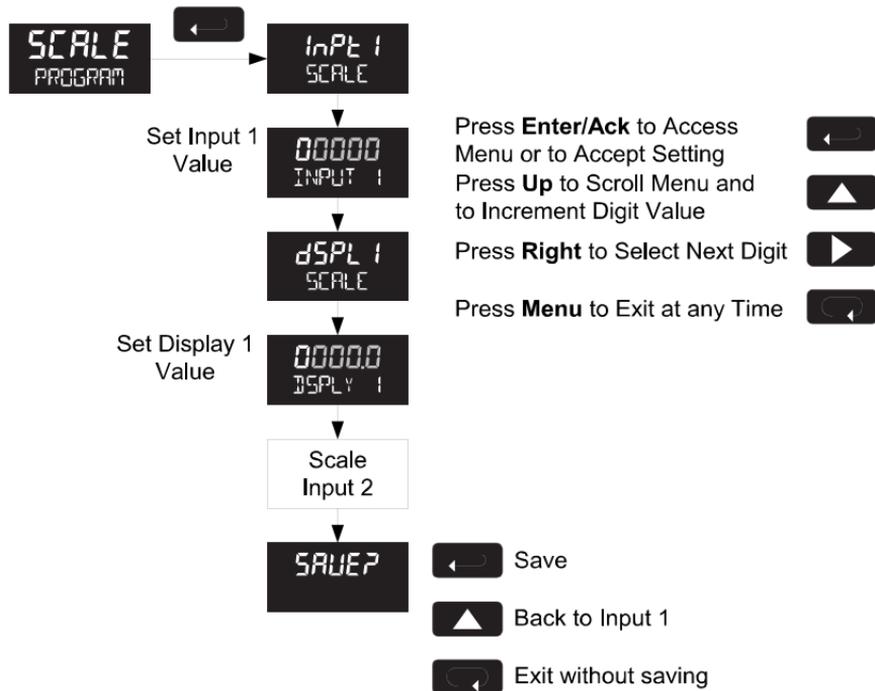


Figure 8. Scale Menu

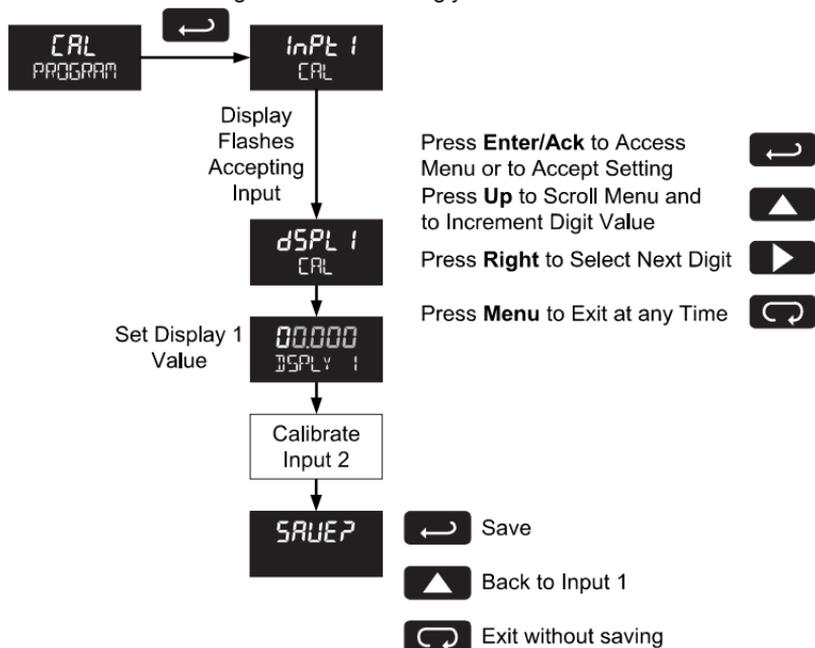
For instructions on how to program numeric values see *Setting Numeric Values*, page 21.

Calibrating the Meter (cRL)

To scale the meter without a signal source refer to Scaling the Meter (ScaLe], page 25.

The meter can be calibrated to display the process in engineering units by applying the appropriate input signal and following the calibration procedure.

The use of a calibrated signal source is strongly recommended.



1. Press the **Up** arrow button to scroll to the *Calibration* menu (cRL) and press **Enter**.
2. The meter displays *InPt 1*. Apply a known signal and press **Enter**. The display will flash while accepting the signal.
3. After the signal is accepted, the meter displays *d5PL 1*. Press **Enter**. Enter a corresponding display value for the signal input, and press **Enter** to accept.
4. The meter displays *InPt 2*. Apply a known signal and press **Enter**. The display will flash while accepting the signal.
5. After the signal is accepted, the meter displays *d5PL 2*. Press **Enter**. Enter a corresponding display value for the signal input and press **Enter** to accept.
6. After completing calibration the *SAVE?* display will need to be acknowledged using the **Enter** key before calibration will take effect.

Minimum Input Span

The minimum input span is the minimum difference between input 1 and input 2 signals required to complete the calibration or scaling of the meter. The minimum span is 0.10 mA.

If the minimum span is not maintained, the meter reverts to input 2, allowing the appropriate input signals to be applied.

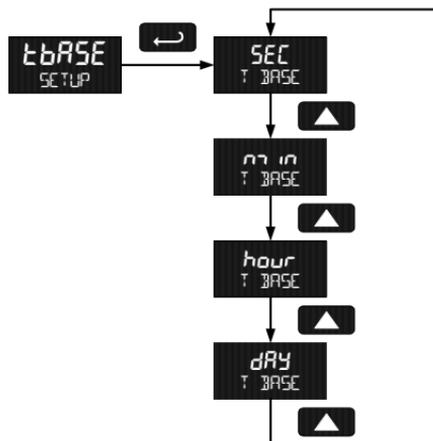
Re-Calibrating the Internal Calibration Reference (ICRL)

The *Internal Calibration (ICRL)* menu, located in the *Advanced* features menu, is used to recalibrate the internal calibration reference. Recalibration is recommended at least every twelve months. Refer to *Internal Calibration (ICRL)*, page 40 for instructions.

Setting the Time Base (tBASE)

The meter calculates total based on rate and a time base of units per second, minute, hour, or day.

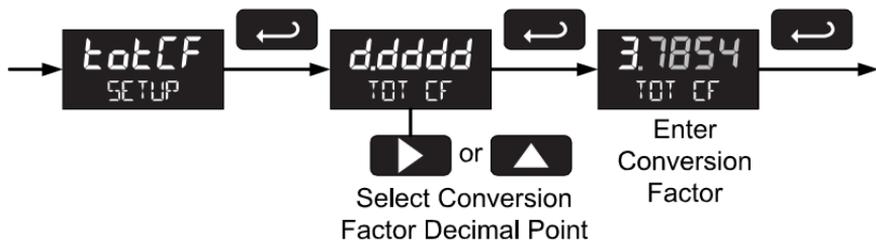
Press the **Enter** button, at any time, to accept a setting or **Menu** button to exit without saving changes.



Setting the Total Conversion Factor (TotCF)

Total Conversion Factor is used to convert to a different unit of total display. For example, to display rate in gallons and total in liters, enter a conversion factor of 3.7854. When rate and total units are the same, the Conversion Factor should be 1.0000.

Press the **Enter** button, at any time, to accept a setting or **Menu** button to exit without saving changes.



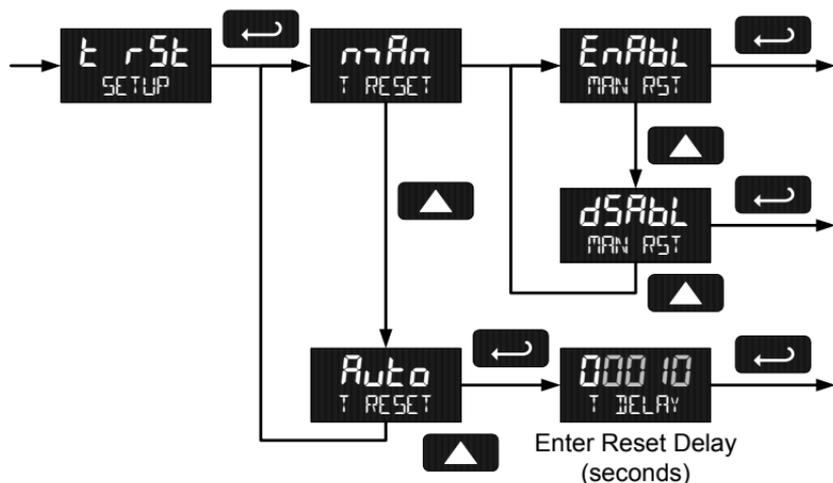
Manual or Automatic Total Reset Function (t rSt)

The meter may be programmed to reset the total either manually using the **Reset** button or automatically. Manual reset button may be disabled to avoid inadvertent total reset.

The automatic reset is based on the set point programmed in the *Advanced* menu: **OUTPUT** → **ALARM** → **LOAL**. Once the set point is reached, the meter waits for a programmed amount of time (t dLY) and then resets the total to zero.

- To enable total reset by **Reset** button, choose **MAN** → **ENABL**.
- To disable total reset by **Reset** button, choose **MAN** → **DSABL**.
- To reset total upon total alarm set point, choose **AUTO**, enter a time delay (t dLY), and proceed to programming the set point, see page 36.

Press the **Enter** button, at any time, to accept a setting or **Menu** button to exit without saving changes.



Setting the Tag Display (TAG)

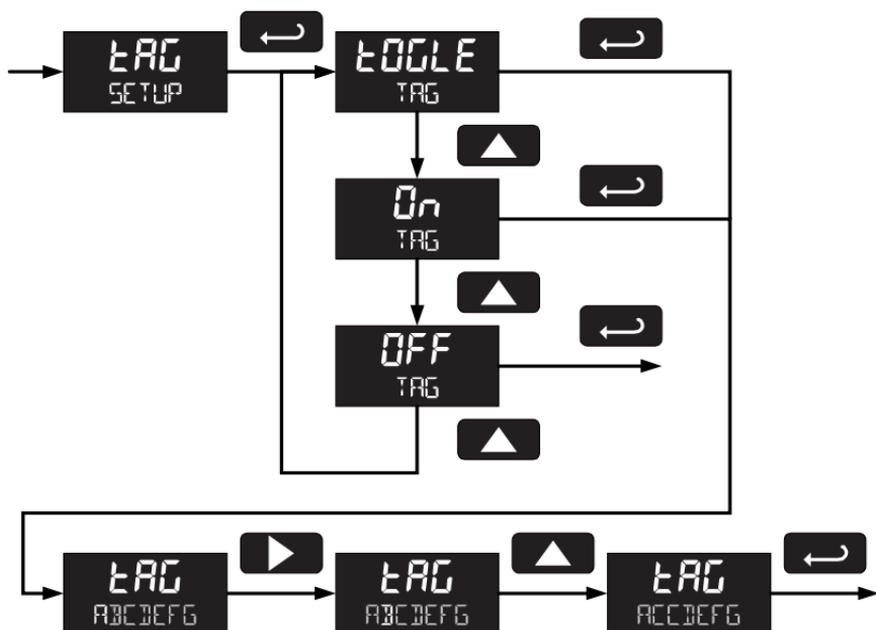
The meter can be set to display a combination of seven alphanumeric characters for engineering units (e.g. GALLONS) or for identification (e.g. TANK 3). Press **Right** arrow to select next unit and **Up** arrow to increment unit.

- To automatically cycle the lower display between total reading for ten seconds and tag for two seconds, choose **TOGLE**.
- To disable the tag display and show only total reading uninterrupted on the lower display, choose **OFF**.
- To show tag only on the lower display choose **On**. Totalizing continues in the background, but is not shown while **On** is selected.

Selecting **On** or **TOGLE** prompts for entry of the tag.

The unit being changed blinks.

Press the **Enter** button, at any time, to accept a setting or **Menu** button to exit without saving changes.



Setting Up the Password (PASSWORD)

The *Password* menu is used to program a five-digit password to prevent unauthorized changes to the programmed parameter settings. The lock symbol is displayed to indicate that settings are protected.

Locking the Meter

Enter the *Password* menu and program a five-digit password.

For instructions on how to program numeric values see Setting Numeric Values, page 21.



Record the password for future reference. If appropriate, it may be recorded in the space provided.

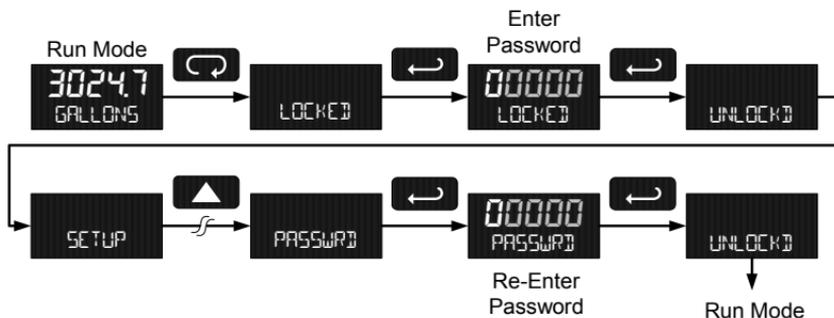
Model:	
Serial Number:	
Password:	_ _ _ _ _

Making Changes to a Password Protected Meter

If the meter is password protected, the meter will display the message `LOCKED` when the Menu button is pressed. Press the Enter button while the message is being displayed and enter the correct password to gain access to the menu. After exiting the programming mode, the meter returns to its password protected condition.

Disabling Password Protection

To disable the password protection, access the *Password* menu and enter the correct password twice, as shown below. The meter is now unprotected until a new password is entered.



If the correct six-digit password is entered, the meter displays the message `UNLOCKED` (*unlocked*) and the protection is disabled until a new password is programmed.

If the password entered is incorrect, the meter displays the message `LOCKED` for about two seconds, and then it returns to Run Mode. To try again, press Enter while the *Locked* message is displayed.

Did you forget the password?

The password may be disabled by entering a master password. If you are authorized to make changes, enter the master password 50865 to unlock the meter.

Service Feature (SERVICE)

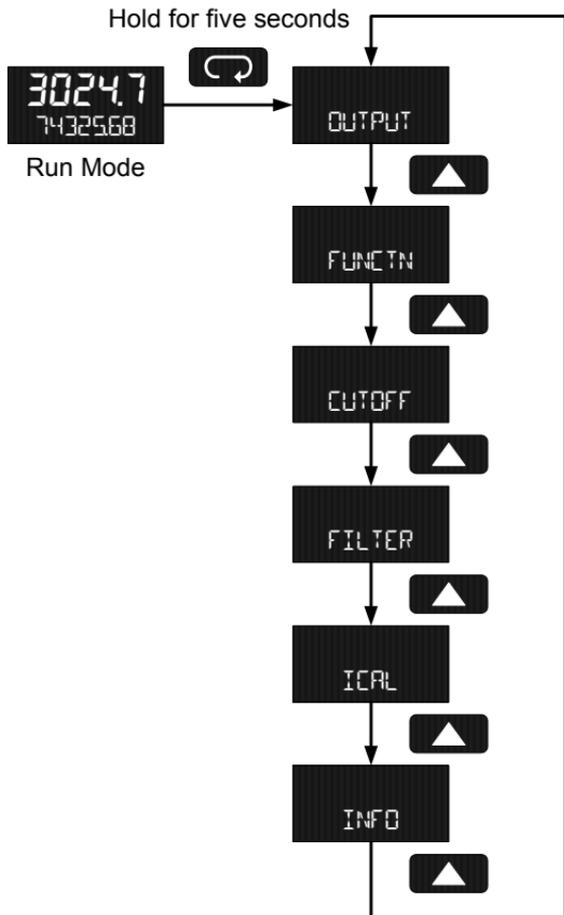
Select `SERVICE` from the main menu to temporarily disable the through-window buttons to prevent inadvertent use. Buttons will automatically resume operation after 60 seconds. The display blinks the message `SERVICE` during this period. This should be used when cleaning the window and when installing or removing the cover while power is applied (in a safe area only).

The service menu is not shown when the through-window buttons are disabled using the slide switch located on the connector board.

Advanced Features Menu

To simplify the setup process, functions not needed for most applications are located in the *Advanced* features menu. Press and hold the **Menu** button for five seconds to access the *Advanced* features menu.

Press the **Enter** button to access any menu or press **Up** arrow button to scroll through choices. Press the **Menu** button to exit at any time.



Advanced Features Menu & Display Messages

The following table shows the *Advanced* features menu functions and messages in the order they appear in the menu.

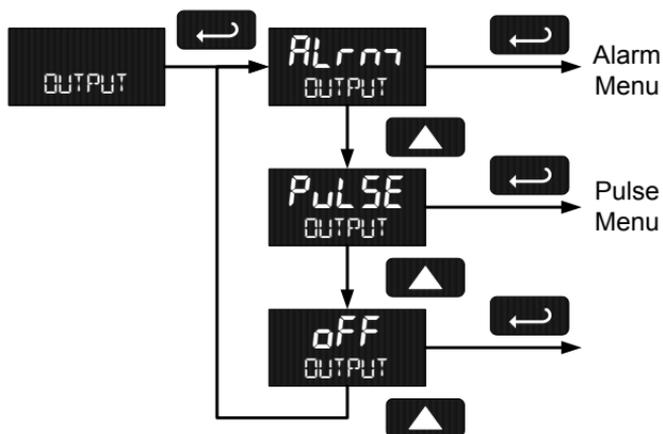
Display	Parameter	Action/Setting
OUTPUT	<i>Output</i>	Enter output menu
OFF	<i>Off</i>	Disable output
ALARM	<i>Alarm Output</i>	Enter alarm output menu
RATE	<i>Rate Alarm</i>	Assign alarm output to rate
TOTAL	<i>Total</i>	Assign alarm output to total
SET	<i>Set Point</i>	Program set point
RESET	<i>Reset Point</i>	Program reset point
PULSE	<i>Pulse Output</i>	Program pulse output K-factor
MAX FZ	<i>Frequency</i>	Program pulse output maximum frequency
FuncT	<i>Function</i>	Enter advanced function menu
LINEAR	<i>Linear</i>	Set linear scaling
SQR	<i>Square Root</i>	Set square root extraction
PROG.E	<i>Programmable Exponent</i>	Set programmable exponent
CUTOFF	<i>Low-Flow Cutoff</i>	Set low-flow cutoff
FILTER	<i>Filter</i>	Set noise filter
OFF	<i>Filter Off</i>	Disable noise filter
LO	<i>Filter Low</i>	Set noise filter to low setting
MED	<i>Filter Medium</i>	Set noise filter to medium setting
H I	<i>Filter High</i>	Set noise filter to high setting
ICAL	<i>Internal Calibration</i>	Enter internal reference calibration
INFO	<i>Meter Information</i>	Show software number and version, or reset to factory defaults
SFt	<i>Software</i>	Software number
VER	<i>Software Version</i>	Software version
RESET DEFAULTS	<i>Reset Defaults</i>	Restore factory default parameter settings

For instructions on how to program numeric values see *Setting Numeric Values*, page 21.

Alarm & Pulse Output (OUTPUT)

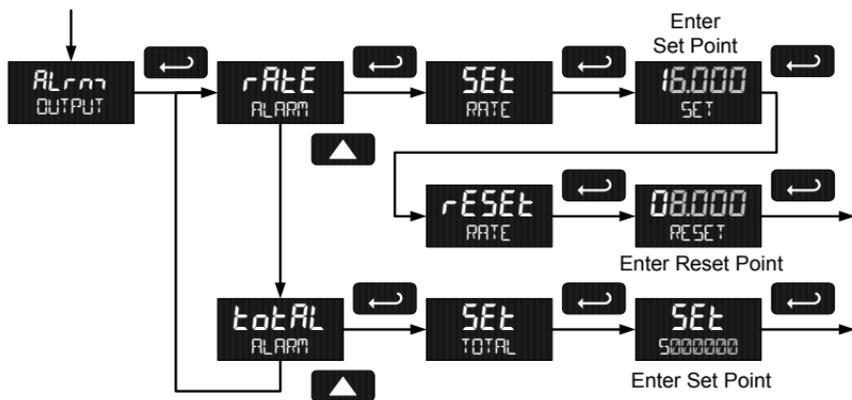
The X145 is equipped with an NPN open collector output that may be set up for high or low rate alarm trip point, total alarm trip point, or pulse output based on K-Factor. The pulse output frequency may be programmed for 2, 4, 8, 16, 32, 64, or 128 Hz.

The output may be disabled by selecting *oFF*. When alarm indication is enabled, the HI and LO symbols are used accompanied by a flashing display. The alarm status will show on the display even if the output is not wired.



Alarm Output (ALARM)

- **Rate high alarm trip point:** program set point above reset point.
- **Rate low alarm trip point:** program set point below reset point.
- Rate alarm deadband is determined by the difference between set and reset points. Minimum deadband is one display count. If set and reset points are programmed the same, output will reset one count below set point.
- **Total alarm trip point:** program total set point. Alarm reset is triggered by total reset (There is no reset parameter entered for total). If automatic total reset is enabled, this setting will be the trigger point for the timer. *It is not necessary to have the output wired for automatic reset function to work.*

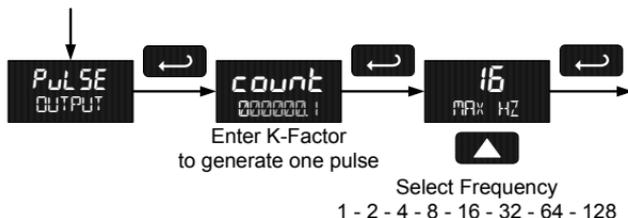


To acknowledge an alarm, press the **Enter** button once for acknowledge prompt and a second time to confirm.

Pulse Output K-Factor (PULSE)

The pulse output K-factor corresponds to the total units (e.g. gallons) needed to generate one pulse. For example, if the K-factor value is set to 10, one pulse is generated for every 10 counts incremented on the display.

If the pulse output exceeds the programmed output frequency, pulses are accumulated as pending. Pulses will continue to output until the buffer is emptied or the total is reset from the front panel.



1 - 2 - 4 - 8 - 16 - 32 - 64 - 128

Advanced Function Selection (FUNCTION)

The *Advanced Function* menu is used to select the advanced function to be applied to the input: linear, square root, programmable exponent, or round horizontal tank volume calculation. The multi-point linearization is part of the linear function selection.

Meters are set up at the factory for linear function with 2-point linearization. The linear function provides a display that is linear with respect to the input signal.

Multi-Point Linearization (LINEAR)

Up to 32 linearization points can be selected under the Linear function. The multi-point linearization can be used to linearize the display for non-linear signals such as those from level transmitters used to measure volume in odd-shaped tanks or to convert level to flow using weirs and flumes that require a complex exponent. These points are established via direct entry (SCALE) or with an external calibration signal (CAL).

Manual Entry (SCALE)

Manual entry of the linearization data is done once the number of points has been selected (NUMPTS). Input signal levels (INP_{i-32}) for up to 32 points, along with the desired/corresponding meter reading ($d_{SP_{i-32}}$) should be entered for each linearization point. See Figure 9 on page 38.

External Calibration (CAL)

Linearization data can be entered using a known accurate signal source (INP_{i-32}) and then entering the desired/corresponding meter reading ($d_{SP_{i-32}}$) for that input signal level. See Figure 9 on page 38.

Important Navigation Note:

After entering the last display value, the linearization entries must be saved (SAVE?) before they will be put into effect. *However*, you may move past this selection using the Up arrow key if you need to go back and correct an earlier entry. Once confident in the entries however, the user must navigate back to the Save menu screen (SAVE?) and press the Enter key to save the changes.

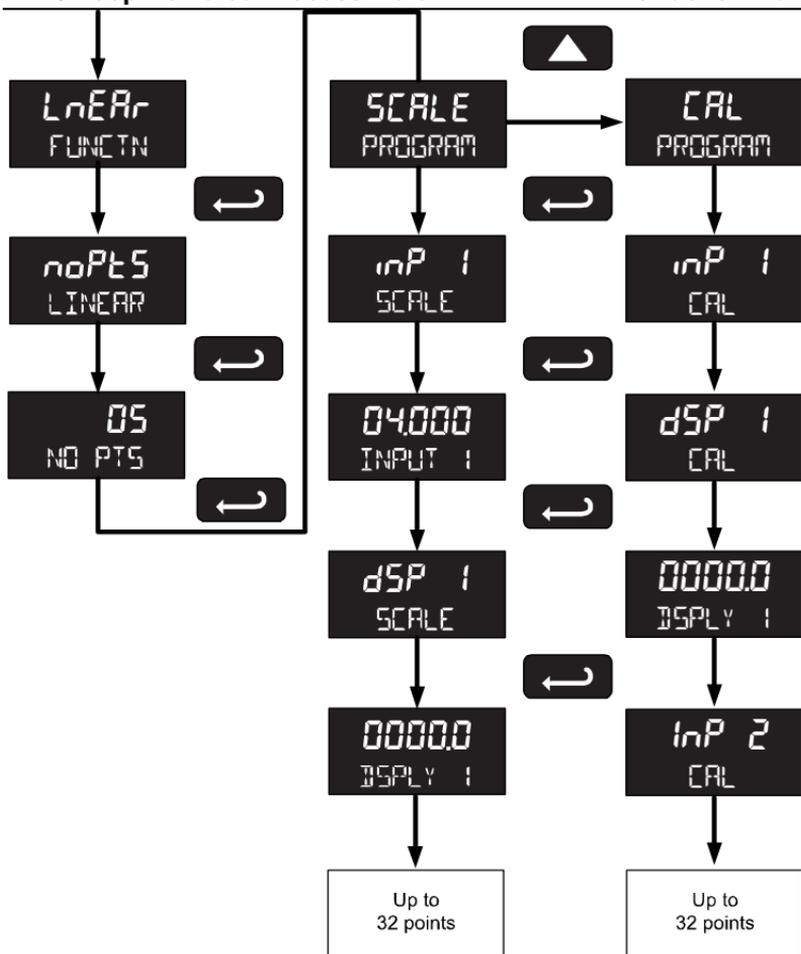


Figure 9. Multi-Point Linearization Menu

Square Root Linearization (SQUR)

The square root function can be used to linearize the signal from a differential pressure transmitter and display flow rate in engineering units.

Programmable Exponent Linearization (PROGE)

The programmable exponent can be used to linearize the signal from level transmitters in open-channel flow applications using weirs and flumes.

Low-Flow Cutoff (CUTOFF)

The low-flow cutoff feature allows the meter to be programmed so that the often-unsteady output from a differential pressure transmitter, at low flow rates, always displays zero on the meter. The default cutoff is zero to prevent negative readings, but this may be overridden to allow them.

The cutoff value may be programmed from -0 to 99999. Below the cutoff value, the meter will display zero. Selecting either square root or programmable exponent will set the cutoff value to 0. Program the cutoff value to 0 to disable.

Input Signal Filter (FILTER)

The noise filter is available for unusually noisy signals that cause an unstable process variable display. The noise filter averages the input signal over a certain period. The filter level can be set to low (L F), medium (M E D), high (H I), or off (OFF). The higher the filter setting, the longer the averaging time and so the longer the display may take to find its final value.

The filter contains a noise filter bypass feature so that while small variations in the signal will be filtered out, large, abrupt changes to the input signal are displayed immediately.

Internal Calibration (ICRL)

There is **no need to recalibrate** the meter for milliamps when first received from the factory.

The meter is **factory calibrated** for milliamps prior to shipment. The calibration equipment is certified to NIST standards.

The internal calibration allows the user to scale the meter without applying a signal. The use of a calibrated signal source is necessary to perform the internal calibration of the meter. Check calibration of the meter at least every 12 months.

Notes:

The signal source must have a full-scale accuracy of 0.002% or better between 4 and 20 mA in order to maintain the specified accuracy of the meter.

Allow the meter to warm up for at least 15 minutes before performing the internal calibration procedure.

The *Internal calibration* menu is part of the *Advanced features* menu.

Press and hold the **Menu** button for 5 seconds to enter the *Advanced features* menu. Press the **Up** arrow button to scroll to the *Internal Calibration* menu (ICRL) and press **Enter**.

The meter displays 4000 mA. Apply a 4.000 mA signal and press **Enter**. The display flashes for a moment while the meter is accepting the signal.

After the signal is accepted, the meter displays 20000 mA. Apply a 20.000 mA signal and press **Enter**. The display flashes for a moment while the meter is accepting the signal.

Error Message (SPAn ERROR)

An error message indicates that the calibration process was not successful. After the error message is displayed, the meter will revert to input 2 calibration settings. The error message might be caused by inadvertently leaving the signal at the previous level or not maintaining the minimum span. Press the Menu button to cancel the current calibration process if necessary.

Information (INFO)

The *Internal calibration* menu is part of the *Advanced features* menu. It shows software identification number and version number. To determine the software version of a meter:

Go to the *Information* menu (INFO) and press **Enter** button.

Continue pressing **Enter** to scroll through the software release number and software version.

Following the information display, the meter will exit the *Advanced features* menu and return to run mode.

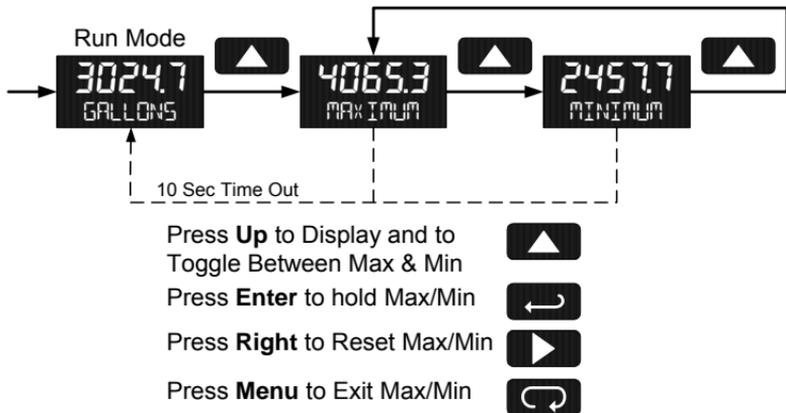
OPERATION

Front Panel Buttons Operation

Button Symbol	Description
	Press to enter or exit Programming Mode or exit Max/Min readings
	Press to reset total (if enabled) Press to reset Max/Min readings
	Press to display Max/Min readings alternately
	Press to acknowledge alarm (if enabled) Press to display Max or Min reading indefinitely while displaying Max or Min

Maximum & Minimum Readings (MAXIMUM & MINIMUM)

The maximum and minimum (peak & valley) readings reached by the rate are stored in the meter since the last reset or power-up. The meter shows MAXIMUM or MINIMUM to differentiate between run mode and max/min display. Press **Enter** to remain in Max/Min display mode. If **Enter** is not pressed, the Max/Min display reading will time out after ten seconds. The meter will return to display the actual reading.



Reset Meter to Factory Defaults

When the parameters have been changed in a way that is difficult to determine what's happening, it might be better to start the setup process from the factory defaults.

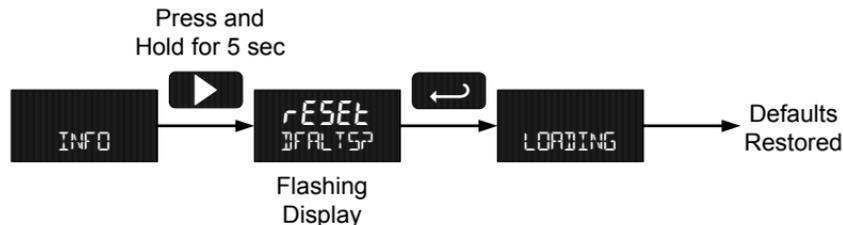
Instructions to load factory defaults:

Enter the *Advanced* features menu.

Press and hold **Reset** button when **INFO** is shown.

Press **Enter** when **RESET DEFAULTS** prompt is shown

Note: If **Enter** is not pressed within three seconds, the prompt will stop flashing return to showing **INFO**.



Factory Defaults & User Settings

The following table shows the factory setting for most of the programmable parameters on the meter. Next to the factory setting, the user may record the new setting for the particular application.

Model: _____ S/N: _____ Date: _____

Parameter	Display	Default Setting	User Setting
Programming	PROGRAM	Scale	
Input 1	InPt 1	4.000 mA	
Display 1	dSP1	4.000	
Input 2	InPt 2	20.00 mA	
Display 2	dSP2	20.000	
Decimal point rate	dddd	3 places	
Decimal point total	ddddddd	2 places	
Tag	tAG	Off	
Time Base	tBASE	Minute	
Conversion Factor	tCF	1.0000	
Total Reset Function	t rSt	Manual - Enabled	
Password	PASSWD	00000 (unlocked)	
Advanced Features			
Output	OUTPUT	Off	
Function	FUNCTN	Linear	
Cutoff	CUTOFF	0 (disabled)	
Filter	FILTER	Low	

TROUBLESHOOTING

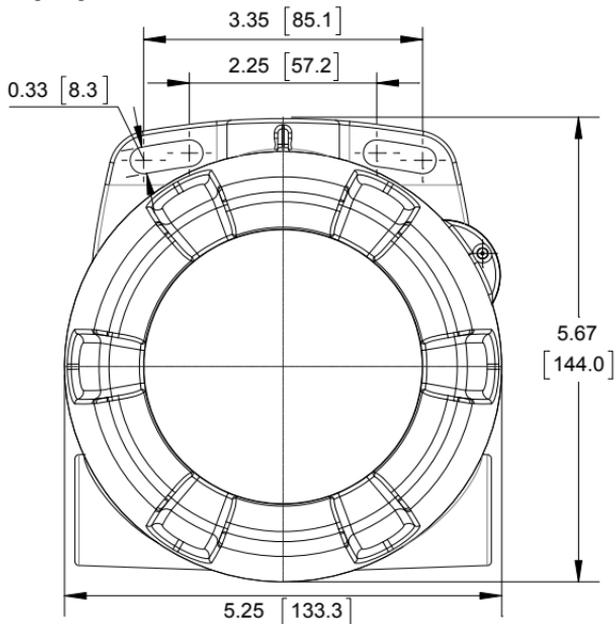
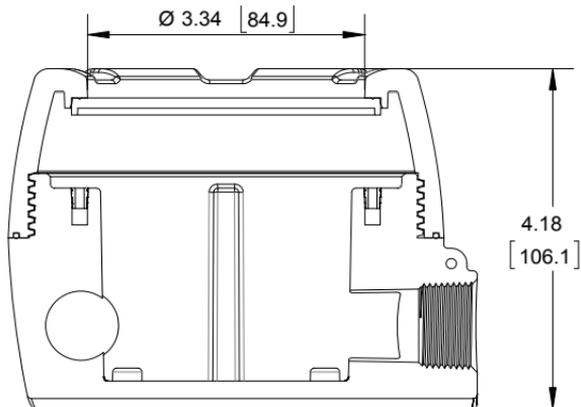
The rugged design and the user-friendly interface of the meter should make it unusual for the installer or operator to refer to this section of the manual. If the meter is not working as expected, refer to the recommendations below.

Troubleshooting Tips

Symptom	Check/Action
No display or faint display	Check input signal connections. Perform hard reset by shorting S+ and S- terminals.
Rate display unsteady	Increase filter setting in <i>Advanced</i> menu.
Meter displays error message during calibration (SPRN ERROR)	Check signal connections. Verify minimum input span requirements
Meter flashes 99999 or -9999	Check input signal is within scaled range of 99999 and -9999.
Display stuck displaying MAXIMUM or MINIMUM	Press Menu to exit Max/Min display readings.
Display response is too slow	Check filter setting to see if it can be lowered to <i>LO</i> or <i>OFF</i> .
If the display locks up or the meter does not respond at all	Perform hard reset by shorting S+ and S- terminals.
Backlight does not appear.	Backlight is intended for viewing assistance in dim lighting conditions. It may not be noticeable under good lighting conditions. Check connections are as shown in Figure 3 or Figure 4 on page 12.
Other symptoms not described above	Call Technical Support for assistance.
Through-window buttons do not respond	Service menu was selected or mechanical button was pushed. The through-window buttons will be re-enabled automatically 60 seconds after the last button push. If slide switch on connector board is in Lock position, switch to Unlock. Sunlight can interfere with the sensors. It is recommended to shield the window from sunlight while operating the buttons by standing so as to block direct sunlight.

MOUNTING DIMENSIONS

All units: inches [mm]

**Figure 10. Enclosure Dimensions – Front View****Figure 11. Enclosure Dimensions – Side Cross Section View**

QUICK USER INTERFACE REFERENCE

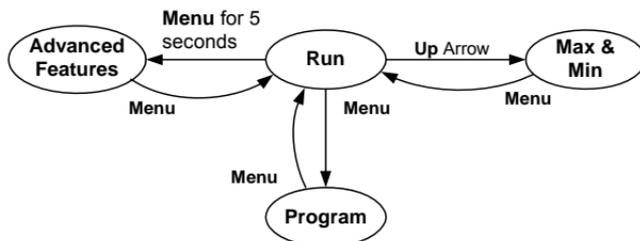
<u>Pushbutton</u>	<u>Function</u>
Menu	Go to Programming Mode or leave Programming, Advanced Features, and Max/Min Modes.
Right Arrow	Move to next digit or decimal point position. Reset Total.
Up Arrow	Move to next selection or increment digit. Go to Max/Min Mode.
Enter/Ack	Accept selection/value and move to next selection. Acknowledge Alarm.

Menu held for 5 seconds enters Advanced Features Menu

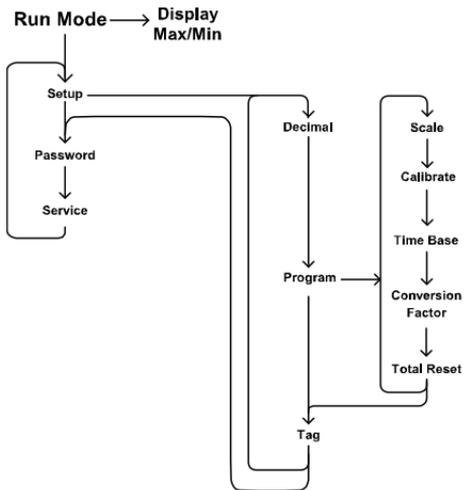
Max/Min Mode

While in Run Mode, pressing **Up Arrow** will initiate Max/Min Mode. **Up Arrow** toggles between Max & Min displays, and **Right Arrow** resets the Max/Min to the current value. Press **Menu** or wait 10 seconds to return to Run Mode. Pressing **Enter/Ack** will disable the 10 second timeout and continuously display Max or Min.

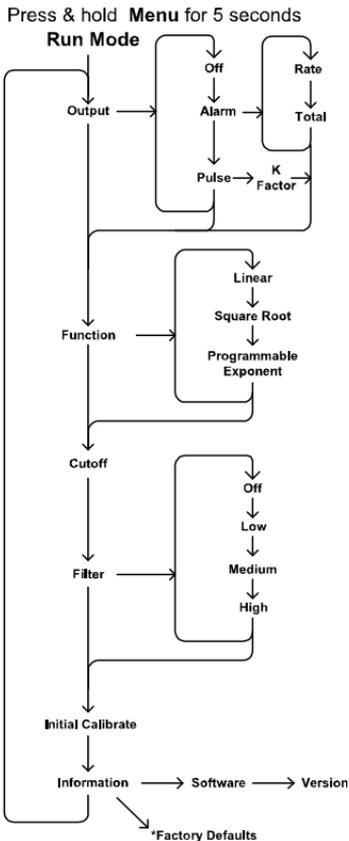
Operational Modes



Main Menu



Advanced Menu



*Access by holding **Right/Reset** for 3 seconds

CLA-VAL

1701 Placentia Avenue • Costa Mesa, CA 92627

800-942-6326 • Fax: 949-548-5441 • Web Site: cla-val.com • E-mail: info@cla-val.com

CLA-VAL CANADA

4687 Christie Drive
Beamsville, Ontario
Canada L0R 1B4
Phone: 905-563-4963
Fax: 905-563-4040
E-mail sales@cla-val.ca

CLA-VAL EUROPE

Chemin des Mésanges 1
CH-1032 Romanel/
Lausanne, Switzerland
Phone: 41-21-643-15-55
Fax: 41-21-643-15-50
E-mail: cla-val@cla-val.ch

CLA-VAL UK

Dainton House, Goods Station Road
Tunbridge Wells
Kent TN1 2 DH England
Phone: 44-1892-514-400
Fax: 44-1892-543-423
E-mail: info@cla-val.co.uk

CLA-VAL FRANCE

Porte du Grand Lyon 1
ZAC du Champ du Périer
France - 01700 Neyron
Phone: 33-4-72-25-92-93
Fax: 33-4-72-25-04-17
E-mail: cla-val@cla-val.fr

CLA-VAL PACIFIC

45 Kennaway Road
Woolston, Christchurch, 8023
New Zealand
Phone: 64-39644860
www.cla-valpacific.com
E-mail: info@cla-valpacific.com