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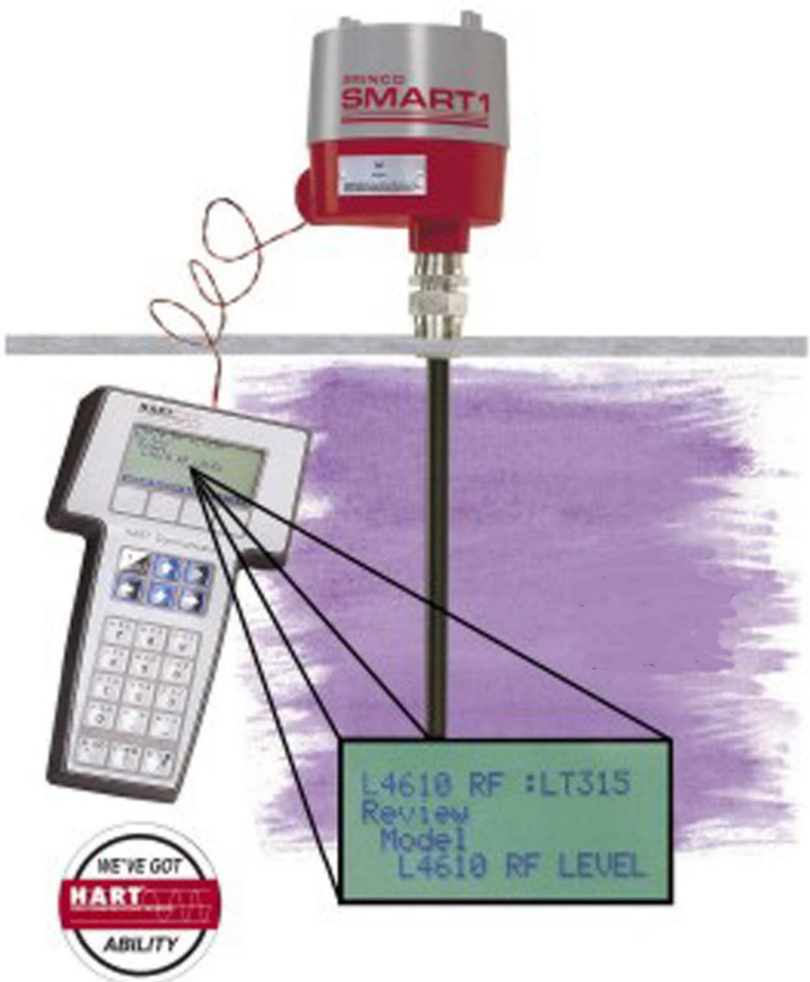
Instruction Manual

Princo Model L4610

SMART 1 Level Transmitter
with Digital NULL-KOTE™

Rev 2, June 2013



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1 Description

1.1 Introduction

This manual covers routine operation and maintenance of the Princo Instruments Models L4610 and L4610R SMART 1 Level Transmitters. This equipment is designed and built to meet the highest industry standards and achieves maximum performance with very little special attention. The procedures in this manual, however, must be followed closely for best results.

Any questions or problems not resolved by this manual should be referred to Princo Instruments, 1020 Industrial Highway, Southampton, PA 18966.

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All inquiries should include the following specific references:

1. Customer Order Number

3. Probe Model Number

2. Transmitter Serial Number

4. Process Material Type

1.2 General Description

The Princo Model L4610 Level Transmitter is a microprocessor-based, RF, impedance-sensing device, which, when connected to any Princo L100 Series Probe, can be used to accurately measure the level of process material within a storage vessel.

The basic instrument consists of a modular electronic chassis contained within a heavy-duty cast aluminum, weatherproof, explosion-proof housing. The instrument housing has a removable lid, which exposes the electronic chassis. The chassis is composed of four circular printed circuit boards, which are held together by a removable system of mechanical spacers, and electrical interconnects. The chassis is easily removed from the instrument housing, allowing convenient replacement of the various board layers, should troubleshooting be required.

Each printed circuit board performs a specific task, which is relevant to the overall transmitter operation. The top board contains a terminal block, which provides signal and power interface to the external world. This board also contains a "human" I/O interface, consisting of a dot matrix, alphanumeric LCD readout and three push-button switches for input. The three descending printed circuit layers contain the sophisticated analog/digital measurement, signal processing, and communication circuits. These circuits comprise the hardware medium for the software that controls the complete transmitter functionality.

The housing, with internal electronics, attaches directly to any one of the Princo L100 Series continuous level probes. The L4610 maintains the integral style mount, in that a mechanical, as well as electrical, probe connection is made by simply screwing the housing directly onto the probe upper hub NPT fitting. The probe lower hub NPT fitting threads directly into the storage vessel, thus allowing probe entry into the vessel, as well as mechanically and electrically fixturing the transmitter/probe measurement system to the vessel construction.

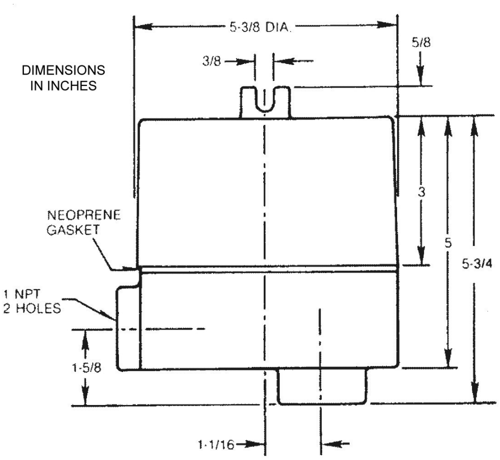


Figure 1-1. L4610 Dimensional Drawing

(Integral Unit)

The Model L4610R (remote unit) allows the electronic controller to be installed in a location removed from the process storage vessel. It consists of a standard L4610 electronic chassis mounted inside a clear-covered, plastic, NEMA 4X housing, which is connected to a Model L216 Remote Head via a Model L214 tri-axial cable. Standard cable length is 25 feet. Connection to the probe is made by simply screwing the L216 onto the probe's 1-inch NPT fitting.

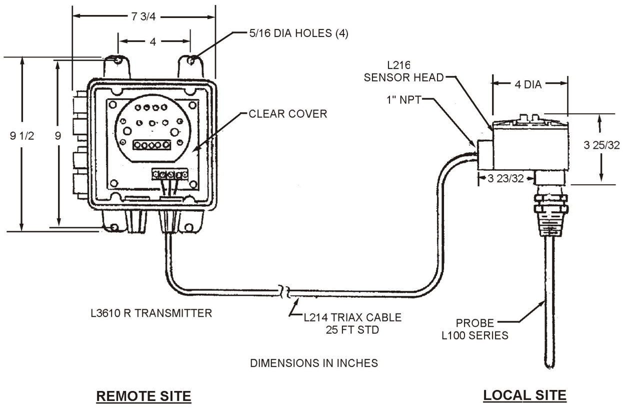


Figure 1-2. L4610R Dimensional Drawing (Remote Unit)

1.3 Functional Description

The major functional features of the L4610 Transmitter are as follows:

- **RF Impedance Technology**

The L4610 SMART1 Transmitter utilizes RF impedance technology proven in thousands of applications. The principle of operation is very simple: a sensing probe, either rigid or flexible, is mounted in the vessel. As the level of the material changes, the RF impedance between the sensing element and the vessel wall changes proportionally with the level. This impedance change is measured, converted to a digital signal, processed by the microprocessor software algorithms, and displayed locally as a real-time numeric readout of the level or volume. In addition, the level or volume information is transmitted as a standard 4 to 20mAdc signal and as an frequency shift keying (FSK) digital bit stream.

- **High Accuracy**

The L4610 Transmitter is substantially more accurate than conventional analog level transmitters that use similar measurement technology. Increased accuracy is achieved by a proprietary Auto Gain Adjust circuit. This circuit, under microprocessor control, dynamically adjusts the amplification of the signal, such that an optimum signal is achieved for the particular real-time level conditions within the storage vessel.

This is in contrast with conventional level transmitters which fix signal amplification for a given process span. The conventional approach sacrifices measurement resolution at the low end of the process span, in order to accommodate the entire span without amplifier saturation.

- **Digital Nullkote™**

In addition, the L4610 achieves increased accuracy when required to measure process materials that are considered electrically conductive and tend to coat the probe. Under these circumstances, the transmitter invokes Digital Nullkote™ - a new approach that negates the measurement errors associated with these coatings.

Digital Nullkote™ is accomplished by measuring the capacitance proportional to the process material level, as well as the capacitance and resistance representative of the material coating.

The transmitter generates a sine wave signal that is proportional in amplitude and phase to this complex impedance. This signal, under microprocessor control, is demodulated into its phasor components - capacitive component (proportional to actual level plus capacitive error), and resistive component (proportional to capacitive error). These two separate analog signals are converted to digital equivalents and processed by the microprocessor software algorithms. The result is an enhanced ability to ignore conductive coatings, which may form on the measurement probe.

- **HART Communications**

The L4610 uses a communications medium known as HART Protocol, Rosemount Corporation's acronym for Highway Addressable Remote Transducer. Developed as an open protocol, HART has become the industry standard for smart transmitter communication.

In conformance to HART Protocol, the L4610 Transmitter provides simultaneously a 4 to 20mA analog signal transmission and digital communications on the same two-wire signal loop. The digital signal is superimposed upon the analog signal in such a way as to not affect or alter the analog signal.

The analog signal, with fast update rate, can be used to control a process. The digital signal can be used simultaneously to access a variety of diagnostic and maintenance information, to configure and calibrate the transmitter, and to monitor, on a real-time basis, the various digital process variables.

- **Stand-Alone or Remote Operation**

The L4610 Transmitter provides the user with powerful monitoring, configuration and calibration abilities. The transmitter can be used in two basic ways: locally, via the built-in push-button controls and alphanumeric LCD readout, and remotely, via a hand-held HART Communicator (HHC) or other HART compatible master device.

In local operation, the L4610 serves as a completely independent, stand-alone level transmitter. Menu driven prompts guide the user through the various operational modes, such that process variable monitoring, transmitter configuration and calibration are easily accomplished without the use of a separate HART compatible master.

In remote operation, the transmitter interfaces to a hand-held HART Communicator or other HART master. The digital communications capability allows the L4610 to be configured, calibrated and monitored from a location remote from the measuring site, anywhere along the signal loop. This means that personnel need not be perched on tall vessels, exposed to inclement weather, or in other hazardous locations or situations to calibrate the unit. In addition, personnel need not venture to the measurement site to re-calibrate, re-configure, or confirm proper operation of the Transmitter. The L4610 communicates with any standard HART compatible hand-held (HHC), HART-compatible distributed control system, or HART-compatible PC based system.

- **Multiple Process Variable Monitoring**

The L4610 Transmitter can be field configured and/or calibrated to allow simultaneous monitoring of multiple process variables. The transmitter measures and outputs, in real-time, the following process variables:

Percent Range Level: This is a representation of level, expressed as a percentage of the difference between two level points (Upper Range Value & Lower Range Value) within the storage vessel. The transmitter is normally configured to output this process variable as a standard 4 to 20mA analog signal.

In addition, the transmitter outputs Percent Range Level as a digital process variable, by displaying it on the local LCD readout, and sending it over the HART data link. Thus, it can be monitored, in remote fashion, on the status screen of hand-held HART Communicator or other HART Master.

Percent Range Volume: The representation of volume, expressed as a percentage of the difference between two volume points (Upper Range Value & Lower Range Value) within the storage vessel. The transmitter can be configured to output this process variable as a standard 4 to 20mA analog signal.

In addition, the transmitter outputs Percent Range Volume as a digital process variable, by displaying it on the local LCD readout, and sending it over the HART data link. Thus, it also can be monitored, in remote fashion, on the status screen of the hand-held HART Communicator or other HART Master.

It should be noted that this process variable can be monitored only if the transmitter is properly configured to monitor Actual Volume.

Actual Level: The actual level of the process material as measured from the storage vessel bottom in units of linear measure. The transmitter can be configured, from the HHC, to account for a separation distance from the probe tip to the vessel bottom.

The transmitter outputs Actual Level as a digital process variable by displaying it on the local LCD readout, and sending it over the HART data link. Thus Actual Level can be monitored remotely at the HHC.

The units of this digital process variable can be selected from the HHC, such that the transmitter outputs the actual level in inches, feet, centimeters, or meters.

Actual Volume: The actual volume of the process material as measured from the storage vessel bottom in units of volumetric measure. The transmitter can be configured, from the HHC, to output Actual Volume for any one of a number of standard tank styles. These tank styles include: Vertical Cylinder, Horizontal Cylinder, Horizontal Cylinder with Spherical End Caps, Horizontal Cylinder with Elliptical End caps, and Spherical. Non-standard tank styles can be factory configured.

The transmitter outputs Actual Volume as a digital process variable by displaying it on the local LCD readout, and sending it over the HART data link. Thus it can be monitored remotely at the HHC.

The units of this digital process variable can be selected from the HHC, such that the transmitter outputs the actual volume in gallons, cubic feet, imperial gallons, cubic centimeters, cubic meters, or liters.

- **Multiple Calibration Methods**

The L4610 Transmitter guides the user through calibration using a choice of methods. These methods are designed to facilitate accurate calibration while minimizing associated costs. The standard transmitter is supplied pre-calibrated. However, if re-calibration is required, it can be accomplished in several ways.

Sensor Trim Calibration (wet): The Sensor Trim is a calibration function, which can be invoked by using a hand-held HART Communicator. This function allows field adjustment to the basic "units" calibration such that accurate monitoring of actual level (inches, feet, centimeters, meters) can be obtained.

The Sensor Trim function is actually a two-point calibration, in which the Transmitter calculates the slope of the linear equation Y=MX+B, where Y=Actual Level (from tank bottom in units of length), M=Unit Length/Pico farads (rise/run - calculated by the transmitter from two measured picofarad values and two corresponding level values input from the HHC), X=Current Level Measurement in picofarads, and B=Tank Offset (distance from the tank bottom to the probe tip in units of length).

The transmitter takes a capacitance measurement, of the process material level, at two specific points along the length of the probe. The points can be any two levels, as long as the points are reasonably separated.

The transmitter uses these values, along with the associated actual level values input to the transmitter from the HHC (i.e. determined by sight-glass, dipstick, or known reference levels), to calculate the slope (M) of the above linear equation.

Once the Sensor Trim is executed, the transmitter reverts to normal operating mode. In this mode the transmitter takes repeated measurements of the real-time level, at a specific periodic time interval. The length of such time interval is typically 500 milliseconds.

Each time through this basic measurement cycle, the transmitter uses the Current Level Measurement (X), along with the above-calculated slope (M), and the Tank Offset (B), to dynamically calculate the Actual Level (Y) in units of linear measure. The resultant Actual Level (Y) is output, within the same measurement cycle, as a digital process variable (PV) on the local LCD and HART data link.

The Sensor Trim Function ensures probe calibration to the actual process application, such that the transmitter outputs the Actual Level (digital PV output - inches, feet, centimeters, meters), for any point along the probe length.

Sensor Trim Calibration (dry): The above Sensor Trim function (wet) directs the transmitter to determine the slope (M) of the above linear equation. This is accomplished by moving the process material level to specific known reference level points (Hi Trim point and Lo Trim point). The transmitter is instructed to take capacitance measurements at each reference point, which it subsequently uses to determine the slope of the linear equation.

The Dry version of the Sensor Trim function invokes the same linear equation. However, the process material level does not have to move in order for the transmitter to establish the slope (M) of the linear equation. The transmitter does not take capacitance measurements of two reference level points. Instead, picofarad equivalents of two reference level points are sent to the transmitter from the HHC. These two capacitance values are the result of calculations, supplied by Princo Instruments Inc., which take into account the specifics of the given application. The transmitter uses these values, along with the level equivalents, also sent to the transmitter from the HHC, to determine the slope. In this way, accurate monitoring of the Actual Level process variable can be achieved, without requiring the user to move material levels within the vessel.

Range Calibration (wet): The Range Calibration Function is a calibration procedure which can be invoked remotely, using the HHC, or locally, using the push-button/LCD interface. This is the only calibration method that may be done through local operation. This function establishes a calibration for the Percent Range Level process variable, independent of the Actual Level process variable.

Range Calibration is merely a means of establishing two reference points, which the transmitter uses to dynamically calculate a representation of the process material level, which is expressed as a percentage of the difference between these two points.

The transmitter takes a capacitance measurement at two specific level points along the length of the probe. The upper point is known as the Hi Range point or Upper Range Value (URV). The lower point is known as the Lo Range point or Lower Range Value (LRV). The points can be any two levels as long as the points are reasonably separated.

Once the Range Calibration is executed, the transmitter reverts to normal operating mode. In this mode the transmitter takes repeated measurements of the real-time process material level - typically every 500 milliseconds.

Each time through this basic measurement cycle, the transmitter uses the above-established Range to calculate the percentage of the Range that the measurement represents. The resultant Percent Range Level is output, within the same measurement cycle, as a digital process variable on the local LCD, the HART data link, and as a 4 to 20mA analog signal.

The Range Calibration, and resultant Percent Range Level process variable, are completely independent of the Sensor Trim Calibration and resultant Actual Level process variable. That is, once a Sensor Trim Calibration is performed, the transmitter can be Range Calibrated ("re-ranged"), with no affect on the Actual Level process variable as previously calibrated.

Range Calibration (dry): The above Range Calibration function (wet), directs the transmitter to take capacitance measurements at two specific level points, which the user would like to associate with the 4 mA and 20 mA points of the analog output signal. These two points, Upper Range Value and Lower Range Value, are used to determine the Percent Range Level process variable.

The Dry version of this Range Calibration function allows the user to install an Upper Range Value and Lower Range Value without having to move the process material level within the storage vessel. Instead, the Dry version allows direct installation of these values from the HHC.

The Upper Range Value and Lower Range Value are first defined by the user. These points can be any physical position on the probe (as measured from the tank bottom), provided there is reasonable separation between the two. From the HHC, Range Units are selected, and the corresponding numeric representations are entered. The transmitter receives these values, and uses them in the same way it does for the measured capacitance values (wet version), to calculate the Percent Range Level process variable.

The Dry Range Calibration is the method of choice for situations in which the Actual Level and Actual Volume process variables are within acceptable accuracy. In this situation "ranging" amounts to simple numerical entry of the desired Upper Range Value and Lower Range Value, in linear or volumetric units.

It should be noted that the 4 to 20mA output signal represents the Percent Range Level process variable if the Range Units selected for Range Calibration (Dry) are linear units (inches, feet, centimeters, meters) and a Range Calibration (Dry) is performed. If the Range Units selected for Range Calibration (Dry) are volumetric units (gallons, cubic-feet, cubic-centimeters, liters), a Range Calibration is performed, and the transmitter has been configured to output the Actual Volume process variable, then the Percent Range Level process variable becomes Percent Range Volume. In this case the 4 to 20mA output represents Percent Range Volume, and is linear with volume for the particular Tank Style configuration.

Sensor Trim, Wet	**Sensor Trim, Dry**	**Range Cal, Wet**	**Range Cal, Dry**
User programs level values (in inches, meters, etc.). Unit reads equivalent capacitance values based on actual process levels on probe.	User programs level values (in inches, meters, etc.) and capacitance values calculated for specific application.	User moves process level to actual Upper Range and Lower range points on probe.	User programs in Upper Range and Lower Range values, does not have to move actual process level within storage vessel.
Reads out actual level.	Reads out actual level.	Does not read out actual level. Readout and 4-20mA are % of range.	Does not read out actual level. Readout and 4-20mA are % of range.
		Not dependent upon Sensor Trim.	Dependent upon accuracy of Sensor Trim.
HART cal only.	HART cal only.	HART or local cal.	HART cal only.

Table 1-1. Calibration Methods Summary

- **Local / Remote Diagnostics**

The L4610 Transmitter incorporates a powerful diagnostic software "engine", which is designed to process a host of error conditions, which could potentially occur during normal transmitter operation.

The software detects the error, and reports the condition, in the form of an error message, via the local LCD readout and remote HART data link. In addition, the transmitter analyzes each error condition and forces the analog output signal to an error state, if the error has the potential to impact the integrity of the basic level measurement.

The transmitter reports all error conditions in the form of an error code. The error code is immediately visible on the local LCD readout. However, the error is only annunciated over the HART data link. The operator must invoke the transmitter Test Function from the HHC, to determine the exact error condition.

1.4 L100 Series Probes

Princo offers a wide variety of probes for use with its continuous transmitters and multi-point controllers. Although the measurement technology remains the same, as outlined in the previous section, different probe designs are suited for different applications.

Electrical, chemical and mechanical considerations affect probe selection. Electrically, a ground reference must be present and the probe must be built to provide proper response.

Chemically, the probe must be compatible with the process material. It must be immune to attack and must offer no chance of contaminating the process.

Mechanically, the probe must be able to withstand the pressure and temperature extremes of the application. In addition, turbulence, consistency, viscosity, abrasion and mounting configuration also play a role in probe selection. A flexible probe is required where probe length exceeds 236 inches or where physical restrictions, such as lack of headroom, prevent installation of a rigid probe.

Single element probes (L101, L104 and L109) are often used in situations where a metal tank wall can provide an adequate ground reference (second element). Non-metallic vessels require dual element probes, as do most non-conductive process applications where probe response and/or linearity would be inadequate using the vessel wall as a ground reference.

Dual element probes are made with either parallel (L115, L116, L127, L128) or concentric (L102, L107) elements. Dual concentric probes provide the best response for low dielectric, low consistency, non-conductive processes as well as minimizing the effects of agitation.

Probe sheathing (Teflon®, Kynar®, or bare) is chosen with regard to chemical compatibility, as well as probe response and ability to withstand abrasion.

All Princo continuous level probes connect to their respective electronic units by means of a 1" NPT threaded hub. The "ground" contact is made by the threads themselves. The "active" contact is made by the spring-loaded pin which projects from the center of the hub NPT fitting. Probes mount to the storage vessel by means of various sizes of flanges, NPT connectors and TRI-CLAMP™ fittings. Refer to Section 2.2 for details.

For detailed listings and specifications for Princo Continuous Probe Selection Guide .

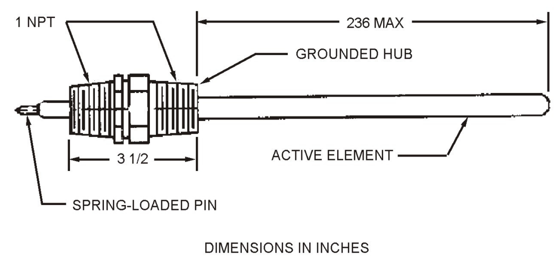


Figure 1-3. Typical 1" NPT Mounted Probe

(Model L101)

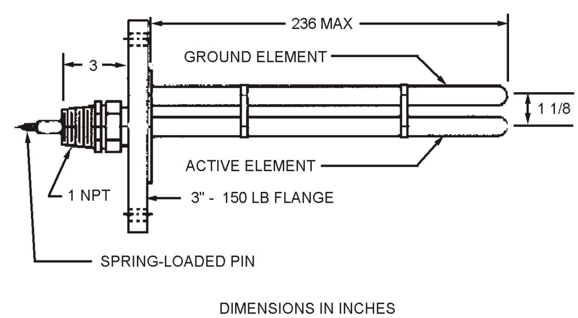


Figure 1-4. Typical 3" Flange Mounted Probe
(Model L127)

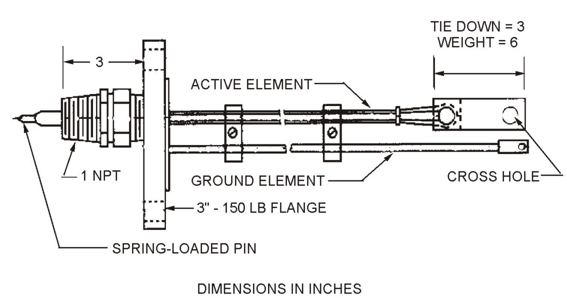


Figure 1-5. Typical Dual Flexible Probe

(Model L115)

2 Specifications

2.1 L4610 and L4610R Continuous Level Controllers

- TYPE

  Intelligent, microprocessor based, Auto Gain Adjust, Digital NullKote™, RF impedance-sensing, level transmitter.

- SPAN RANGE

  From 3 inches to 150 ft typical, depending upon probe type

  Capacitance range: 20 pF to 60,000 pF

- OUTPUT

1) HART Protocol: simultaneous transmission of analog (4 to 20mAdc) and digital FSK (frequency shift keying) signal on same twisted pair. Digital serial bit stream permits two-way communication and does not affect or alter analog 4 to 20mA signal.
   a) Baud Rate: 1200 bps.
   b) Digital "0" Frequency: 2200 Hz.
   c) Digital "1" Frequency: 1200 Hz.
   d) Single digital process variable rate: 2.0 per second.
   e) Digital signal carries multiple process variables: % Level Range, % Volume Range, Actual Level (inches, feet, centimeters, meters), Actual Volume (gallons, cubic feet cubic centimeters, liters).
   f) Digital signal carries configuration, calibration, diagnostics, data and instructions.
2) Dot matrix alpha-numeric LCD display
   a) User-friendly, menu-driven operator interface (push-button operation).
   b) Process variable display.
   c) Configuration / Calibration.
   d) Diagnostics.

- LINEARITY / ACCURACY

  +/-0.5% typical

- TEMPERATURE STABILITY

  +/-0.015% per 1 degree F

- POWER REQUIREMENTS

  AC Models:

  115 Vac +/-10%, 50-60 Hz, 5 Watts

  220 Vac +/-10%, 50-60 Hz, 5 Watts

  DC Models:

  24 Vdc +/-10%, 2.0 Watts

- ELECTRONIC HOUSINGS

  L4610: Heavy-duty, cast aluminum.

  Explosion-proof for: Class I, groups C & D; Class II, groups E, F & G.

  Weather proof: NEMA 4.

  L4610R Sensor Head (Model L216): Heavy-duty, cast aluminum.

  Explosion-proof for: Class I, Groups C & D; Class II, Groups E, F & G; Class III.

  Weather proof: NEMA 7 CD, 9 EFG.

  L4610R Transmitter: Structural foam thermoplastic molded base with hinged, clear polycarbonate cover.

  Weather proof: NEMA 1,3, 3S, 4, 4X, 12, 13.

2.2 L100 Series probes

- TYPE

  Single- and dual-element, continuous, RF impedance level probes.

- DESCRIPTION BY MODEL NUMBER

  The below list includes the most commonly used probes. Princo also makes other variations for special applications.

MODEL NO.	ELEMENT CONFIGURATION	TYPE	VESSEL CONNECTION	INSULATION OPTIONS
L101	Single	Rigid	1" NPT	B, KP, KS, TP, TS
L104	Single	Rigid	1", 2", 3" OR 4" TRI-CLAMP™	B, KP, KS, TP, TS
L102	Dual Concentric	Rigid	1½" NPT	B, KP, KS, TP, TS
L107	Dual Concentric	Rigid	1" NPT	B, KS, TP, TS
L109	Single	Flexible	1" NPT	KW, TW
L113	Dual Parallel	Flexible	1" NPT	KW, TW
L115	Dual Parallel	Flexible	3" Flange	KW, TW
L116	Dual Parallel	Flexible	3" Flange	KW, TW
L127	Dual Parallel	Rigid	3" Flange	B, KP, KS, TP, TS
L128	Dual Parallel	Rigid	3" Flange	KP, KS, TP, TS

B = Bare (No insulation)

KP = Kynar® Pipe (60 mil Kynar over carbon steel)

KS = Kynar® Sheath (17 mil Kynar over 316 SS rod)

TP = Teflon® Pipe (60 mil PFA Teflon over 316 SS rod)

TS = Teflon® Sheath (17 mil Teflon over 316 SS rod)

KW = Kynar ®Wire (20 mil Kynar over 316 SS wire rope)

TW = Teflon® Wire (12 mil Teflon over copper wire)

- PRESSURE / TEMPERATURE RATINGS

Model Number	Probe Covering	Pressure Rating (PSI) at Temperature Indicated (ºF)						
		-300	-40	100	250	300	400	500
L101, L102, L104, L107, L109, L113	Teflon or Bare	1250	1250	1250	550	450	350	0
	Kynar		1000	1000	250	0		
L115, L116, L127, L128	Teflon or Bare	275[1]	275[1]	275[1]	225[1]	210[1]	180[1]	0
	Kynar		275[1]	275[1]	225[1]	0		

NOTES:

1. Rating of Carbon Steel 150 lb. flange. For higher ratings, consult factory.
2. Temperature Limits: Bare or Teflon covered probes: -300ºF (-184ºC) to 500ºF (260ºC); Kynar covered probes: -40ºF (-40ºC) to 300ºF (149ºC). For temperatures beyond these limits, consult factory.

- SELECTION GUIDE / PHYSICAL DIMENSIONS

Refer to Princo Continuous Probe Selection Guide

3 Installation

3.1 Inspection

The L4610 & L4610R Transmitters are supplied with one of the Princo L100 Series Level Probes (sensing element). The transmitter and probe are normally shipped in separate packages.

Carefully remove each package's contents and check each item against the packing list. Inspect each item for shipping damage. In particular, check the spring-loaded connection pin, located on the threaded hub end of the probe (see figures 1-3, 1-4 and 1-5). This pin provides the necessary electrical connection from the transmitter bottom printed circuit board, to the active element of the probe. Make sure this pin is not missing, bent, jammed, or otherwise damaged.

If the probe has a sheathed active element, then carefully inspect the condition of the sheathing. Make sure that the sheathing forms a smooth continuous coverage over the metal active element. Discontinuities in the sheathing material, which breach through to the active element will render the probe useless in most applications. Report any such damage immediately to the factory.

> CAUTION!
>
> Care must be exercised when handling probes that incorporate an insulating sheath. Do not allow the sheathed sensing element to come in contact with a rough or sharp surface, as this may cause a breach in the insulating sheath, and render the probe inoperable.

3.2 Installation

The L4610 & L4610R Transmitters are supplied pre-calibrated according to probe type, process material characteristics, and probe mounting geometry. This information was supplied to Princo Instruments at the time the equipment was ordered. The final sale of this equipment was factory approved on the basis of this information.

3.2.1 Mounting Headroom

Proper specification of a Princo Model L100 Series Probe must take into consideration the amount of space available above the storage vessel from which the probe can be lowered into the vessel. This aspect must be considered prior to probe selection and ordering.

In a situation where headroom limits the use of a rigid type probe, a flexible cable type probe may be used. Refer to Figure 1-1 for the dimensions of the L4610 electronics assembly.

3.2.2 Probe Mounting

3.2.2.1 Mounting Location

Single element probes use the metal tank wall as a ground reference. If they are used in non-conductive applications, they must be mounted close to the sidewall of the tank (6 to 8 inches recommended) and should maintain an equidistant spacing from the sidewall, as the spacing affects measurement linearity. (Princo generally recommends use of factory-made dual element probes for this reason.) When it is impossible to mount the sensing probe close to the sidewall, at least try to favor an off-center mounting. In conductive applications, single element probes may be mounted anywhere relative to metal tank walls. Refer to Figure 3-1.

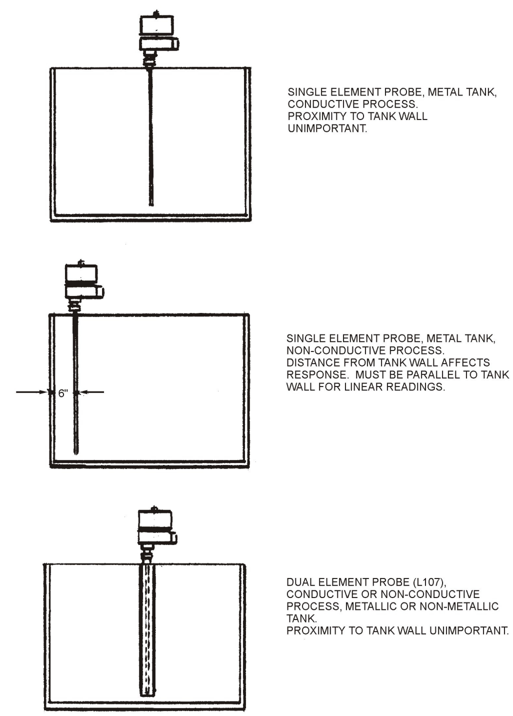


Figure 3-1. Probe Mounting Locations

Dual element probes have a built-in ground reference and generally can be mounted anywhere relative to tank walls, regardless of whether the process is conductive or non-conductive.

Be careful not to mount probes any closer than necessary to such devices as baffles, agitators, heaters, etc. This is especially important when the process is non-conductive. When the process is conductive, it is only necessary to have adequate physical clearance, since there should be little or no adverse electrical effects due to proximity of these devices.

Whether the process is conductive or non-conductive, try to mount the probe in an area where the level is stable and representative. Mounting near an input flow or near splashing might create artificially high-level readings. Mounting in a vortex created by a mixer might give an atypically low reading.

3.2.2.2 Ground Reference

Normally, dual element probes (probes with built-in ground references) are used in non-metallic storage vessels. A single element probe may be adapted to the same purpose by supplying a ground reference. The ground reference should be a metal rod, equal in length to the probe. The reference should be mounted parallel to the length of the probe, no greater than 6 to 8 inches from it.

The reference must be electrically connected to the transmitter chassis ground, either directly to the terminal strip ground terminal, or indirectly, by wiring it to the threaded hub of the probe or to the metal housing of the electronic unit. In any case, perform Ground Continuity Test, Section 3.2.4.3 to ensure that a good ground connection exists.

If the process is non-conductive, non-parallel spacing between the probe and the ground rod will negatively affect the linearity of the level readings. Also, the probe response will decrease as the distance between the two elements increases.

Princo L100 Series Probes are normally mounted by means of a flange (typically two or three inch insertion hole diameter) or an NPT type fitting (standard size is one inch).

3.2.2.3 Flange Type Probes

Slip the probe tip into the storage vessel entry port. Lower the probe into the vessel, until the probe flange seats and aligns with the corresponding mating surface on the storage vessel. Fasten the flange to the vessel using the appropriate metal fasteners, gaskets, and sealing compounds, as required by the specific installation.

3.2.2.4 NPT Type Probes

Slip the probe tip into the storage vessel NPT-threaded entry port. Lower the probe into the vessel until the probe's lower hub NPT fitting seats into the vessel NPT receptacle. Use an appropriately sized wrench on the probe hub hex head fitting, to tighten the probe lower hub NPT threads into the storage vessel NPT receptacle.

> CAUTION!
>
> Single element, flange type probes must be fastened to the storage vessel with metal fasteners such that electrical continuity exists (zero ohms) between probe flange and metal storage vessel. NPT type probes must be fastened to the storage vessel such that electrical continuity (zero ohms) exists between the probe NPT hub and the metal storage vessel. Do not use any kind of thread lubricant on the NPT threads. If lubrication and/or sealing are required, a small amount of Teflon tape can be used. Refer to Section 3.2.4.3 for ground continuity testing.

3.2.2.5 Cable Probe Tie-Down

Princo flexible cable type probes incorporate either a weight or a tie-down at the probe tip, which is designed to keep the sensing element taunt as it is immersed in the process material. Refer to Figure 1-5.

If the process material is agitated or is turbulent in any way, it may be necessary to fasten the probe tip to the bottom of the storage vessel. This can be accomplished by using a light cable or nylon rope, looped through the hole in the bottom of the weight or tie-down and, in turn, through a hook fitting in the bottom of the storage tank.

Do not apply excessive downward force to the cable-sensing element through the tie-down. It is not necessary and could potentially damage the probe.

Also, note that the weight or tie-down is not an electrically active part of the probe. That is, it stands below the zero level of the measured process material. Standard weight length is six inches. Standard tie-down length is three inches.

Teflon spacers on dual element probes (L113, L115, & L116) are designed to keep the dual cables equidistant. Try to maintain even spacing between them, and avoid crossing of cables by excessive twisting, as this will affect accuracy and linearity.

3.2.3 Electronic Housing Mounting

The electronic chassis of "integral" units (L4610) is contained within a cast aluminum housing. It is mounted onto the top of the probe by threading the housing's bottom NPT opening onto the probe hub's 1" NPT male connector. As with the probe to tank connection, electrical continuity must be maintained through the threaded connection.

NOTE
Do not use any type of thread lubricant on the NPT probe mounting threads or the NPT threads, which mount the electronic housing. Application of thread lubricant may cause faulty or improper ground connection. If required, Teflon tape may be used as a thread seal for either threaded connection. If Teflon tape thread sealant is used, the installer should make an electrical continuity check with a hand held ohmmeter. Less than 1 ohm resistance should exist between the storage vessel and the electronic housing. See Section 3.2.4.3.

The spring-loaded pin projecting from the middle of the probe NPT fitting should now be pressing against the underside of the bottom circuit board of the electronic chassis. This may be verified visually through the 1" NPT wiring port on the side of the housing. If the pin is failing to make contact, stretch the spring-loaded pin out further with a pair of pliers. To access the spring-loaded pin, either unthread the housing from the probe hub, or lift the electronic chassis out of the housing after removing the two 8-32 screws which hold it in. Hint: If the spring-loaded pin is properly contacting the circuit board, you will feel the chassis being pushed upward by it as you loosen the two 8-32 screws.

With "remote units" (L4610R), the procedure is basically the same, except that it is the Model L216 Remote Head, which is threaded onto the probe NPT fitting. The electronic chassis is contained in a clear-covered, plastic, NEMA 4X housing that is mounted in a location of the customer's choosing and connected by tri-axial cable to the probe via the L216 circuit board.

3.2.4 Electrical Connections

3.2.4.1 Electrical Connections – Integral Units

Remove the lid of the L4610 Transmitter in preparation for connection of signal and power wires. Before drawing wires into the equipment housing, remove the electronic circuit board chassis. This may be done by unfastening the two 8-32 chassis mounting screws and lift the chassis off of the mounting posts and out of the housing.

Bring the signal and power wires into the transmitter housing through the wiring port. Leave enough slack in each wire to make connection to the terminal block at the top of the transmitter.

Replace the electronic chassis back into the housing, the flat side of the printed circuit boards facing the wiring port. Slide the chassis onto the mounting posts, keeping the wires toward the housing inner wall, so as not to interfere with the chassis. Replace the two 8-32 mounting screws and tighten firmly to ensure proper chassis electrical ground connection.

Connect the signal and power wires to the terminal block as illustrated in the appropriate interconnection diagram of Figures 3-2, 3-3, and 3-4.

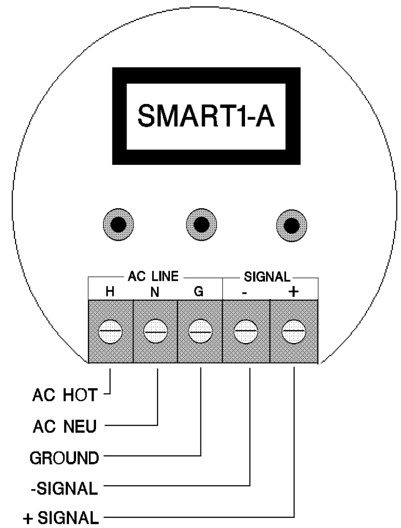


Figure 3-2. Electrical Connections 115Vac & 230Vac

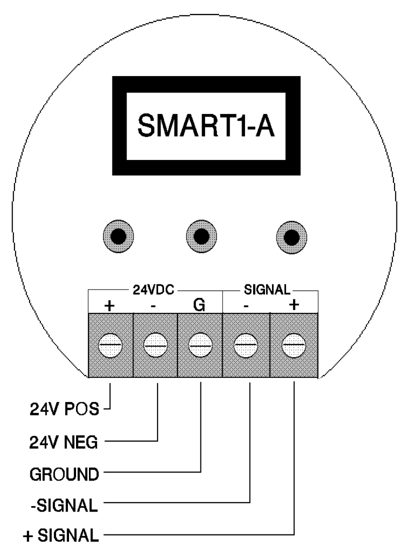


Figure 3-3. Electrical Connections 24Vdc, 5-Wire

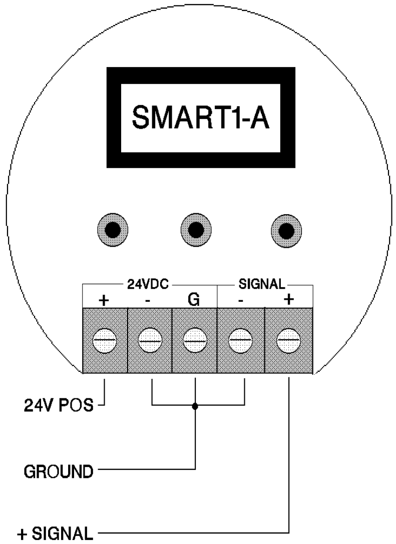


Figure 3-4. Electrical Connections 24Vdc, 3-Wire

3.2.4.2 Electrical Connections – Remote Units

The Model L214 tri-axial cable connects the probe to the L4610R electronic chassis through two three-connection terminal blocks. One is located on the circuit board of the L216 Remote Head. The other is on the electronic chassis mounting plate inside the plastic NEMA 4X housing. Refer to Figure 3-6 for the wiring diagram. Note that the wiring order on both terminal blocks is the same from left to right - Red (guard), Clear (active), and Black (ground). The cable may be drawn through the 1" NPT port on the side of the L216 housing and connected accordingly. Likewise, the other end of the cable can be drawn through one of the two ½ " NPT wiring ports on the control unit housing and connected to its terminal block.

The power and current output wires can be drawn through the other ½" wiring port and connected appropriately as per figure 3-6.

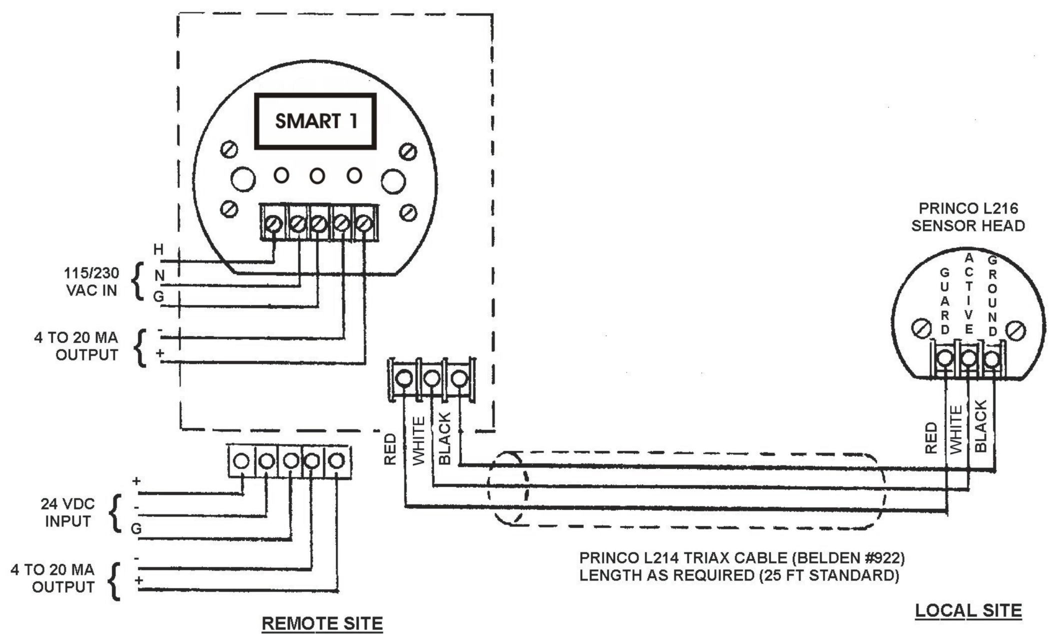


Figure 3-5. L4610R Dimensional Drawing (Remote Unit)

3.2.4.3 Ground Continuity Test

With unit power off, using an ohmmeter on the lowest range, a check between the following points should yield less than one ohm.

1. Point A (posts) to point B (housing).
2. Point B to point C (hub of probe).
3. Point C to point D (except in non-metallic tank).

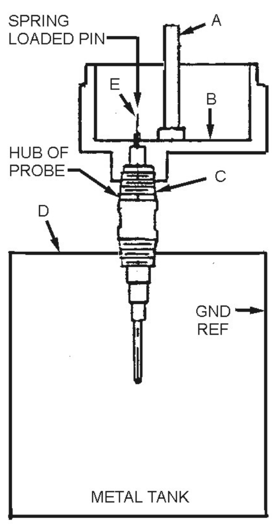


Figure 3-6. Ground Continuity Test

3.3 Installation in Hazardous Areas

The outline which follows points out some of the major requirements of the NEC's (National Electric Code) Section 501, as it relates to typical level control installations.

WARNING!
For applications that must be explosion-proof and/or weatherproof, it is the customer's responsibility to install the required conduit, seals, wiring, etc., which meet national, as well as applicable local and plant safety codes.

For Class 1 locations, rigid metal conduit must be used. At least five full threads of the conduit must be tightly engaged in the enclosure. Conduit seal fittings must also be used. These seal fittings, must be filled with an approved sealing compound and must be installed within 18 inches (or closer) of the enclosure. Conduit seals are also required when the conduit passes from a hazardous area into a non-hazardous area. Water drain seal fittings eliminate or minimize the effect of water that tends to collect in the conduit or enclosure due to condensation.

Approved wire type, such as mineral-insulated wire, is required for use in Division 1 installations. Certain types of metal-clad cable or shielded non-metallic sheathed cable are permitted in Division 2 installations. When multi-conductor cables are used in the conduit, the outer jacket must be cut away in such a manner that allows the sealing compound to surround each insulated wire as well as the jacket.

The preceding information should act as guide to assist the customer/installer in satisfying their responsibility for producing safe installations in hazardous area.

4 Operation

4.1 Operation

The L4610 Transmitter provides the user with powerful monitoring, configuration and calibration abilities. The transmitter can be utilized in two basic ways: locally, via the built-in push-button controls and alphanumeric LCD readout, and remotely via a hand-held HART communicator (HHC), or other HART master device.

In local operation, the L4610 serves as a completely independent, stand-alone level transmitter. Convenient push-button input and alphanumeric menu-driven prompts guide the user through the various operational modes. In this way, process variable monitoring, transmitter configuration and calibration are easily accomplished without the use of the digital communications feature.

In remote operation, the transmitter interfaces with an HHC or other HART master. The digital communications capability allows the L4610 to be configured, calibrated and monitored from a location remote from the measuring site, anywhere along the signal loop. The L4610 communicates with any standard HART compatible HHC, HART compatible distributed control system, or HART compatible PC based system.

4.2 Start-up

Before applying power to the L4610 Transmitter, be certain that the proper input voltage is applied, proper wiring connections made, and that the transmitter and probe are installed per the information contained in Section Three.

Apply power and allow 30 minutes before checking and/or adjusting calibration.

4.3 Local (Stand Alone) Operation

4.3.1 General

The L4610 Transmitter front panel contains an alphanumeric, dot-matrix LCD display and three push-button switches. These devices form an operator interface, which allows transmitter use without an HHC or other HART Master.

The three push-button switches are labeled “MODE”, “SET” and “INC”. These input switches each perform a specific function within the local operating system.

The MODE push-button instructs the transmitter to display the various Mode Menu Headings on the local LCD. The various Mode Headings are defined in Table 3-1 below.

Each depression of the Mode push-button produces a new Mode Heading on the local LCD readout. The Mode Headings appear successively, with each push-button depression, in the above listed order. When the last Mode Heading is displayed (CAL MODE), the next push-button depression produces the original SMART 1 default Mode Heading. In this way, the MODE push-button cycles through the various Mode Headings, from start to finish, and back to start again.

Once the particular Mode Heading is displayed, the SET push-button is used to enter that particular operational mode. The SET push-button is also used to instruct the transmitter to take measurements for use as calibration points. In addition, the SET push-button is used to input numbers into the L4610's microprocessor parametric database (i.e. high and low points for a Two-Point Calibration).

The INC push-button is used to increment a number as it appears on the local LCD readout (i.e. the high and low points for a Two-Point Calibration). The INC push-button is also used to return the Mode Heading back to the default SMART 1 position.

CAUTION!

Before the explosion-proof housing cover is removed (i.e. to access the local operator interface for calibration, monitoring, diagnostics, troubleshooting, etc.), the area must be known to be non-hazardous. When internal access is complete, the housing cover must be replaced. Secure housing cover tightly to assure proper seal. Per instructions in the installation section of this manual, all exit/entry ports must be equipped with an approved seal fitting.

4.3.2 Operational Modes

4.3.2.1 Process Monitoring (Percent Range Level)

SMART 1

At power up, the default Mode Heading appears. Depress the Mode push-button once.

%RNG LEV

The Percent Range Level Mode Heading appears. Depress the Set push-button to enter this mode.

<table>
<tr><th>MESSAGE DISPLAY</th><th colspan="2">MODE DESCRIPTION</th></tr>
<tr><td>SMART 1</td><td colspan="2">Firmware Version. Default Mode Heading</td></tr>
<tr><td>%RNG LEV</td><td colspan="2">Percent Range Level monitoring</td></tr>
<tr><td>%RNG VOL</td><td colspan="2">Percent Range Volume monitoring</td></tr>
<tr><td>%TNK LEV</td><td colspan="2">Percent Tank Level monitoring (un-configured for stand-alone - requires HHC)</td></tr>
<tr><td>% TNK VOL</td><td colspan="2">Percent Tank Volume monitoring (un-configured for stand-alone - requires HHC)</td></tr>
<tr><td>SERIAL #</td><td colspan="2">Display field/factory configured serial number</td></tr>
<tr><td>TANK STY</td><td colspan="2">Display field/factory configured Tank Style</td></tr>
<tr><td>OUT MODE</td><td colspan="2">Display field/factory configured Output Mode</td></tr>
<tr><td>MSR MODE</td><td colspan="2">Display field/factory configured Measurement Mode</td></tr>
<tr><td rowspan="6">CAL MODE</td><td colspan="2">Enter Calibration Sub-menu. (See Figure 4-4 for the full Cal Mode menu.) The following calibration modes are available from this sub-menu:</td></tr>
<tr><td>SET EMT?</td><td>Wet Calibration for Lower Range Value (LRV)</td></tr>
<tr><td>SET FUL?</td><td>Wet Calibration for Upper Range Value (URV)</td></tr>
<tr><td>2PT RNG</td><td>Wet 2-Point Range Calibration</td></tr>
<tr><td>OFFSET</td><td>Field adjustment of Tank Offset compensation</td></tr>
<tr><td>MAINMENU</td><td>Return to main menu from cal menu.</td></tr>
</table>

Table 3-1. Local Operation Modes

40.0%F

The digital process variable "Percent Range Level" is displayed. This is a real-time representation of the level conditions within the storage vessel, expressed as a percentage of the difference between the Upper Range Value (URV - the level point at which the "SET FUL?" calibration mode was invoked), and the Lower Range Value (LRV - the level point at which the "SET EMT?" calibration mode was invoked). The trailing "F" in the Percent Range Level display identifies percent Full (i.e. normal output signal - 4 mA @ 0%F, and 20 mA @ 100%F).

NOTE
The standard L4610 Factory configuration causes the analog output (4 to 20mA) signal to represent this "Percent Range Level" process variable.

60.0%E

If the L4610 Transmitter is factory configured for Reverse Output (i.e. output signal equals 4 mA @ 100%F, and 20 mA @ 0% F), then the digital representation of "Percent Range Level" is shown as the percentage "E" for empty. That is, at sixty percent empty, the vessel is forty percent full, across the calibrated range, and the output current is 13.6 mA.

4.3.2.2 Process Monitoring (Percent Range Volume)

%RNG VOL

Depress the Mode push-button until the Percent Range Volume Mode Heading appears. Depress the Set push-button to enter this mode.

40.0%F

The digital process variable "Percent Range Volume" is displayed. This is a real-time representation of the volume conditions within the storage vessel. If the L4610 is factory configured (or field configured from an HHC or other HART master) to measure volume for a specific tank geometry, then Percent Range Volume is available as shown. If no volumetric configuration is performed, then the Percent Range Volume display reads “UNCONFIG”.

4.3.2.3 Calibration (Cal Mode)

The Calibration Mode is a sub-menu of the various calibration functions that are available for stand-alone operation. See Figure 4-4 for a complete menu of the Cal Mode for local operation. A detailed description of each Cal Mode function occurs in the following sections.

CAL MODE

Depress the MODE push-button until the Cal Mode Heading appears. Depress the SET push-button to enter this mode. Operation from within the sub-menu is the same as previously described (see 4.3.1).

SET EMT?

The Set Empty Mode Heading appears. Depress MODE.

SET FUL?

The Set Full Mode Heading appears. Depress MODE.

2PT RNG

The 2-Pt Cal Mode Heading appears. Depress MODE.

OFFSET

The Offset Compensation Mode Heading appears. Depress MODE.

MAINMENU

The Main Menu Heading appears. Depress SET to return to the main-menu.

With other Cal Mode headings displayed, depress the SET push-button to enter the particular Cal Mode sub-menu.

4.3.2.4 Range Calibration, Wet (Set Empty / Set Full)

A Range Calibration is a means of establishing two reference points, which the Transmitter uses to dynamically calculate a representation of the process material level, which is expressed as a percentage of the difference between these two points.

In stand-alone operation, the L4610 transmitter establishes these reference points by taking a "wet" measurement of the process material level at each of two specific level points along the length of the probe. The process material level is physically raised or lowered to the points where the transmitter must indicate points, the appropriate Set Empty, or Set Full Calibration Mode is invoked.

The Set Empty Calibration and Set Full Calibration modes are completely independent calibration functions. Each of these functions can be performed independently, without altering the previously established opposite Range Value. As such, the executive sequence of these functions is not mandatory. The Set Empty Calibration can be performed, independently, to change the LRV only. Likewise, the Set Full Calibration can be performed, independently, to change the URV only.

In addition, the Set Empty Calibration and Set Full Calibration modes can be executed, in either order, to accomplish a complete Range Calibration.

SET EMT?

Raise or lower the process material level to the desired Low Range point within the storage vessel. The Low Range point must be the lower of the two reference level points. Depress MODE until CAL MODE appears. Depress SET to enter the Calibration Sub-menu. SET EMT? appears. Depress SET to enter this mode.

SET EMTY

SET EMTY appears. With the process material level at the correct Low Range point within the storage vessel, depress the SET to initiate the Set Empty Calibration.

RDG EMTY

RDG EMTY appears. The L4610 takes a measurement of the actual process material level for use as the Lower Range Value (LRV). During normal operation, the transmitter uses this measured capacitance value to calculate the Percent Range Level process variable.

CAL MODE

The Cal Mode Heading appears when the Set Empty Calibration is complete and the new LRV is established.

SET FUL?

Raise or lower the process material level to the desired High Range point within the storage vessel. The High Range point must be the upper of the two reference level points. Depress SET to enter the Calibration Sub-menu. Depress MODE until SET FUL? appears. Depress SET to enter this mode.

SET FULL

The SET FULL appears. With the process material level at the correct High Range point within the storage vessel, depress SET to initiate the Set Full Calibration.

RDG FULL

RDG FULL appears. The L4610 takes a measurement of the actual process material level for use as the Upper Range Value (URV). During normal operation, the transmitter uses this measured capacitance value to calculate the Percent Range Level process variable.

CAL MODE

CAL MODE appears when the Set Full Calibration is complete and the new URV is established.

> NOTE
>
> If the L4610 is configured to measure Percent Range Volume of a non-linear Tank Style (i.e. any Tank Style other than Vertical Cylinder), then the Low Range Mark MUST be located at the probe tip. Typically this is the bottom most point of the storage vessel inner wall surface - empty tank.
>
> In addition, the High Range Mark MUST be located at the top of the storage vessel. That is, the upper most point of the storage vessel inner wall surface - full tank.
>
> Failure to perform a Set Empty/Set Full Range Calibration with the Low Range Mark and High Range Mark in the above stated positions, will result in an inaccurate Percent Range Volume process variable, in both the digital and analog (4 to 20mA) representations.

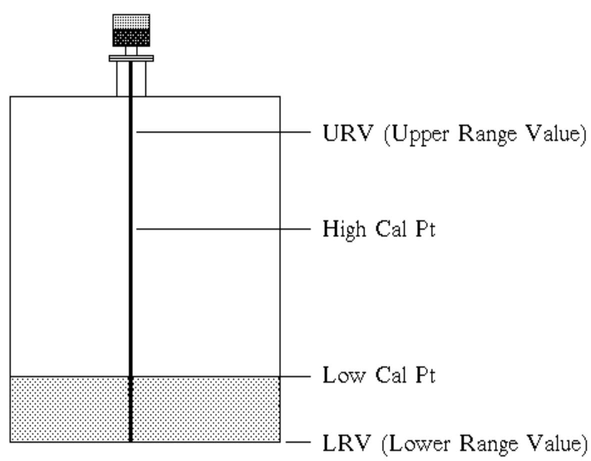
4.3.2.5 Range Calibration, Wet (2-Point Cal)

The above Set Empty and Set Full calibration modes can be performed together to perform a complete Range Calibration to the L4610 Transmitter. This particular method of Range Calibration requires the user to move the process material level to the Low Range point and High Range point to perform the complete calibration. Although this is the preferred method, it is not always the most practical when a large volume of process material must be displaced to perform such calibration.

The 2-Point Cal can be used to perform the same Range Calibration, except that the process material level does not have to be moved to the extremes of the Low and High Range points. Instead, the process material is positioned at two intermediate calibration points, from which the transmitter extrapolates the Lower Range Value and Upper Range Value.

The first step in performing a 2-Point Range Calibration is to establish exactly where the Low Range point (LRV), and High Range point (URV) are positioned within the storage vessel (refer to Figure 4-1). Once these physical positions have been determined, the process material is moved to the more convenient intermediate level points (Low Cal Pt and High Cal Pt) during the actual calibration procedure.

The two calibration points can be located anywhere along the physical probe length. The only restriction is that the High Cal Pt is positioned above the Low Cal Pt, and separated by at least 50 percent of the total Range (URV - LRV). Both High Cal and Low Cal must be performed to complete the calibration. They may be performed in any order. If just one is performed, the unit will maintain its previous calibration. The procedure is outlined below.



- URV (100 in.)
- High Cal Pt (75 in.)
- Low Cal Pt (25 in.)
- LRV (0 in.)

Note: Parameter Dimensions are referenced to Tank Bottom.

Figure 4-1. Example 1: 2 Point Cal, LRV at Probe Tip

Example 1. LRV at Probe Tip

Raise or lower the process material level to the desired Low Cal Point or High Cal Point within the storage vessel. Depress MODE repeatedly until CAL MODE appears. Depress SET to enter the Calibration Sub-menu. Depress MODE until 2PT RNG appears.

2PT RNG

Depress SET to enter the 2-Point Range Calibration Mode.

LOW PT

LOW PT appears. (If High Point adjustment is desired first, use the INC push-button to toggle to HIGH PT display. Proceed with HIGH PT cal below.) Depress SET to initiate the Low Point adjustment.

__%LO

% LO numerical value appears. Using sight-glass or dipstick method, measure the actual material level in the vessel. Calculate the value that this represents as a percentage of the desired measurement range. Enter this value in the displayed field by using INC to increment the value and SET to decrement.

25%LO

With the correct percentage shown, depress MODE.

SET LO?

SET LO? appears. Depress SET.

RDG LOW

RDG LOW appears. This action sets the percentage into microprocessor memory, and instructs the L4610 to take a measurement of the actual process material level.

HIGH PT

HIGH PT appears when the Low Point measurement is complete. (If High Point cal was performed first, CAL MODE appears. Depress SET to re-enter cal mode or press MODE to return to main menu.) Depress SET to initiate the High Cal Point adjustment.

__%HI

% HI numerical value appears. Using sight-glass or dipstick method, measure the actual material level in the vessel. Calculate the value that this represents as a percentage of the desired measurement range. Enter this value in the displayed field by using SET to decrement and INC to increment the value.

75%HI

With the correct percentage shown, depress MODE.

SET HI?

SET HI? appears. Depress SET.

RDG HI

RDG HI appears. This action sets the percentage into microprocessor memory, and instructs the L4610 to take a measurement of the actual process material level.

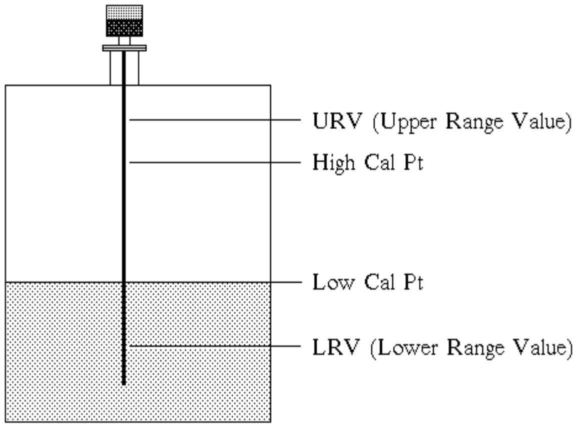
CAL MODE

If both Low and High Cals have been completed, CAL MODE appears. Depress SET to re-enter cal mode or press MODE to return to main menu. (If Low Cal has not been completed, LOW PT appears. Proceed with LOW PT cal above.)

NOTES

- Upon entrance of the 2-Point Calibration Mode, the message "LOW PT" is displayed as described above. At this juncture in the procedure, the INC push-button could be depressed to toggle between LOW PT and HIGH PT. SET would then be depressed, with either message shown, to enter the adjustment and measurement sequence for that particular point.
- Within the percentage adjustment screen (i.e. 00%LO or 100%HI), the INC is used to increment the number shown and SET is used to decrement the number shown. Pressing MODE twice at this point, displays the message ABORTING and the unit returns to either LOW PT or HIGH PT display. The L4610 aborts the calibration and maintains the previous Range Calibration (LRV & URV).
- The L4610 software program is designed to protect against an aborted calibration sequence should a power down condition occur in the middle of the two point sequence (i.e. one calibration point successfully taken).

The L4610 maintains the calibration point measurement in non-volatile memory, such that upon re-entrance of the 2-Pt Cal Mode, the appropriate "LOW PT", or "HIGH PT" message appears. Thus the calibration sequence can continue from this juncture without re-issuing the first calibration point



•URV (110 in.)

•High Cal Pt (70 in.)

•Low Cal Pt (20 in.)

•LRV (10 in.)

Note: Parameter Dimensions are referenced to Tank Bottom.

Figure 4-2. Example 2: 2 Point Cal, LRV Above Probe Tip

Example 2. 2-Point Cal, LRV Above Probe Tip

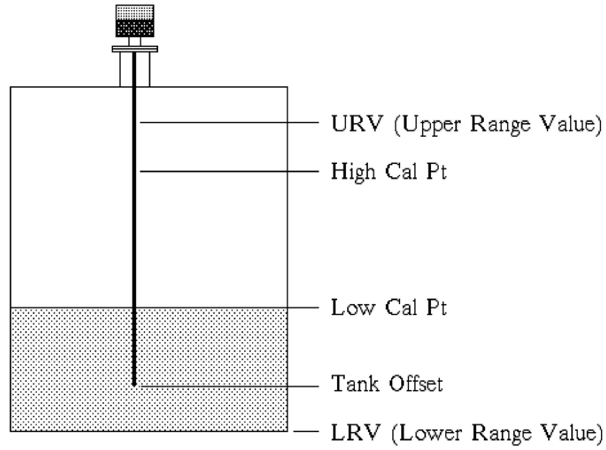
The Low Point and High Point percentages are entered in similar fashion to the previous example, as percentages of the overall Range, for applications in which the LRV is not coincident with the probe tip or vessel bottom (i.e. LRV is above probe tip). Follow the steps in example 1 above and enter the following low and high values.

10%LO

With the process material level at the Low Cal Pt, depress INC to increment or SET to decrement the number displayed to the proper percentage - the percentage of the overall range which represents the process material level at the Low Cal Pt, (i.e.{[LCP-LRV] / [URV-LRV]} x 100%). With the correct percentage shown, depress MODE, etc.

60%HI

Likewise, with the process level at the High Cal Pt, depress INC to increment or SET to decrement the number displayed to the proper percentage - the percentage of the overall range which represents the process material level at the High Cal Pt, (i.e.{[HCP-LRV] / [URV-LRV]} x 100%). With the correct percentage shown, depress MODE, etc.



•URV (110 in.)

•High Cal Pt (75 in.)

•Low Cal Pt (25 in.)

•Tank Offset (10 in.)

•LRV (0 in.)

Note: Parameter Dimensions are referenced to Tank Bottom.

Figure 4-3. Example 3: 2 Point Cal, LRV Below Probe Tip

Example 3. 2-Point Cal, LRV Below Probe Tip

If a Tank Offset exists (i.e. probe does not extend completely to bottom of storage vessel), and the LRV is located at the storage vessel bottom, then the Low and High Cal Points must be entered as *probe relative percentages*. In other words, they would be the same percentages as if the tip of the probe were the LRV. Once the Tank Offset Compensation is programmed, values will automatically be set to their proper percentage of overall range. Follow the steps in example 1 above and enter the following low and high values for the example above.

15%LO

With the process material level at the Low Cal Pt, depress INC to increment or SET to decrement the number displayed to the proper percentage - the percentage which the process material level, at the Low Cal Pt, represents of the *probe span* (i.e. {[LCP-TANK OFFSET] / [URV-TANK OFFSET]} x 100%). With the correct percentage shown, depress MODE, etc.

65%HI

Likewise, with the process material level at the High Cal Pt, depress INC to increment or SET to decrement the number displayed to the percentage which the process material level, at the High Cal Pt, represents of the *probe span* (i.e. {[HCP-TANK OFFSET] / [URV-TANK OFFSET]} x 100%). With correct percentage shown, depress the MODE, etc.

Now, enter Probe Offset Compensation Value per the following section.

4.3.2.6 Tank Offset Compensation

Tank Offset is defined as the lineal distance from the measurement probe tip (i.e. bottom most point of the measurement probe active sensing element), to the bottom of the storage vessel.

The Tank Offset Compensation Mode allows field entry of the Tank Offset (expressed as a percentage of the overall range) such that accurate Percent Range can be achieved for those applications where the Low Range Mark is located at the bottom of the storage vessel, and the probe tip is not (i.e. probe tip is elevated from storage vessel bottom).

Depress MODE until the CAL MODE appears. Depress SET to enter the calibration sub-menu. Depress MODE until OFFSET appears.

OFFSET

Depress SET to enter this mode.

0.0%L

The numerical offset percentage value appears. Using physical tank and probe dimensions (i.e. either measured or determined from installation drawings), determine the distance from probe tip to tank bottom (Tank Offset) expressed as a percentage of the overall level Range. Depress INC to increment or SET to decrement the number displayed to this percentage.

9.1%L

With the correct number displayed, depress MODE.

SET OFS?

SET OFS? appears. Press SET.

This action sets the percentage into microprocessor memory, and instructs the L4610 to use the number to compensate for the Tank Offset in the Percent Range process variables.

OFFSET

OFFSET appears. Press MODE to cycle through other Cal menu options. Press INC to return to default display (SMART1).

4.3.3 Status Modes

4.3.3.1 Display Serial Number

SERIAL#

Depress MODE until SERIAL# appears. Depress SET to enter this mode.

999 48

The factory -configured serial number is displayed.

4.3.3.2 Display Tank Style

TANK STY

Depress MODE until the TANK STY appears. Depress SET to enter this mode. A message appears which indicates the tank style the L4610 is configured to measure. One of the following messages appears:

VERT CYL

Vertical Cylinder. Factory configured for stand-alone unit, or field configured with HART Communicator.

HORZ CYL

Horizontal Cylinder. Factory configured for stand-alone unit, or field configured with HART Communicator.

HC SP EC

Horizontal Cylinder with Spherical End Caps. Factory configured for stand-alone unit, or field configured with HART Communicator.

SPHERE

Spherical Tank. Factory configured for stand-alone unit, or field configured with HART Communicator.

SPECIAL

Non-standard tank styles. Factory configured only.

OC FLOW

Open channel flow. Factory configured only.

4.3.3.3 Display Output (4 to 20mA) Configuration

OUT MODE

Depress MODE until OUT MODE is displayed. Depress SET to enter this mode. A message appears which indicates the configuration of the instrument analog output signal (4 to 20mAdc).

The Output Mode is factory configured for stand-alone units and field configured from the HART Communicator. One of the following messages appears:

NORM LIN

This message indicates the output is configured as proportional to Percent Range Level, and is normal-acting (i.e. 4 mA @ 0% Range Level and 20 mA @ 100% Range Level).

NORM VOL

This message indicates the output is configured as proportional to Percent Range Volume, and is normal-acting (i.e. 4 mA @ 0% Range Volume and 20 mA @ 100% Range Volume).

REV LIN

This message indicates the output is configured as proportional to Percent Range Level, and is reverse-acting (i.e. 4 mA @ 100% Range Level and 20 mA @ 0% Range Level).

REV VOL

This message indicates the output is configured as proportional to Percent Range Volume, and is reverse-acting (i.e. 4 mA @ 100% Range Volume and 20 mA @ 0% Range Volume).

4.3.3.4 Display Measurement Type (Measurement Mode)

MSR MODE

Depress MODE until the MSR MODE is displayed. Depress SET to enter this mode. A message appears which indicates the configuration of the instrument Measurement Mode. The Measurement Mode defines the measurement characteristics of the process material. This information determines whether or not the L4610 employs Digital NullKote in the basic measurement algorithm.

The Measurement Mode is factory configured for stand-alone units and can be field configured from the HART Communicator. One of the following messages appears:

NC COND

The process material to be measured is non-coating in nature (i.e. does not leave a coating on the measurement probe) and is electrically conductive.

COAT CON

The process material to be measured is coating in nature (i.e. leaves a coating on the measurement probe) and is electrically conductive.

NC DILEC

The process material to be measured is non-coating in nature (i.e. does not leave a coating on the measurement probe) and is electrically non-conductive.

CT DILEC

The process material to be measured is coating in nature (i.e. leaves a coating on the measurement probe) and is electrically non-conductive.

4.4 Remote Operation

The L4610 Transmitter can be connected to a Fisher-Rosemount Model 275 HART Communicator or other HART compatible master device. In this configuration, the L4610 becomes a much more powerful instrument. When used with the Model 275, the user has available all of the functional features, as described in Section 1.3. Refer to the Model 275 Instruction Manual for a detailed description of remote operation.

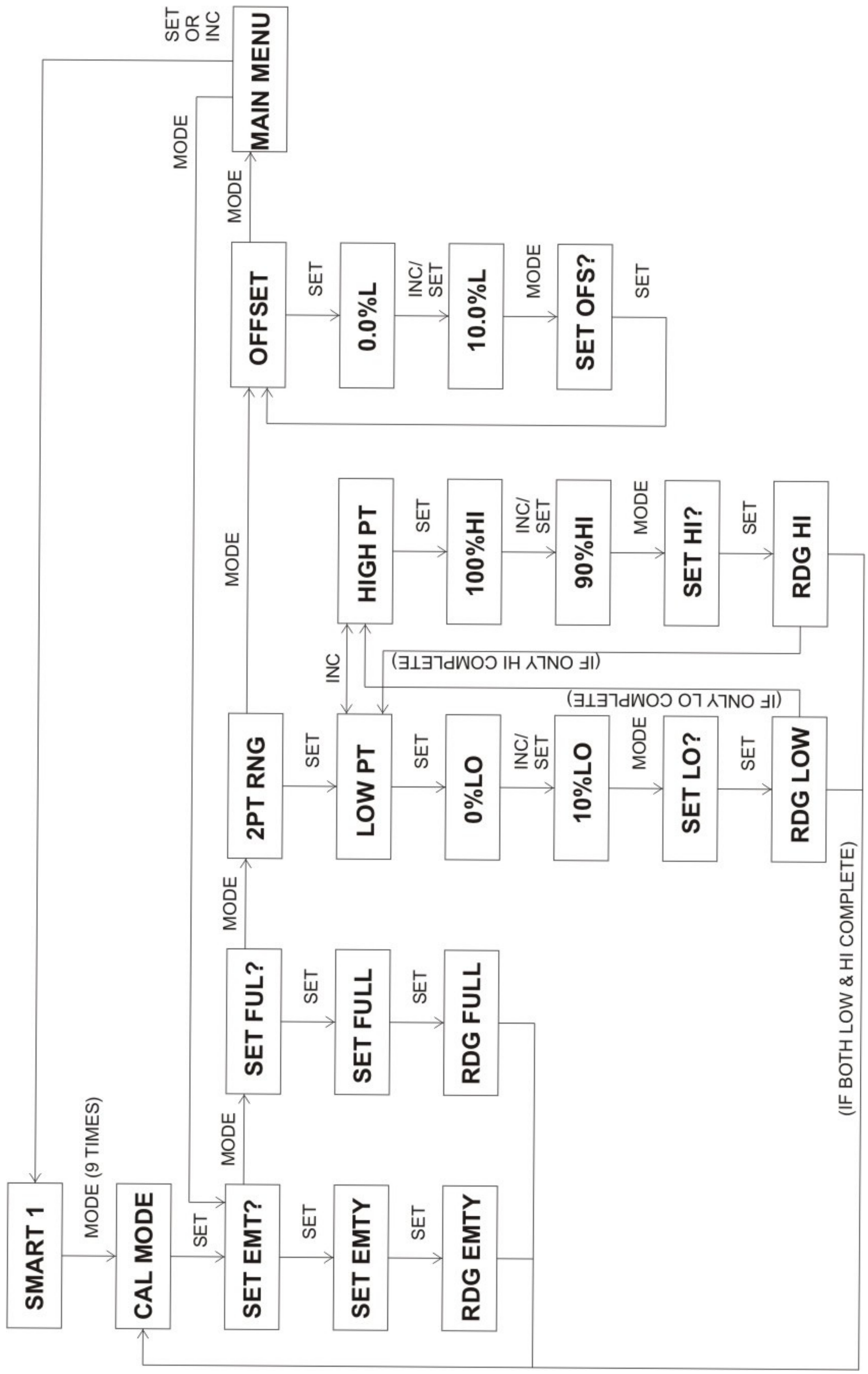


Figure 4-4: Menu for Cal Mode in Local Operation

5 Diagnostics

5.1 Diagnostic Error Messages

The Princo Model L4610 Transmitter requires virtually no routine maintenance beyond the usual practices and precautions normally associated with microprocessor based electronic instruments. The simple, modular design of the L4610, however, allows quick and easy removal of the major subassemblies for inspection and replacement (factory authorized personnel only). Self-diagnostic routines built into the transmitter ensure that most major malfunctions are quickly discovered by automatic checks and tests carried out by the microprocessor firmware.

Detailed field troubleshooting is NOT recommended for the L4610 electronic chassis, as this may destroy critical configuration data stored in the microprocessor non-volatile memory chips. Field troubleshooting of the electronic chassis must be performed by factory-authorized personnel only.

Table 4.0 (below) lists the diagnostic error messages, which could occur on the L4610 LCD readout. If in the event that an error message does occur, follow the corrective action outlined in the table.

5.2 Factory Diagnostic Modes

Further information, including that on Factory Modes, is available from the factory. The L4610 Transmitter incorporates several Factory Modes, which can be used by qualified field personnel for diagnostic and troubleshooting purposes.

The Factory Modes allow direct monitoring of the actual measured physical variable. This measured physical variable is the electrical impedance (see section 1) presented by the measurement transducer (probe, storage vessel, process material) to the transmitter. The Factory Modes allow direct monitoring of each component of the overall impedance measurement - capacitance (level plus coating) and resistance (coating only).

The Factory Modes provide a powerful tool for use in analyzing system related problems. In the unlikely event of inoperable or malfunctional conditions, refer to section six of this manual. This section outlines basic diagnostic and troubleshooting information.

5.3 Getting Help

If your Princo equipment is not functioning properly, and attempts to solve the problem have failed, contact the closest Princo sales representative in your area, or call the factory direct and ask for service assistance. The factory telephone number is 1-800-221-9237.

To assist us in providing an efficient solution to the particular problem, please have the following information available when you call:

1. Instrument Model Number
2. Probe Model Number
3. Purchase Order Number
4. Date of Purchase Order
5. Process Material Being Monitored
6. Detailed Description of the Problem

If your equipment problem cannot be resolved over the phone, then it may be necessary to return the equipment for checkout/repair.

Do not return equipment without first contacting the factory for a Return Material Authorization number (RMA #).

Any equipment that is returned MUST include the following information in addition to the list above.

7. RMA Number
8. Person to contact at your Company
9. Return (Ship to) Address

Princo level instruments are covered by a 10-year limited warranty. You will not be charged if it is determined that the problem is covered under warranty. Please return your equipment with freight charges prepaid. If repair is covered under warranty, Princo will pay return freight charges.

If telephone assistance or equipment return is not a practical solution to the problem, then it may be necessary for field assistance. Trained field servicemen are available from the factory on a time/expense basis to assist in these instances.

5.4 Warranty Statement

All Princo level control instruments are backed by a 10-year warranty. Princo will repair or replace, at its option, any instrument that fails under normal use for up to 10 years after purchase.

DIAGNOSTIC ERROR CODE	ERROR DESCRIPTION	CORRECTIVE ACTION
ER01	Auto Ranging Error	Consult factory.
ER02	Range Calibration Error. Zero span error.	Re-calibrate with URV > LRV.
ER03	Range Calibration Error. Reverse span error: LRV > URV.	Re-calibrate with URV > LRV.
ER04	Range Calibration Error. Less than minimum allowed span.	Re-calibrate with acceptable span - consult factory.
ER05	Communication Error (remote operation only).	Refer to HHC Manual for communication troubleshooting.
ER06	Range Calibration attempt with improper configuration (remote operation only).	Refer to HHC Manual for communication troubleshooting.
ER07	Volume Configuration Error. Tank table not presently configured (remote operation only).	Select appropriate Tank Style from HHC. Consult factory.
ER08	Analog to digital conversion error.	Depress Mode push-button. If reoccurring, consult factory.
ER14	XRAM Checksum Error. Auto-Ranging Switching Limits.	Depress Mode push-button. If reoccurring, consult factory.
ER15	XRAM Checksum Error. Linearity Table.	Depress Mode push-button. If reoccurring, consult factory.
ER0A	Two Pt Cal Error. Attempted calibration aborted. Incorrect percentages entered during calibration sequence.	Note: Previous Range Calibration is maintained. Re-issue Two Pt Cal with more accurate Low Pt and High Pt percentage input.
ER0C	Two Pt Cal Error. Attempted calibration inaccurate. Incorrect percentages entered during calibration sequence.	Check %RNG LVL for acceptable results. If unacceptable, re-issue calibration with more accurate Low Pt and High Pt percentage input.
ERDD	XRAM Signature Error.	Depress Mode push-button. If reoccurring, consult factory.
EREE	XRAM Write Error.	Depress Mode push-button. If reoccurring, consult factory.

Table 4-1. Diagnostic Error Messages