OHMART VEGA

Technical Reference MANUAL

CONTINUOUS LEVEL
MODELS LSTH, LJTH, LNTH
WITH HART® COMMUNICATIONS PROTOCOL

Revision history

Table 1: Revision history

Version	Description	Date
1.0	Initial release. Formerly 237473.	051201

ISO 9001 approval by Lloyd's Register Quality Assurance Limited, to the following Quality Management System Standards: ISO 9001:1994, ANSI/ASQC Q9001-1994, Approval Certificate No. 107563.

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WARNING

Use this equipment only in the manner that this manual describes. If you do not use the equipment per Ohmart/VEGA specifications, the unit is not CE compliant, and may be damaged or cause personal injury.

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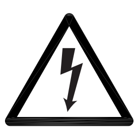
Explanation of symbols

Table 2 lists the symbols that the manual and instrument use.

Table 2: Explanation of symbols

	**Radiation notice** In the manual, information concerning radioactive materials or radiation safety information is found in the accompanying text.
	**Caution** In the manual, warnings concerning potential damage to the equipment or bodily harm are found in the accompanying text.
	**AC current or voltage** On the instrument, a terminal to which or from which an alternating (sine wave) current or voltage may be applied or supplied.
	DC current or voltage On the instrument, a terminal to which or from which a direct current voltage may be applied or supplied.
	**Potentially hazardous voltages** On the instrument, a terminal on which potentially hazardous voltage exists.

Notes

HART software screens

The two charts that follow illustrate the offline and online HART® communication screens. For complete illustrations of all HART hand-held communicator menus and screens, see “Appendix IV”.

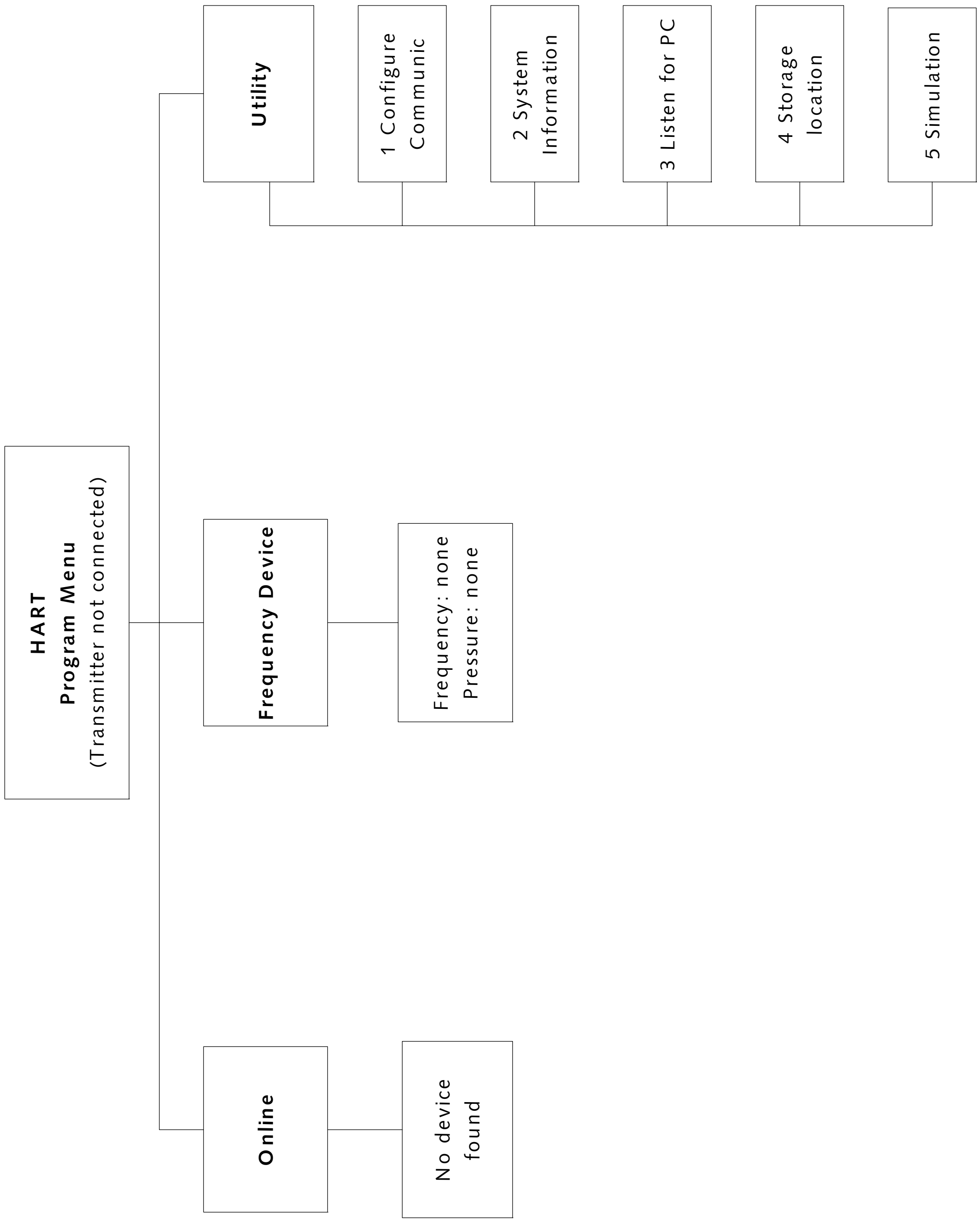


Figure 1: HART screen—gauge not connected

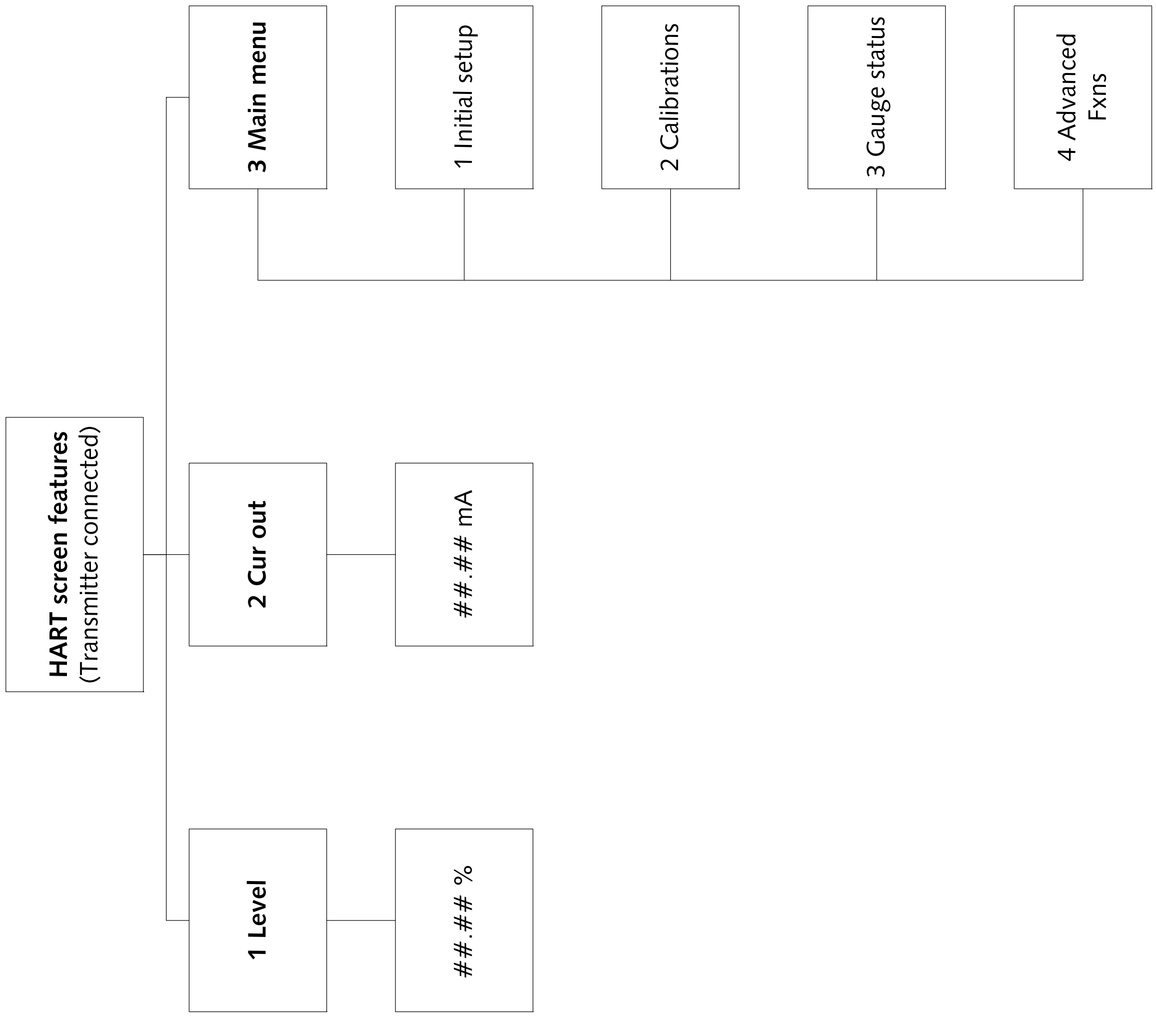


Figure 2: HART screen—gauge connected

User's comments

Ohmart values your opinion! Please fill out this page so that we can continually improve our technical documentation.

Manual: Continuous Level (LSTH, LJTH, LNTH) Technical Reference Manual

Date: _______________

Customer Order Number: ____________________

How we can contact you (optional if you prefer to remain anonymous):

Name: ___________________________

Title: ___________________________

Company: ____________________________

Address: ____________________________

____

____

Did you find errors in this manual? If so, specify the error and page number.

Did you find this manual understandable, usable, and well organized? Please make suggestions for improvement.

Was information you needed or would find helpful not in this manual? Please specify.

Please send this page to:

Ohmart Corporation
Director of Engineering
4241 Allendorf Drive
Cincinnati, OH 45209-1599

Chapter 1: Introduction

Nuclear materials notice

This equipment contains radioactive source material that emits gamma radiation. Gamma radiation is a form of high-energy electromagnetic radiation. Only persons with a specific license from the U.S. NRC (or other regulating body) may perform the following to the source holder:

- Dismantle
- Install
- Maintain
- Relocate
- Repair
- Test

Ohmart Field Service engineers have the specific license to install and commission nuclear gauges, and can instruct you in the safe operation of your density gauge. To contact Ohmart Field Service, call 513-272-0131. Users outside the U.S. and Canada may contact their local representative for parts and service.

> **Note:** Special instructions concerning your source holder are found in the envelope that was shipped with the source holder and the "*Radiation Safety for U.S. General and Specific Licensees, Canadian, and International Users Manual" and "Radiation Safety Manual Addendum of Reference Information"*. Please refer to this document for radiation safety information.

Unpacking the equipment

CAUTION!

Make sure that you are familiar with radiation safety practices in accordance with your U.S. Agreement State, U.S. NRC, or your country's applicable regulations before unpacking the equipment.

- ☑ Unpack the unit in a clean, dry area
- ☑ Inspect the shipment for completeness, by checking against the packing slip
- ☑ Inspect the shipment for damage during shipment or storage
- ☑ If the detector is included as a separate package in the shipment, inspect the assembly for damage that may have occurred during shipment or storage
- ☑ If there was damage to the unit during shipment, file a claim against the carrier, reporting the damage in detail. Any claim on the Ohmart Corporation for shortages, errors in shipment, etc., must be made within 30 days of receipt of the shipment
- ☑ If you need to return the equipment, see the section "Returning equipment for repair to Ohmart" in the "Diagnostics and Repair" chapter
- ☑ After you unpack the equipment, inspect each source holder in the shipment to assure that the operating handle is in the OFF position. In the event that you find the handle in the ON position, place it in the OFF position immediately and secure it.

Note: Most source holder models accept a lock. Call Ohmart Field Service immediately for further instructions, at 513-272-0131, if the source holder has one of the following conditions:

- Does accept a lock and there is no lock on it
- The lock is not secured
- You are unable to secure the lock
- The operating handle does not properly move into the off position

Storing the equipment

Storing the source holder

If it is necessary to store the source holder, do so in a clean, dry area. Be sure the source holder shutter is in the OFF or CLOSED position. Check the current local regulations (U.S. NRC, Agreement State, or other) to determine if this area must have any restrictions.

Storing the detector

Avoid storage at temperatures below freezing. Store the detector indoors in an area that has temperature-control between 50 °F and 95 °F (10 °C and 35 °C) and less than 50% relative humidity. Store equipment in dry conditions until installation.

LSTH specifications

Table 3: LSTH specifications

System Accuracy	□1% of span typical	Accuracy depends on specific application parameters
Active Lengths	Model LSTH	6"–72" (153mm–1,829mm) in 6" (153mm) increments
Typical Sources	Cesium-137	0.66MeV gamma radiation emitter, 30.2 year half life
	Cobalt-60	1.2 and 1.3 MeV gamma radiation emitter, 5.3 year half life
Power Requirements*	AC	90–270VA□10% C at 50–60Hz, at 20VA maximum power consumption. 30VA max with internal heater for low ambient temp. CE compliance requires 100–230VAC
	DC	10–30VDC (less than 100mV, 1–1,000Hz ripple) at 10VA. CE compliance requires 24VDC
	Wire size	14-22AWG (1.63–0.643mm)
Signal Cable	Maximum length	3,280ft (1,000 m)
	HART signal	18–22 AWG (1.02–0.643mm) two conductor shielded
	4-Wire hookup with DC	18–22 AWG (1.02–0.643mm) four conductor shielded
Housing	Certification to CSA and UL standards	Designed to meet National Electric Code (U.S. & Canada) Class I, Groups A, B, C & D, Division 1 & 2 Class II, Groups E, F & G, Division 1 & 2
	CENELEC Certification	EExd IIC T5, IP-66
	Temperature	–4°F–140°F (–20°C–60°C), option for lower temperatures available, water cooling required above 140°F (60°C)
	Humidity	0–95%, non-condensing
	Vibration	0.5g at 300cps
	Material	Carbon Steel (others optional)
	Paint	Epoxy Powder Coat
	Detector weight	44lb. + 1.02lb. □ active length in inches (20kg + 0.0186kg □ active length in mm)
Current Loop Output	Rating	4–20mA, isolated, into 250–1,000ohm
	Power	Jumper selectable: source (active) or sink (passive) mode.
Relay Output	Software user settable	Diagnostic alarm or process high/low alarm function
	Rating	10A at 240VAC, or 8A at 24VDC (SPDT Form C)
HART Communication	HART Protocol on current loop output	BEL202 FSK standard
	PC interface	HART modem and Ohmart communications software package
	Optional hand-held interface	HART Communicator model 275 hand-held terminal with Ohmart device descriptions loaded
Serial Communication	Full duplex RS-422/485 port, 2,400 baud	(Not used for normal operation)
Auxiliary Input Capability	Type	Frequency input (0–100kHz) Analog input
	Possible function	Optional temperature compensation, multiple gauge linking and others
Electronics	On-board memory	FLASH and two EEPROMs
	Real-time clock	Maintains time, date and source decay compensation. Year 2000 compatible
Diagnostics	LED indication	+5V, Memory Corruption, HART, +30V, CPU Active, Auxiliary, High Voltage, Relay, & Field Strength

* Power specifications change to 115 VAC or 230 VAC if an internal heater kit is used. For more information, see page 142.

LJTH specifications

Table 4: LJTH specifications

System Accuracy	□1% of span typical	Accuracy depends on specific application parameters
Active Lengths	Model LJTH	12"–234" (305mm–5,944mm) in 12" (305mm) increments
Typical Sources	Cesium-137	0.66MeV gamma radiation emitter, 30.2 year half life
	Cobalt-60	1.2 and 1.3MeV gamma radiation emitter, 5.3 year half life
Power Requirements	AC	115 or 230VAC □10% at 50–60Hz, at 525VA max. power consumption. CE compliance requires 24VDC
	Wire size	14–22AWG (1.63–0.643mm)
Signal Cable	Maximum length	3,280ft (1,000 m)
	HART signal	18–22 AWG (1.02–0.643mm) two conductor shielded
Housing	CSA	Designed to meet National Electric Code (U.S. & Canada)
	Certification	Class I, Groups A, B, C & D, Division 1 & 2
		Class II, Groups E, F & G, Division 1 & 2
	CENELEC Certification	EExd IIC T5, IP-66
	Temperature	–4°F–140°F (–20°C–60°C), option for lower temperatures available, water cooling required above 140°F (60°C)
	Humidity	0–95%, non-condensing
	Vibration	0.5g at 300cps
	Material	Carbon Steel (others optional)
	Paint	Epoxy Powder Coat
	Detector Weight	50lb. + 1.02lb. □ active length in inches (23kg + 0.0186kg □ active length in mm)
Current Loop Output	Rating	4–20mA, isolated, into 250–1,000ohm
	Power source	Jumper selectable source (active) or sink (passive) mode
Relay Output	Software user settable	Diagnostic alarm or process high/low alarm function
	Rating	10A at 240VAC, or 8A at 24VDC (SPDTForm C)
HART Communication	HART Protocol on current loop output	BEL202 FSK standard
	PC interface	HART modem and Ohmart communications software package
	Optional hand-held interface	HART Communicator model 275 hand-held terminal with Ohmart device descriptions loaded
Serial Communication	Full duplex RS-422/485 port, 2,400 baud	(Not used for normal operation)
Auxiliary Input Capability	Type	Frequency input (0–100kHz) Analog input
	Possible function	Optional temperature compensation, multiple gauge linking and others
Electronics	On-board memory	FLASH and two EEPROMs
	Real-time clock	Maintains time, date and source decay compensation Year 2000 compatible
Diagnostics	LED indication	+5V, Memory Corruption, HART, +30V, CPU Active, Auxiliary, High Voltage, Relay, & Field Strength

* Power specifications change to 115 VAC or 230 VAC if an internal heater kit is used. For more information, see page 142.

LNTH specifications

Table 5: LNTH specifications

System Accuracy	□1% of span typical	Accuracy depends on specific application parameters
Active Lengths	Model LNTH	12"–120" (305mm–3,048mm) in 12" (305mm) increments
Typical Sources	Cesium-137	0.66MeV gamma radiation emitter, 30.2 year half life
	Cobalt-60	1.2 and 1.3MeV gamma radiation emitter, 5.3 year half life
Power Requirements	AC	115 or 230VAC □10% at 50–60Hz, at 525VA max. power consumption. CE compliance requires 24VDC
	Wire size	14-22AWG (1.63–0.643mm)
Signal Cable	Maximum length	3,280ft (1,000 m)
	HART signal	18–22 AWG (1.02–0.643mm) two conductor shielded
Housing	CSA	Designed to meet National Electric Code (U.S. & Canada)
	Certification	Class I, Groups A, B, C & D, Division 1 & 2
		Class II, Groups E, F & G, Division 1 & 2
	CENELEC Certification	EExd IIC T5, IP-66
	Temperature	–4°F–140°F (–20°C–60°C), option for lower temperatures available, water cooling required above 140°F (60°C)
	Humidity	0–95%, non-condensing
	Vibration	0.5g at 300cps
	Material	Carbon Steel (others optional)
	Paint	Epoxy Powder Coat
Detector Weight	12"–60" (305mm–1524mm)	60lb. + 1.83lb. □ active length in inches (27.kg + 0.0371kg □ active length in mm)
	72"–120" (1,829mm–3,048mm)	100lb. + 2.08lb. □ active length in inches (45kg + 0.037kg □ active length in mm)
Current Loop Output	Rating	4–20mA, isolated, into 250–1,000ohm
	Power	Jumper selectable source (active) or sink (passive) mode
Relay Output	Software user settable	Diagnostic alarm or process high/low alarm function
	Rating	10A at 240VAC, or 8A at 24VDC (SPDT Form C)
HART Communication	HART Protocol on current loop output	BEL202 FSK standard
	PC interface	HART modem and Ohmart communications software package
	Optional hand-held interface	HART Communicator model 275 hand-held terminal with Ohmart device descriptions loaded
Serial Communication	Full duplex RS-422/485 port, 2,400 baud	(Not used for normal operation)
Auxiliary Input Capability	Type	Frequency input (0–100kHz) Analog input
	Possible function	Optional temperature compensation, multiple gauge linking and others
Electronics	On-board memory	FLASH and two EEPROMs
	Real-time clock	Maintains time, date, and source decay compensation. Year 2000 compatible
Diagnostics	LED indication	+5V, Memory Corruption, HART, +30V, CPU Active, Auxiliary, High Voltage, Relay, & Field Strength

- Power specifications change to 115 VAC or 230 VAC if an internal heater kit is used. For more information, see page 142.

Typical applications

Ohmart level gauges accurately indicate the level of liquids or bulk materials throughout a range on vessels, reactors, or tanks.

In order to achieve a level indication over the desired length, it may be necessary to use more than one detector. The manner in which these multiple detectors link together depends upon the types of detectors used. Specific details on using multiple detectors are available in “Appendix II: Special Applications”.

The accuracy of quality control systems that use Ohmart nuclear level gauges is profitable to a wide range of industry operations. A number of applications that use a level gauge are:

Pulp and Paper

- Liquors
- Bleach plant chemicals
- Coating chemical storage
- Lime mud
- Wastewater treatment tanks

Chemical

- Low pressure/low vapor chemical storage
- Settlers
- Surge tanks

Food and beverage

- Food slurries
- Pastes
- Syrups
- Dough level
- Intermediate batch storage

Water and wastewater

- Settling/aeration tanks
- Clarifiers
- Sludge holding tanks
- Wet wells

Where to find help

If you need help finding information, check the Index and Table of Contents within this manual. In addition, the gauge has "Help" screens that you can view using the universal hand-held terminal or Ohmart View™ software. These help screens are useful references for definitions of parameters and hints.

Ohmart Customer Service

Ohmart Customer Service has Field Service Engineers located across the U.S. for on-site service to U.S. and Canada. In many cases, a Field Service Engineer is at your plant for the start up of your gauge. In addition, Field Service Engineers regularly assist customers over the phone.

If you have a question or need help, call Customer Service during office hours. If your problem is an emergency (for example, line shut down because of Ohmart equipment), you can reach us 24-hours a day.

Table 6: Contact information

Ohmart Phone	513-272-0131
Ohmart FAX	513-272-0133
Ohmart Field Service E-mail	fieldservice@ohmart.com

In addition, Ohmart provides field service for customers outside the U.S. and Canada. Customers outside the U.S. and Canada can also contact their local Ohmart representative for parts and service.

When calling with a question, if possible, please have the following information ready:

☑ Ohmart Customer Order (C.O.) Number—Locate on the engraved label on the source holder

☑ Sensor serial number—Locate on the sensor housing inside the external housing

Principle of operation

Ohmart's continuous level gauge is a nuclear gauge that receives a shaped or collimated beam of radiation, through the process material, from the source holder. The material in the vessel acts as a shield that prevents a portion of the detector from exposure to the radiation field. As the level decreases, the detector senses more radiation. As the level increases, the detector senses less radiation.

Calibration of the level gauge associates the detector readings, known as counts, with the level of the material in engineering units. The output range of the gauge is a 4–20mA current loop signal, in proportion to the level of the process. See "Appendix I," for examples of process value settings.

System overview

The level measurement system consists of three main components:

1. Source holder
2. Detector assembly (model LSTH, LJTH, or LNTH)
3. Communication device (HART® modem with PC or HART Communicator model 275)

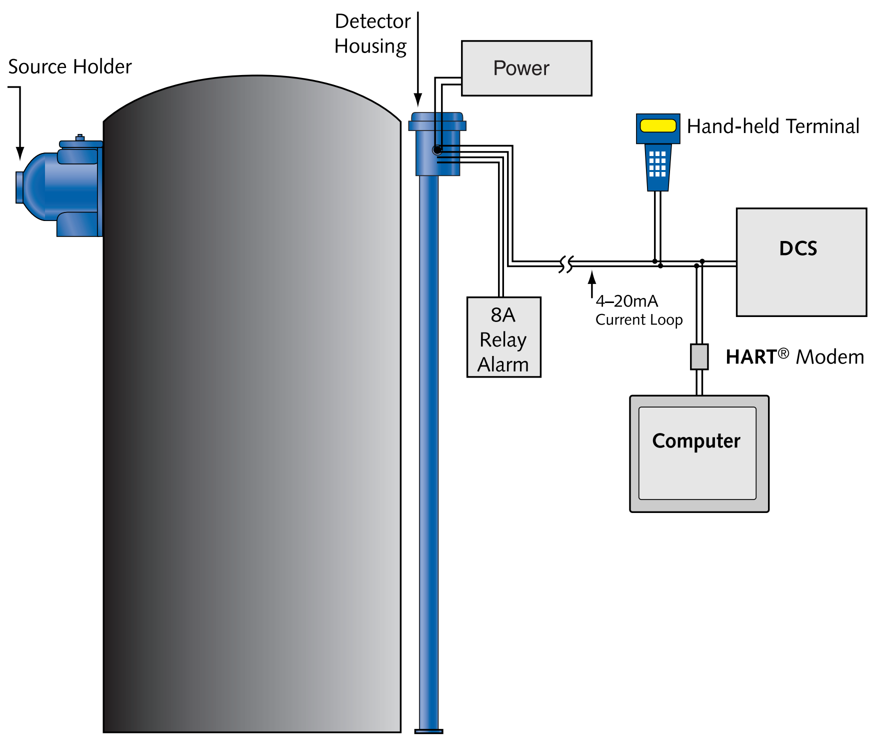


Figure 3: System overview

The following statements describe the source holder:

- A cast or welded steel device that houses a radiation-emitting source capsule
- Directs the radiation in a narrow collimated beam through the process vessel
- Shields the radiation elsewhere
- The model chosen for each particular system depends on the source capsule inside and the radiation specification requirements
- A shutter on the source holder either completely shields the radiation (source off) or allows it to pass through the process (source on)

The source holder model chosen for each particular system depends on the source capsule enclosed and the radiation specifications required. A shutter on the source holder can either completely shield the radiation ("source off") or allow it to pass through the process ("source on").

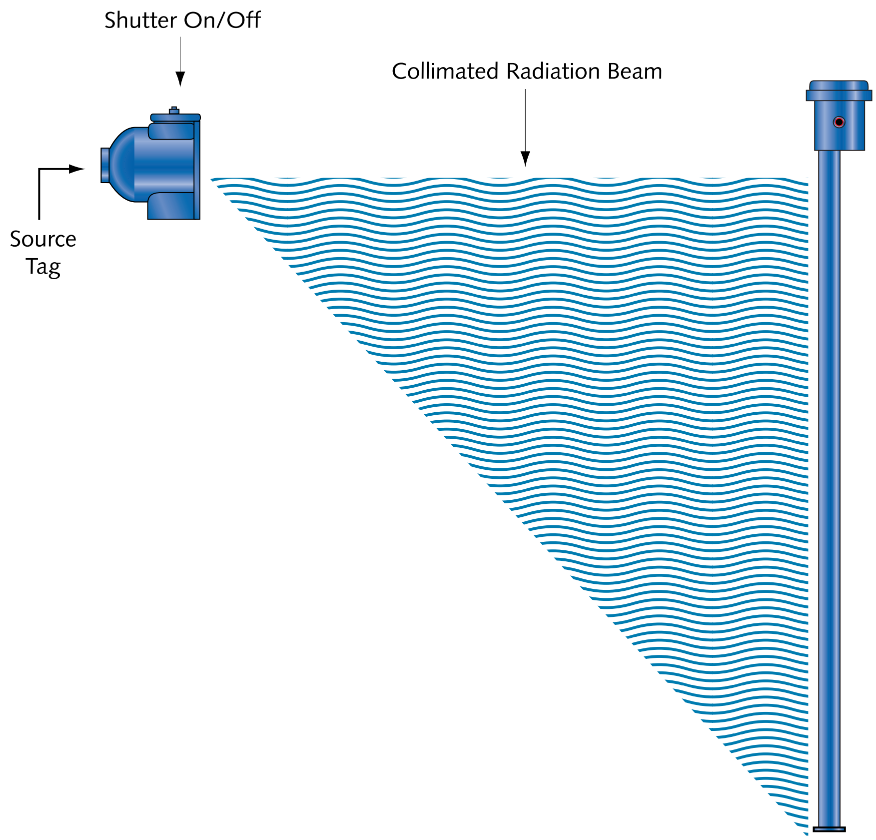


Figure 4: Typical source holder

Scintillator model LSTH

The following statements describe the functions of the LSTH detector assembly:

- Mounts opposite the source holder
- Inside the housing is a scintillation material
- The scintillation material produces light in proportion to the intensity of its exposure to radiation
- A photomultiplier tube detects the scintillator's light and converts it into voltage pulses
- The microprocessor receives these voltage pulses after amplification and conditioning by the photomultiplier tube
- The microprocessor and associated electronics convert the pulses into a calibratable output

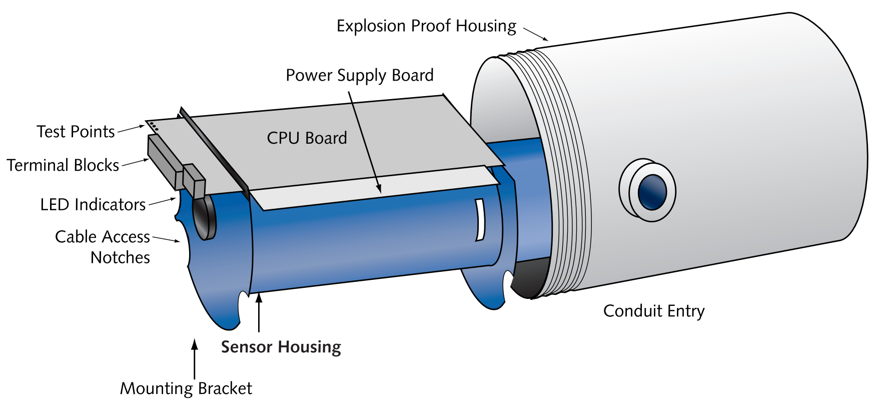


Figure 5: LSTH exploded view

Ion chamber models LJTH and LNTH

Models LJTH and LNTH contain an ion chamber, which is a metal tube with a central electrode that extends the length of the tube. The electrode and tube are biased with a 15VDC voltage with respect to one another. The tube is filled with an inert gas (usually argon at 300psig) that ionizes when exposed to radiation, causing a picoamp current to generate on the electrode, in proportion to the intensity of the radiation.

The current amplifies and converts to a 0–10kHz signal by the DF amplifier. This digital signal sends to the microprocessor through the CPU board terminal blocks. The microprocessor and associated electronics convert the signal into a calibratable output, proportional to the level of liquid in the vessel.

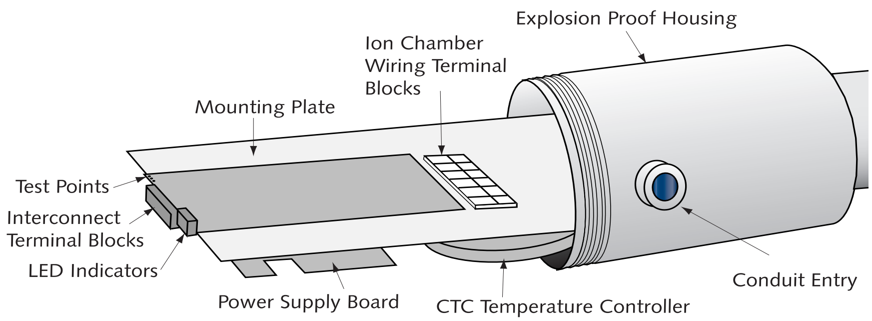


Figure 6: LJTH and LNTH exploded view

DF amplifier

The DF amplifier coverts a very small current (picoamp range) from the ion chamber to a usable voltage by use of a high megaohm glass feedback resistor. The glass resistor is especially prone to failure if exposed to dust contamination or oils from contact with skin. Only clean it with acetone, when necessary to remove oils or dust.

On the DF amplifier, the W1 switch combinations select the gain resistors (R2 through R5). The factory sets the switch combinations so that the feedback resistor and gain resistors produce a 9–10 V output on an empty vessel. On some installations, these feedback resistors may need adjustment in the field. *Do not change these gain resistor settings without first consulting Ohmart.*

CTC temperature controller

The DF amplifier requires a steady operating temperature of 140°F (60°C). The CTC temperature controller monitors the amplifier housing temperature with a thermistor. The CTC controls a heater blanket that surrounds the amplifier housing. A safety thermostat cuts the power to the heater blanket if the temperature exceeds 190°F (88°C) and reinstates power at 160°F (71°C).

Heated ion chamber models H-LJTH and H-LNTH have a heater blanket that surrounds both the amplifier housing and the ion chamber. Heated ion chambers are for applications requiring extremely high accuracy or for active lengths less than 36 inches.

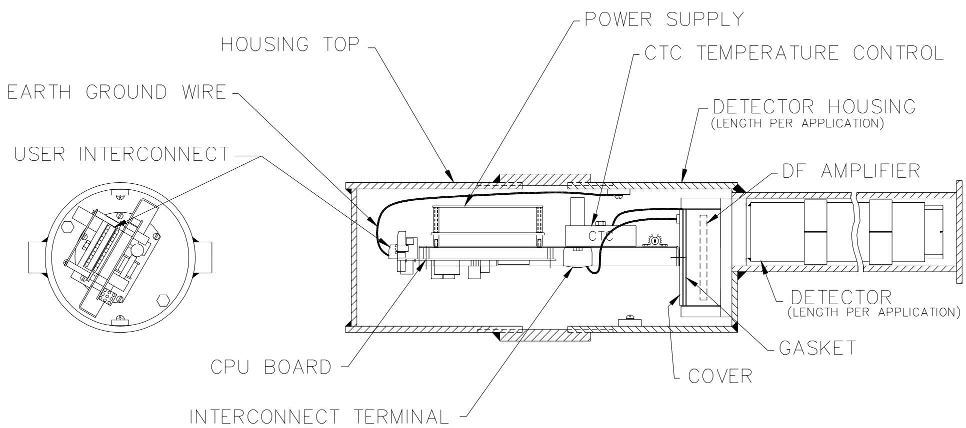


Figure 7: LJTH electronics assembly

Communicating with the gauge

The Ohmart continuous level gauge is a transmitter, so it produces the current loop signal directly at the measurement site.

Use either a HART® Communicator or, HART modem and Ohmart View™ software with a PC to enable the following:

- Initial setup
- Calibration
- Other communication with the gauge

You can make a connection anywhere along the 4–20mA current-loop line. After setup and calibration of the level gauge, there are no day-to-day requirements for external electronics.

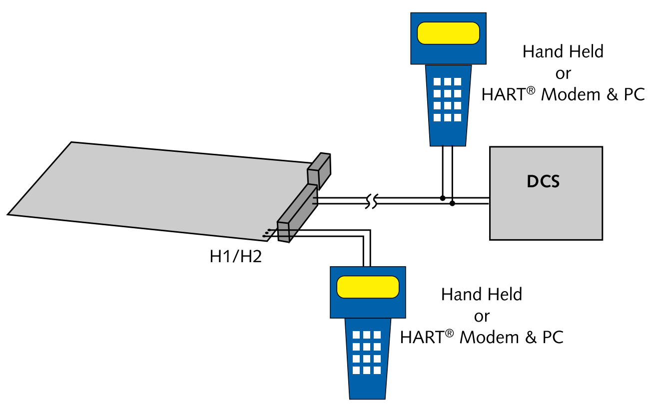


Figure 8: HART connections

Using a universal hand-held terminal

Ohmart's LSTH, LNTH, and LJTH level gauges are compatible with the Fisher-Rosemount HART Communicator. The HART (Highway Addressable Remote Transducer) Communicator uses the Bell 202 Frequency Shift Keying technique to superimpose high frequency digital communication signals on the standard 4–20mA current loop. To function, the minimum load resistance on the 4–20mA loop must be 250ohms (Ω).

Refer to the instruction manual for your HART Communicator for information on the following:

- Key usage
- Data entry
- Equipment interface

In order to effectively use the features in Ohmart's level gauge, you must use Ohmart's device description (DD) to program the HART communicator. You may purchase a universal hand-held terminal, programmed with the device, through Ohmart (Ohmart part number 236907).

Use firmware 2.02C or higher when you use the hand-held HART communicator to make NORM or vapor compensation. See "Appendix II: Special Applications" for further information concerning NORM and vapor compensation.

Using Ohmart View Software on a PC

When you use an IBM-compatible personal computer to communicate with the LSTH, LJTH, LNTH, or other Ohmart HART transmitter field device, you must have a HART modem and Ohmart View software. The Ohmart View software kit, part number 237857, includes the following:

- Modem
- Cables
- Software
- Manual

Ohmart View software is a DOS program that emulates the HART Communicator Model 275. In addition, Ohmart View enables the following:

- Charts the 4–20mA current output graphically
- Stores and retrieves configuration data to disk
- Off-line editing of configurations

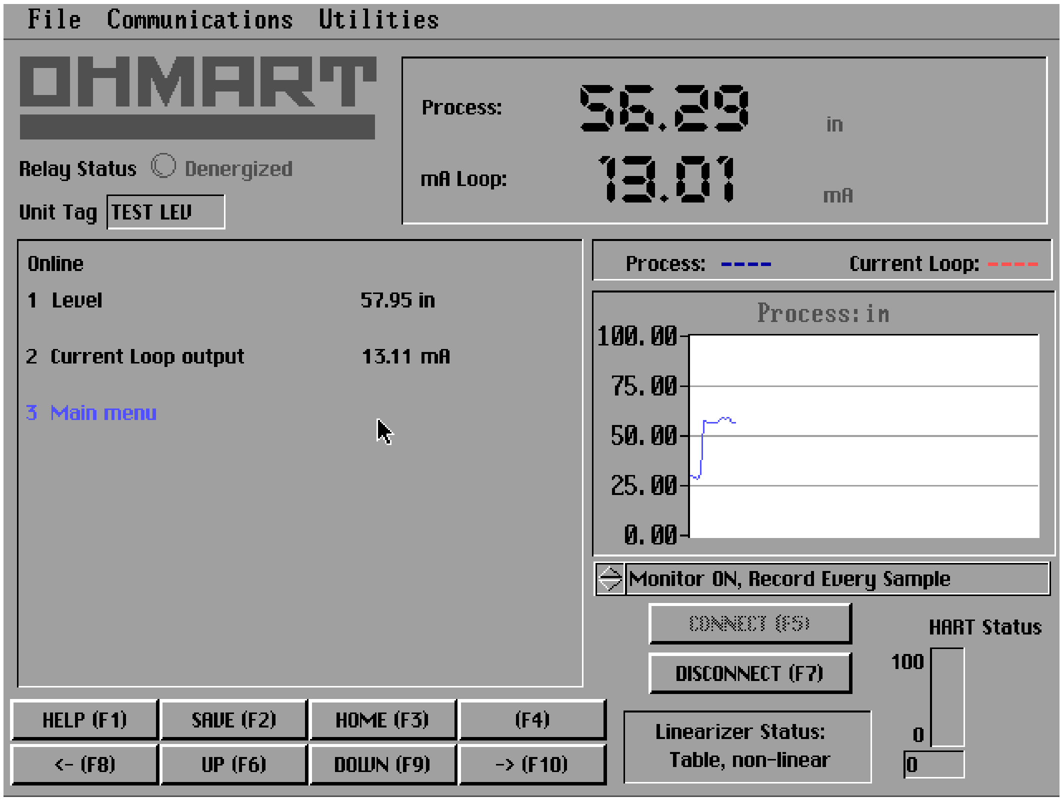


Figure 9:Ohmart View software

Note: There are some minor differences in operation of the Ohmart View software and the hand-held communicator. Most significantly, Ohmart View software writes entries immediately to the level transmitter, but a communicator only sends changes after pressing F2 to send.

This manual's instructions are for the hand-held communicator, but most procedures use exactly the same steps.

Refer to the *Ohmart View User Manual* that accompanies the software diskette for complete instructions for using Ohmart View software.

The HART screens menu structure

In both the hand-held HART Communicator and the Ohmart View software, the user-interface for HART functions is in a menu structure. When the HART Communicator or Ohmart View starts up, the **Online** menu displays.

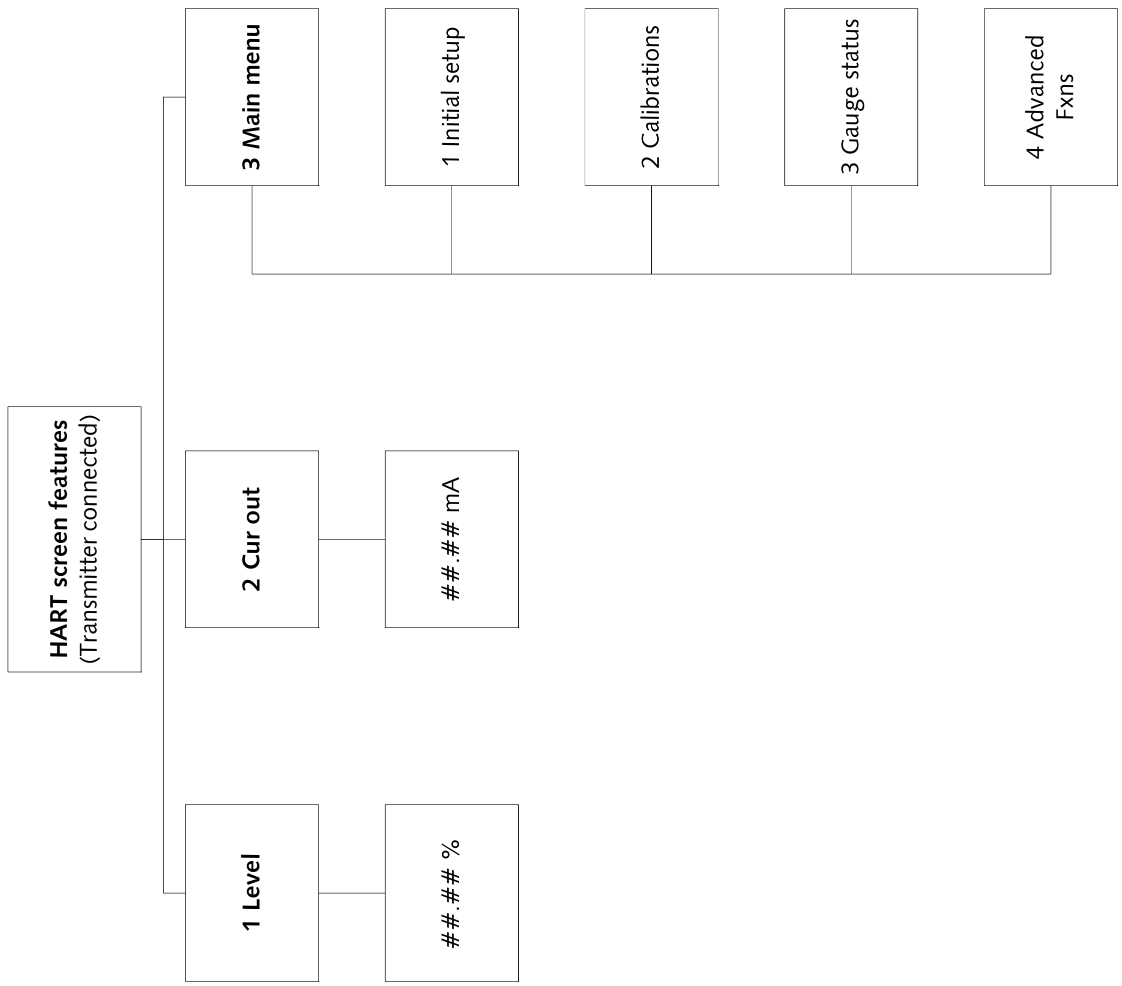


Figure 10: Online menu

For a detailed list of HART screen sub-menus, see “Appendix IV” of this manual.

Chapter 2: Installation

Testing on the bench

To ensure a quick start up after installation, you can test the detector assembly with the HART compatible communication device (either a universal hand-held terminal or a personal computer with a HART modem and Ohmart software). Bench testing enables you to check the following:

- Power
- Communication
- Initial setup software parameters
- Some diagnostics

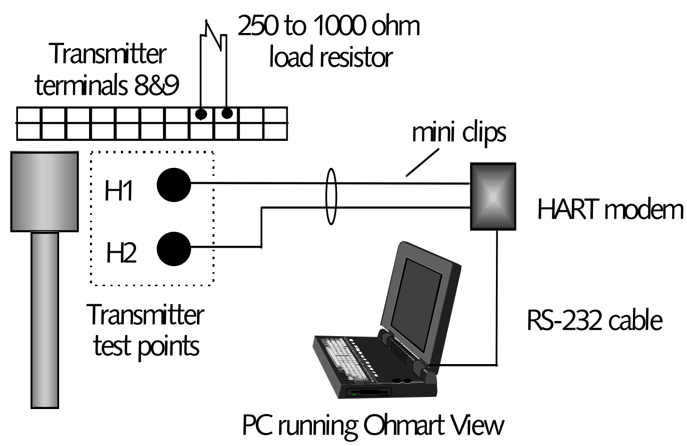


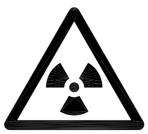
Figure 11: Bench test setup

> **Note:** You may need to reset the time and date if the transmitter has not had power for over 28 days. The Real Time Clock Fail message may display. It is important to enter the correct time and date, because the clock is the basis for source decay calculations. For instructions to set the time and date, see page 104.

Many users choose to calibrate the current loop output "on the bench" before mounting the detector on the process. Refer to page 32 for further information on calibration of the current loop.

Location considerations

At the time you ordered the level transmitter, Ohmart sized the source for optimal performance. Notify Ohmart prior to installation of the gauge if the location of the gauge is different from the original order location. Proper location of the level gauge can sometimes mean the difference between satisfactory and unsatisfactory operation.



Note: Try to locate the source holder in such a place that process material will not coat it. This ensures the continuing proper operation of the source ON/OFF mechanism. Many regulatory agencies (for example, the U.S. NRC) require periodic testing of the ON/OFF mechanism.

Special instructions concerning your source holder are found in the envelope that was shipped with the source holder and the "*Radiation Safety for U.S. General and Specific Licensees, Canadian, and International Users Manual" and "Radiation Safety Manual Addendum of Reference Information"*. Please refer to this document for radiation safety information.

Stable temperature

Mount the level gauge on a portion of the line where the temperature of the process material is relatively stable. Process temperature can effect the gauge indication. The amount of the effect depends upon the following:

- Sensitivity of the gauge
- Temperature coefficient of the process material

Protect insulation

If insulation is between the measuring assembly and the process, protect the insulation from liquids. The absorption of a liquid, such as water, can affect the gauge indication because it blocks some radiation.

Avoid internal obstructions

The best possible installation of a nuclear level gauge is on a vessel that has no internal obstructions (agitator, baffle, manways, and so forth) directly in the path of the radiation beam. If one of these obstructions is present, it can shield the radiation from the detector, causing an erroneous reading. If the vessel has a central agitator, the source holder and detector can mount to the vessel on an arc other than a diameter, so that the beam of radiation does not cross the agitator. You can also avoid other obstructions this way.

Avoid external obstructions

Any material in the path of the radiation can affect the measurement. Some materials that are present when the gauge initially calibrates pose no problem because the calibration accounts for their effect. Examples of these materials are:

- Tank walls
- Liners
- Insulation

However, when the materials change or you introduce new ones, the gauge reading can be erroneous.

Examples of these situations are:

- Insulation that you add after calibration absorbs the radiation and causes the gauge to erroneously read upscale.
- Rapidly changing tank conditions due to material buildup. Regular standardizations compensate for slowly changing tank conditions due to material buildup. See the “Calibration” chapter for information on standardization.

Avoid source cross-talk

When multiple adjacent pipes or vessels have nuclear gauges, you must consider the orientation of the source beams so that each detector senses radiation only from its appropriate source. The best orientation, in this case, is for the source holders to be on the inside with radiation beams pointing away from each other.

Mounting the measuring assembly

The level detector has two sets of mounting tab brackets (provided by Ohmart) that bolt onto the brackets securely welded to the vessel (or in some cases, nearby structure).

Note: The detector active area (where it is possible to make a level measurement) is between the mounting brackets. Mount the detector so that the lower and upper brackets span the desired measurement length.

Note: The handle on the source holder operates a rotating shutter. When installing or removing the assembly from the pipe, you must turn the handle to the closed or Off position and lock the handle with the combination lock that Ohmart provides.

Wiring the equipment

A detailed interconnect drawing for the transmitter is available from Ohmart.

Note: If the instructions on the drawing differ from the instructions in this manual, use the drawing. It may contain special instructions specific to your order.

Use the drawing notes and the steps that follow to make the input and output connections. Make the connections at the removable terminal strips mounted on the CPU board. Access the CPU board by removing the explosion-proof housing cap.

Note: Not all connections are required for operation. See the table on page 24.

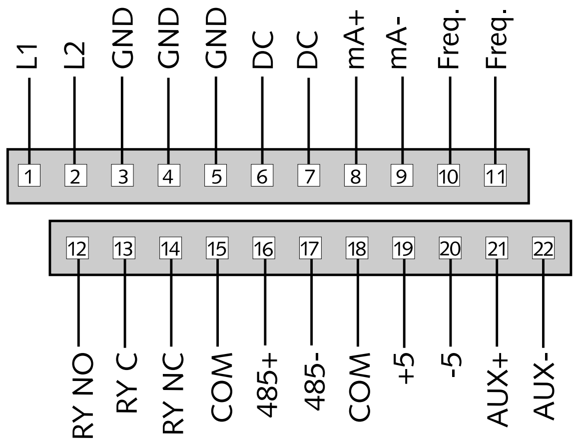


Figure 12: Interconnect

Table 7: Terminal names and descriptions

Terminal	Name	Description
1 *	L1	AC power input
2 *	L2	AC power input
3 *	GND	Earth ground connection
4	GND	Redundant earth ground connection
5	GND	Redundant earth ground connection
6 **	DC	DC power input - used only in place of AC power
7 **	DC	DC power input - used only in place of AC power
8 * **	mA+	Positive current loop output
9 * **	mA–	Negative current loop output
10	Freq	Not used in HART applications
11	Freq	Not used in HART applications
12	RY NO	Relay normally open
13	RY C	Relay common
14	RY NC	Relay normally closed
15	COM	Serial 485 common—not used for normal operation
16	485+	Serial 485—not used for normal operation
17	485-	Serial 485—not used for normal operation
18	COM	Auxiliary input power common, used only with aux input circuit board
19	+5	Auxiliary input power, used only with aux input circuit board
20	–5	Auxiliary input power, used only with aux input circuit board
21	Aux+	Auxiliary input frequency signal
22	Aux–	Auxiliary input frequency signal
*		Required for AC powered HART applications
**		Required for DC powered HART applications

Power

CAUTION!

DO NOT APPLY POWER until a thorough check of all the wiring is complete!

The AC power source voltage input is 90–270VAC at 50–60Hz, at 20VA maximum power consumption. Do not share AC power with transient producing loads.

For the LSTH only, the DC power source voltage input is 10–30VDC (less than 100mV, 1–1,000 Hz ripple) at 20VA maximum power consumption. DC power cable can be part of a single cable 4-wire hookup, or can be separate from output signal cable. See the "Output Current Loop " section.

Note: The LSTH can accept either AC or DC input power, but not both at the same time. Models LJTH and LNTH accept only AC power.

Use #14–#22AWG wire for power wiring to the gauge.

Switch for CE compliance

For CE compliance, install a power line switch no more than one meter from the operator control station.

Output current loop

Output signal is 4–20mA into 250–1000ohms (Ω). Terminal P1-8 is positive and P1-9 is negative. HART communication protocol (BEL202 FSK standard) is available on these connections. The output is isolated to standard ISA 50.1 Type 4 Class U.

When using signal (current loop or 4–20mA output) cables that Ohmart did not supply, the cables should meet the following specifications:

- Maximum cable length is 1,000m (3,280ft)
- All wires should be #18 or #22AWG (1.02–0.643mm)

If using DC power, signal and power can run on a single cable 4-wire hookup (two wires for power, two for 4–20mA).

Communication

The HART hand-held terminal can connect anywhere across the 4–20mA wires to communicate with the level transmitter. A minimum requirement is a 250Ω load-resistance on the current loop. The hand-held terminal is Rosemount model 275 or equivalent (Ohmart number 236907).

A HART modem may also connect across the 4–20mA wires to enable communication between the level transmitter and an IBM compatible PC.

Process alarm override switch

If the output relay is set as a process alarm relay (high or low-level alarm), you can install an override switch to manually deactivate the alarm. If you do not install an override switch, the process alarm relay de-energizes only when the measured level is out of the alarm condition. The function of the output relay is set in the **Alarms** screen from the **Initial Setup** menu.

Conduit

Conduit runs must be continuous and you must provide protection to prevent conduit moisture condensation from dripping into any of the housings or junction boxes. Use sealant in the conduit, or arrange the runs so that they are below the entries to the housings and use weep holes where permitted.

You must use a conduit seal-off in the proximity of the housing when the location is in a hazardous area. Requirements for the actual distance must be in accordance with local code.

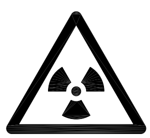
If you use only one conduit hub, plug the other conduit hub to prevent the entry of dirt and moisture.

Commissioning the gauge

The process of commissioning the gauge includes the following:

- Taking appropriate radiation field tests
- Checking the pre-programmed setup parameters
- Calibrating on process
- Verifying the working of the gauge.

Ohmart Field Service Engineers typically commission the gauge. It is necessary to remove the source holder lock the first time the gauge takes measurements in the field. Only persons with a specific license from the U.S. NRC, Agreement State, or other appropriate nuclear regulatory body may remove the source holder lock.



Note: Users outside the U.S. must comply with the appropriate nuclear regulatory body regulations in matters pertaining to licensing and handling the equipment.

Can you remove the source holder lock?

If you are in doubt whether you have permission to remove the source holder lock…Do not!

The license sets limits on what the user can do with the gauge. Licenses fall into two categories:

1. General
2. Specific

It is up to the user to review the license to determine if they have the appropriate permission to perform any of the following:

- Disassemble
- Install
- Relocate
- Repair
- Test
- Unlock

You can remove the source lock if installation of the gauge is in the U.S. and you have the specific license to remove the source holder lock. Confirm that your license specifically states that you have the permission to perform this operation and then contact Ohmart Field Service Radiation Safety for the combination.

Do not remove the lock if the gauge has a general license tag, installation is in the U.S., and you do not have the specific license that gives you permission to remove the lock. You can verify whether the gauge is a general license gauge by checking the source holder for the general license tag. If it is not there, it is not a general license device.

If you do not have permission to remove the source holder lock, an Ohmart Field Service Engineer or another person with this specific license must remove it for you.

Field service commissioning call checklist

In many U.S. installations, an Ohmart Field Service Engineer commissions the gauge. To reduce service time and costs, use this checklist to ensure the gauge is ready for commission before the Field Service Engineer arrives:

☑ Mount the source holder and detector per the certified drawings found in the custom information folder in this manual, allowing access for future maintenance

☑ Make all wiring connections per the certified drawings and the "Wiring the Equipment" section in this manual. Tie in the wiring from the field transmitter analog output to the DCS/PLC/chart recorder

☑ Ensure that the AC power to the transmitter is a regulated transient-free power source. UPS type power is the best

☑ If using DC power, verify that the ripple is less than 100 millivolts

Note: The equipment warranty is void if there is damage to the gauge due to incorrect wiring not checked by the Ohmart Field Service Engineer.

☑ Models LJTH and LNTH require 12 hours warm-up time with power applied before calibration.

☑ Have process ready for calibration

☑ When possible, it is best to have process available near both the low and high end of the measurement span.

☑ When possible, it is best to be able to completely fill and empty the vessel, at the high and low levels for the initial calibration procedure, and when possible at 10% increments in between for the linearization procedure.

☑ Do not remove the lock on the source holder. Notify Ohmart Field Service if there is damage to the lock or it is missing.

Chapter 3: Calibration

All of these functions group together in the **Calibrations** screens. See “Appendix IV” of this manual for **Calibrations** menus and screens.

Before using the level transmitter to make measurements, you must perform the following:

- Calibrate it to relate the detection of radiation from the source to the level of the process material
- Calibrate the current loop to a reference ammeter or the DCS
- Periodically, you must standardize the system on process to adjust for changes over time

Note: Ion chamber detector models (LJTH and LNTH) require a warm-up time before calibration or any time there is an interruption in power. Ohmart recommends a continuous application of power for approximately 12 hours before using the detector.

Current loop (analog output) calibration

Calibrating the current loop adjusts the 4–20mA output to a reference—either the PLC/DCS or a certified ammeter. It forces the 4mA and 20mA outputs to the external reference. The Ohmart factory pre-adjusts the current loop with a certified ammeter, so it is very close to the outputs required.

To correlate the 4–20mA to the process value, set the span of the current loop output in the **Loop Span** screen from the **Initial setup**, **Process parameters**, **Spans**, **Current Loops Span** menu. See the “Appendix I, Initial Factory Setup” section for details.

Note: The current loop and process spans are independent and set separately. The current loop span sets the level indications for the 4mA and the 20mA outputs. The process span sets the endpoints of the calibration curve. The current loop span and process span are set in the **Initial setup** screen from the **Main menu**.

A quick way to check the span settings is to use the **View settings** menu from the **Initial setup** menu.

A direct measurement of the current is preferable. Take this measurement by hooking the meter up in series with the instrument and the DCS. However, if you know the resistance of the DCS, use a voltage measurement to calculate the current.

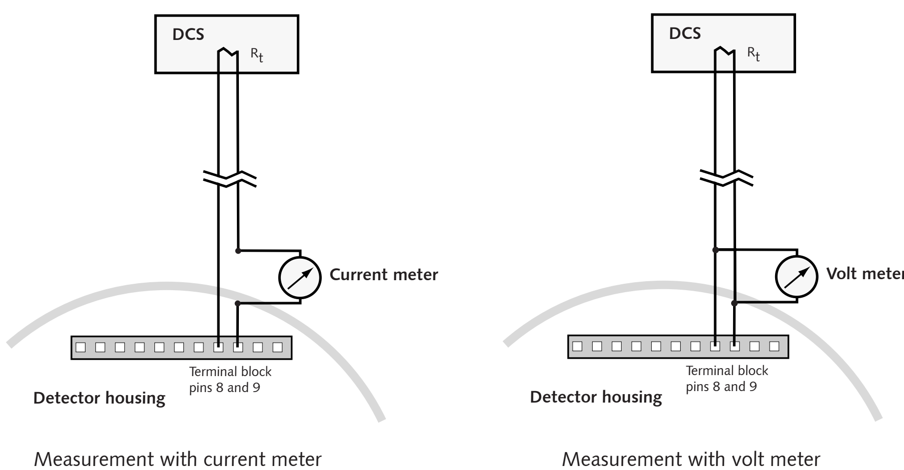


Figure 13: Measuring the current loop output

Before a current loop calibration:

- ☑ Connect an ammeter or the DCS to terminal connections 8 (mA +) and 9 (mA −) or the test points H1 and H2, or anywhere along the current loop

- ☑ Make sure there is a 250–1,000Ω load on the current loop. If no load or an insufficient load exists on the loop, it may require temporary placement of a resistor across terminals 8 and 9. Hook the meter or DCS in series with the load resistor.

Calibrating the current loop

Procedure 1: Calibrating the current loop

1. From **Calibrations** menu, select **Current loop cal**

2. The Current loop cal screen prompts you to connect the reference meter. Press F4 when the ammeter connects

   The screen displays, Setting Field Device Output To 4mA. The analog output circuit on the transmitter sets the current to approximately 4mA

3. Read the ammeter and enter the actual milliamp reading
   Note: If using a voltmeter, calculate the current value

4. The next screen prompts, Field Device Output 4.00mA Equal to Reference Meter?

   - Choose **Yes** if the ammeter reads 4.00mA
   - Choose **No** if the ammeter reads anything but 4.00mA

6. Repeat until the meter reads 4.00mA. The meter approaches the 4.00mA successively

7. Repeat procedure for 20mA setting.

You can check the current loop output calibration at any time by using the test mode to output a user-specified milliamp setting. See the section “Milliamp Output Test Mode” in the manual.

Calibration

Calibration establishes a reference point or points that relate the detector output to actual (or known) values of the process.

You must make a calibration before the gauge can make measurements of any accuracy. Perform the calibration after the installation and commission of the gauge at the actual field site.

You do not need to repeat the calibration procedures as long as certain critical process and equipment conditions remain the same. See "When a New Calibration May Be Necessary" in this manual. The gauge requires only a periodic standardization to compensate for changing conditions.

Choosing the calibration method

For each installation, the user must choose one of two ways to calibrate the level transmitter. The best calibration method depends on how you use the continuous level transmitter. Read the following table to decide which method to use.

Table 8: Calibration methods

Standard method	Simple method
Use the standard method if…the gauge is required to be repeatable and accurately indicate the level of process throughout the span.	Use the simple method if…the gauge is only required to be repeatable, but need not accurately indicate the level of process.
Typically used for vessels in which it is critical to know the accurate level.	Typically used for surge bins or other vessels under control that maintains one level.
The linearizer type chosen must be "Non-linear table"	The linearizer type chosen must be "Linear table"

Note: The simple calibration method produces a measurement indication that is repeatable but not accurate between the Cal Low Level and Cal High Level points. The measurement indication is not linear with respect to the actual process level.

In some applications, accuracy is not critical and this method is valid.

If your application requires a linear or accurate indication of the actual process level, you must use the standard method of calibration

Standard method of calibration

Figure 14 illustrates the steps to prepare for and perform a standard method calibration.

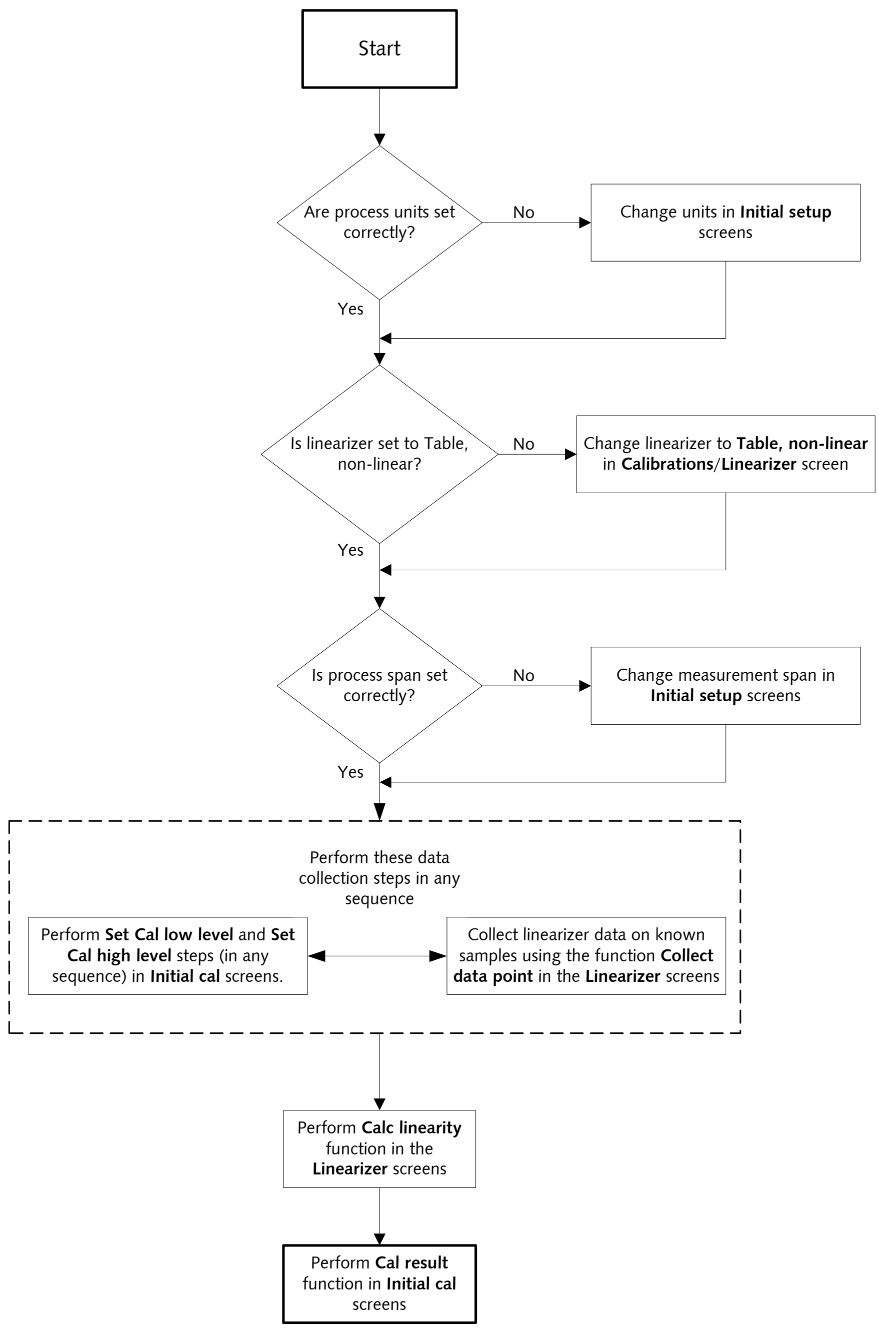


Figure 14: Standard method calibration flow chart

Table 9: Standard method calibration

Standard method calibration		
Step in flow chart	**Manual heading**	**Page**
Check process engineering units	Units	96
Check process span	Span settings, process span	101
Check linearizer type, set to table, non-linear	Choosing the linearizer type	37
Check the repeatability of measurement	Checking the gauge repeatability	42
Perform “Set Cal low level” and “Set Cal high level”	Step 1: Set low level Step 2: Set high level	45 46
Collect linearizer data on known samples	Step 3: Collecting linearizer table data	46
Perform “Calc linearity”	Step 4: Calculating the linearity	48
Perform “Cal result”	Step 5: Calculate calibration	48

Simple method of calibration

Figure 15 illustrates the steps to prepare for and perform a simple method calibration.

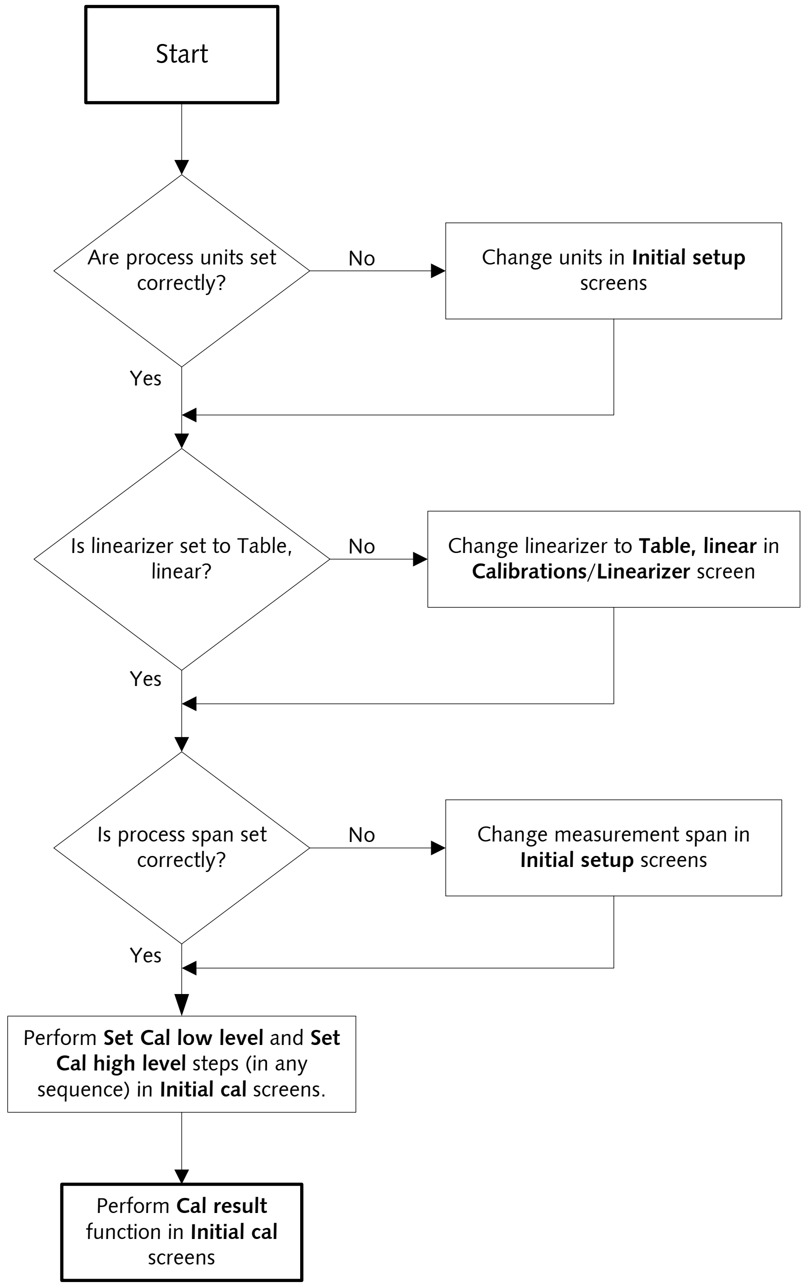


Figure 15: Simple method calibration flow chart

Table 10: Simple method calibration

Simple method calibration		
Step in flow chart	**Manual heading**	**Page**
Check process engineering units	Units	96
Check process span	Span settings, process span	101
Check linearizer type, set to linear table	Choosing the linearizer type	37
Check the repeatability of measurement	Checking the gauge repeatability	42
Perform “Set Cal low level” and “Set Cal high level”	Step 1: Set low level Step 2: Set high level	45 46
Perform “Cal result”	Step 5: Calculate calibration	48

Theory of calibration

This section explains both the standard and simple methods of calibration.

Both calibration methods

Enter the values that define the maximum and minimum levels to measure in the **Process span** screens, from the **Initial setup**, **Process parameters**, **Spans** menus. These parameters are Max Level and Min Level, and must be set correctly before any of the calibration steps.

Both calibration methods

Collection of data points nearest the Maximum (but not higher) and Minimum (but not lower) levels occurs during calibration. Refer to the “Two Point Cal“ procedure in this manual for the steps necessary to collect these data points. In Figure 16, stars indicate the Maximum and minimum level data points.

Standard calibration method

A standard calibration method requires collection of intermediate data points. Use the **Linear data collect** function from the **Calibrations**, **Linearizer** menus to collect these data points. In Figure 16, circles indicate the intermediate data points.

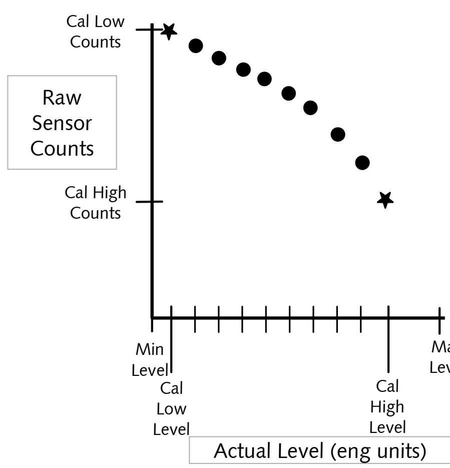


Figure 16: Linearizer data collected at various process levels

Simple calibration method

The simple method of calibration does not require collection of intermediate data points.

Standard calibration method

Internal software calculates a linearizer curve based on data points. The curve is the most accurate between the Cal Low Level and Cal High Level, as shown in Figure 17. For this reason, it is best to take the Cal Low and Cal High samples as close as possible to the Min Level and Max Level to maximize the accuracy within the span.

Simple calibration method

Based on the Cal Low Level and Cal High Level, the internal software calculates a straight line between the Min Level and Max Level.

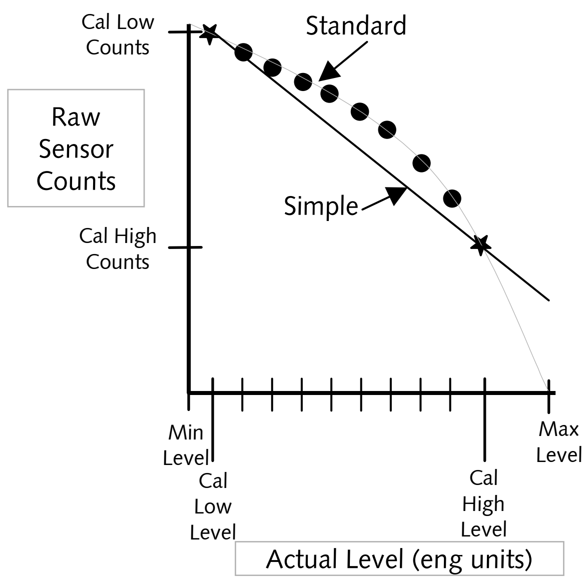


Figure 17: Raw counts vs. actual level with linearizers

Standard calibration method

The linearizer curve maps on two axes so that it indicates % Count Range vs. % Span, as shown in Figure 18. To construct the linearizer table, a data point calculates for every 2.5% of the span. View or edit these points in the Linearizer table screen.

Simple calibration method

The internal software calculates a straight line between the Min Level and Max Level based on the Cal Low Level and Cal High Level.

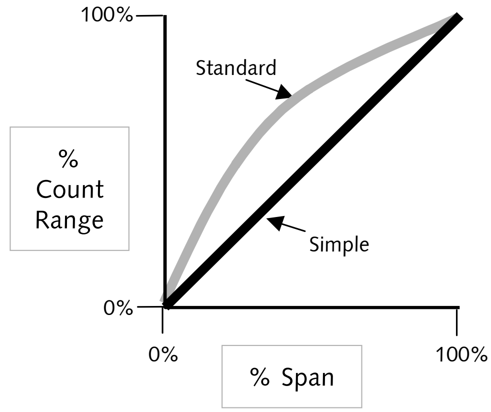


Figure 18: %Count range vs. %span (shown in linearizer table)

Both calibration methods

Figure 19 illustrates the effect on the final output of using the non-linear table vs. the linear table for the linearizer. Using the non-linear table linearizer in the standard method produces a linear output. Using the linear table linearizer table produces a non-linear output.

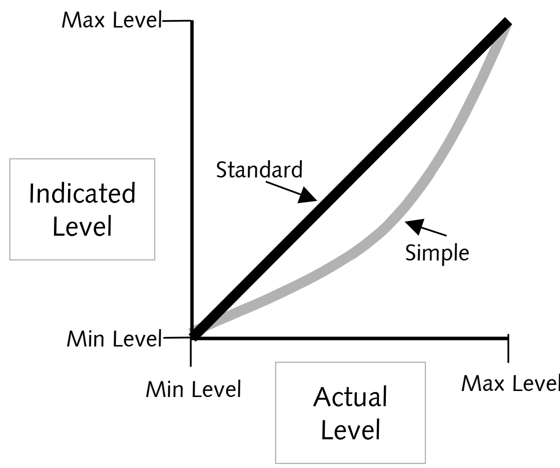


Figure 19: Indicated level vs. actual level

Choosing the linearizer type

The level transmitter response curve is non-linear, due to the measurement method of radiation transmission. The linearizer determines the shape of the curve between the endpoints.

As part of the signal processing necessary to produce a linear final output with respect to the change in level of process material, the level transmitter offers the following choices:

1. Non-linear table
2. Linear table

Non-linear table

Use this option for a standard method calibration. The non-linear table is more accurate than the linear table. This is because it the non-linear table takes into account the inherent non-linearity of a nuclear transmission measurement. The non-linear table can use data from the following:

- Linearizer look up table, data points that you collect and enter during the calibration process
- Linearizer data from an earlier model Ohmart level gauge

Table, linear

Use this option for a simple method calibration. This option enables you to use a linear (straight-line) set of data for a linearizer look up table. You do not need to collect linearizer table data points. The straight-line linearizer calculates from the high and low-level initial calibration points. This requires you to perform the following:

- Two-point calibration
- Calculate the calibration

This is not as accurate because it does not compensate for the non-linearity of a radiation transmission measurement.

Choosing a linearizer method

Procedure 2: Choosing a linearizer method

1. From the **Online** menu, select **Main menu**
2. From the **Main menu**, select **Calibrations**
3. From the **Calibrations** menu, select **Linearizer**
4. From the **Linearizer** menu, choose **Select linearizer**
5. On the **Select linearizer** screen, the currently used linearizer is displayed on the second line
6. From the **Select linearizer** screen, select either:
   - Table, non-linear
   - Table, linear
7. Press F4 to enter.

   Refer to “Appendix III” for further instructions if you choose the Table, linear option.

Checking the gauge repeatability

Check the level transmitter measurement repeatability before performing the calibration.

Access the **Data collect** function in the **Data Collect** screen, from the **Calibrations** menu to enable simple measurement of the process, without altering the calibration or standardization values. It enables the system to measure the process and report the number of sensor counts. For more information about counts and the calculations performed to produce the final process value, see the “Process Chain” section in the “Advanced Functions” chapter.

You can perform a data collect three or four times on the same level to check the repeatability of the sensor. If the sensor counts vary widely, you should increase the Data collection interval parameter from the **Initial setup** menu**, Process parameters** menu, **Data coll interval** screen. Refer to page 97 for further information.

Performing a data collect

Procedure 3: Performing a data collect

1. From the **Main menu**, select **Calibrations**
2. From the **Calibrations** menu, select **Data collect**
3. At the prompt, select **Yes** to enable the data collection to take place. The on-screen counter displays the time left. Press F3 to abort if necessary to discontinue data collect
4. After data collection, the screen displays the number of counts (cnts) output by the sensor. Make note of the counts value
5. Repeat as often as necessary if checking repeatability.

Initial calibration

The standard calibration method involves five main steps:

1. Setting the low level and collecting Cal low data*
2. Setting the high level and collecting Cal high data*
3. Collecting linearizer data*
4. Calculating the linearizer
5. Calculating the calibration

* Perform these data collection steps in any sequence. Your ability to empty and fill the vessel determines the best sequence.

The simple calibration method skips Step 3 and 4.

If using the standard calibration method, you may find it helpful to record the sensor counts and levels at each step on Table 11.

Table 11: Standard calibration sensor counts and levels record

Data type	Sensor counts	Actual level (eng units)
Cal low level (usually empty) and Linearizer data point 1		
Linearizer data point 2		
Linearizer data point 3		
Linearizer data point 4		
Linearizer data point 5		
Linearizer data point 6		
Linearizer data point 7		
Linearizer data point 8		
Linearizer data point 9		
Cal high level (usually full) and Linearizer data point 10		

Step 1: Set low level

Setting the low level for calibration requires the following activities

- Measurement with the level transmitter of the low process level
- Entry of the actual level

This sets the low end (sometimes referred to in the U.S. as “zero”) of the calibration curve. Perform this procedure either before or after setting the high level.

> Note: You must perform data collection for the low and high level within ten days of each other for a good calibration. The low and high values must be more than 10 percent of the process span apart for the most accurate calibration.
>
> Increasing the process span usually increases the gauge accuracy.

Before starting the cal low data collection:

- ☑ Fill vessel to its low level
- ☑ Have actual level value ready to enter

Setting the cal low level

Procedure 4: Setting the cal low density

1. From the **Main menu**, select **Calibrations**
2. From the **Calibrations** menu, select **Initial cal**
3. From the **Initial cal** menu, select **Two point cal**
4. From the **Two point cal** menu, select **Set Cal low level**
5. The prompt, Set process to desired value. Take data? displays. Select **Yes** to enable the data collection to take place. The on-screen counter displays the time left. If necessary, press F3 to discontinue data collection
6. After collection of the data, the screen prompts you to input the actual value. Input the actual value in engineering units
7. If using a hand-held Communicator, press F2 to send the calibration setting to the level gauge.

Step 2: Set high level

Setting the high level for calibration requires the following activities:

- Measurement with the level transmitter of the high process condition
- Entry of the actual level

This sets the “gain” of the calibration curve. Perform this procedure either before or after setting the low level.

> Note: You must perform data collection for the low and high level within ten days of each other for a good calibration. The low and high values must be more than 10 percent of the process span apart for the most accurate calibration.
>
> Increasing the process span usually increases the gauge accuracy.

Before starting the cal high data collection:

☑ Fill vessel or pipe with high process, or close the source holder shutter to simulate high process

☑ Have actual level ready to enter

Setting the cal high level

Procedure 5: Setting the cal high level

1. From the **Main menu**, select **Calibrations**
2. From the **Calibrations** menu, select **Initial cal**
3. From the **Initial cal** menu, select **Two point cal**
4. From the **Two point cal** menu, select **Set Cal high level**
5. The prompt, Set Process To High Calibration Point. Take Data? displays. Select **Yes** to allow the data collection to take place. The on-screen counter displays the time left. If necessary, press F3 to discontinue data collection
6. After data collection, the screen prompts you to input the actual value in engineering units. The prompt, Input Actual Value, displays. Enter the actual level in engineering units
7. If using a hand-held communicator, press F2 to send the calibration setting to the level transmitter.

Step 3: Collecting linearizer table data

Note: The simple method of initial calibration does not use this step.

This step allows you to collect data points between the high and the low calibration points so that the Ohmart level transmitter calculates a response curve based on your data.

Note: Ohmart View PC Software users: The linearizer data collection procedure is significantly different in Ohmart View. Refer to the Ohmart View User Manual for instructions to collect linearizer data.

Before collecting the linearizer table data:

- ☑ Prepare to set the level and take data. Ten levels (including the Cal low and Cal high levels) are the maximum
- ☑ Prepare to enter the levels into the transmitter
- ☑ You can collect linearizer table data along with the data collection for the Cal low and Cal high levels

Collecting linearizer table data

Procedure 6: Collecting linearizer table data

1. From the **Main menu**, select **Calibrations**
2. From the **Calibrations** menu, select **Linearizer**
3. From the **Linearizer** menu, select **Linearizer data**
4. From the **Linearizer data** menu, select **Linear data collect**
5. From **Linear data collect** menu, select **Collect datapoint**
6. At the prompt, enter the actual known level of process
7. Accept or reject the results when they display
8. Repeat procedure for all available levels
9. Press F2 to send.

Note: Include the data for the Cal low and Cal high with the linearizer data before you perform Calculate linearity. If you did not perform a linearizer data collect while the process was at the levels for Cal low and Cal high, you can manually add those values to the linearizer data.

To add a data point to the linearizer data, you must know the level in engineering units and the sensor counts. Go to the **Add new data pt** screen, from the **Calibration**, **Linearizer**, **Linearizer data**, **Linear data collect** menus, and follow the prompts to enter the data.

Step 4: Calculating the linearity

Note: The simple method of calibration does not use this step.

After collecting the data for a linearizer table, the transmitter uses the data to calculate a new calibration linearizer table. The **Calc linearity** function initiates this calculation. You must perform this step before the Calculate Calibration step, described in the next section.

Calculating a new linearizer table

Calculate the linearizer after you perform the following steps:

- Select non-linear table for the linearizer curve
- Collect linearizer data

Procedure 7: Calculating the linearizer

1. From the **Main menu**, select **Calibrations**
2. From the **Calibrations** menu, select **Linearizer**
3. From the **Linearizer** menu, select **Linearizer data**
4. From the **Linearizer data** menu, select **Linear data collect**
5. From the **Linear data collect** menu, select **Calc linearity**
6. At the prompt, select **Yes** to proceed with the linearity calculation. The linearizer table calculates based on the level values
7. Press F2 to save.

Step 5: Calculate calibration

After collecting the high and low level calibration data and calculating the linearity, the level transmitter is ready to make the calibration calculation.

Calculating the calibration result

Procedure 8: Calculating the calibration result

1. From the **Main menu**, select **Calibrations**
2. From the **Calibrations** menu, select **Initial cal**
3. From the **Initial cal** menu, select **Two point cal**
4. From the **Two point cal** menu, select **Cal result**
5. The screens display the results of the cal low and cal high sensor counts and values. Review the values. You can manually edit the counts and actual or new data can be collected by repeating the Set low and Set high procedures, or press F4 to continue
6. The prompt, Proceed with Calibration Calculation?, displays. Select **Yes** to proceed with the calculation
7. Press F2 to save.

When a new calibration may be necessary

Under most circumstances, you do not need to repeat the calibration procedure. The system requires only periodic standardization to compensate for drifts over time. However, certain events necessitate a new initial calibration. The events are:

- Measurement of a new process application (contact Ohmart for recommendation)
- Process requires a new measurement span
- Entry of a new measurement span setting into the software
- Installation of a new radiation source holder
- Moving the level transmitter to another location (in U.S. only specifically licensed persons may relocate the gauge)
- Changes to the process vessel, for example: lining, insulation, or agitator
- Excessive build up or erosion of vessel that standardization cannot compensate for (check standardize gain)
- Standardize gain is greater than 1.2 after a standardization, indicating it made a 20% adjustment from the initial calibration

Periodic process standardization

Standardization adjusts the system by resetting one point of the calibration curve to an independently measured or known level.

The frequency of standardization depends on several factors, including desired accuracy of the reading.

During the standardization procedure, the system displays either:

- A default value for the standardization condition
- A prompt to enter the actual level of the standardization condition

The Initial factory setup appendix details how to set up the software for either prompt.

Automatic standardization reminder

If you enable the standardization due alarm, the level transmitter alarms when standardization is due. The standardize interval is programmed into the calibration parameters setup. Refer to "Appendix I, Initial Factory Setup", for details on the following subjects:

- Output relay setup
- Standardization due alarm
- Standardization interval

Performing a standardization

Standardizing the gauge

Procedure 9: Standardizing the gauge

1. From the **Main menu**, select **Calibrations**
2. From the **Calibrations** menu, select **Process stdz**
3. The **Process stdz** screen prompts if you want to take data. Select **Yes** if you are ready with the standardization material in the process vessel to continue the standardization procedure. The timer counts down while it is collecting data
4. Depending on how the system is set up, it displays one of the following:
    - The message, Gage Set up to Use Default Value, indicates the system is using the default value as the actual value of the standardization material
    - A screen that displays the detector counts, the calculated process value, and a field for the user to input the actual value of the level. The prompt asks, Edit Counts? Select **No** to continue or **Yes** to input the average counts
5. Press F2 to send.

Chapter 4: Advanced functions

Functions not required for normal operation of the transmitter are found in the software menu structure under the heading, **Advanced Fxns**. These functions are primarily for use by Ohmart personnel for advanced troubleshooting and repair. This chapter gives a basic explanation of these functions.

Note: Ohmart strongly recommends that you ask our advice before using any of these advanced functions.

Process chain

The process chain is a description of the transmitter software's calculation of a level measurement from a radiation reading. In the **Process chain** screen, you can view intermediate values of the calculation to verify proper functionality of the software.

Primary channel

Press the hot spot key (➤➤➤)on the hand-held communicator to display the **Primary channel** screen. The display values for the **Primary channel** screen are:

Temp

Temperature displays the internal probe's measurement of the sensor temperature. (This does not apply to ion chamber detectors, models LNTH and LJTH.)

Sensor cnts

Displays the sensor counts that are true counts output, from the sensor, before application of the following:

- Temperature compensation
- Standardize
- Sensor uniformity gains

TC counts

Displays temperature compensated counts that are sensor counts with application of temperature compensation.

Raw counts

Displays raw counts that are temperature compensated counts with application of uniformity gain.

Adj counts

Displays adjusted or sum counts that are raw counts plus auxiliary raw counts. In most applications, this does not use auxiliary input, so sum counts are equal to raw counts.

SD counts

Displays source decay counts that are sum counts with application of source decay gain.

Stdz counts

Displays standardize counts that are source decay counts with application of standardization gain.

% Cnt range

Displays compensated measurement counts that express as a percent of the counts at the high and low-endpoints of the calibration (determined with the two point initial calibration.) This quantity shows where the current measurement is in relation to the total count range.

$$\% \text{ count range} = 100 \times (C_L - C_S) / (C_L - C_H)$$

where

C_S = sum counts
C_L, C_H = counts at Cal low level and Cal high level
$C_L – C_H$ = counts range

% of span

The percent process span indicates the measurement value as a percent of the measurement span. The maximum and minimum level values are input in the **Initial setup** screens. A graph of percent count range vs. percent process span indicates the non-linearity of the radiation transmission measurement. If using a table linearizer, the values in the table are percent count range and percent process span.

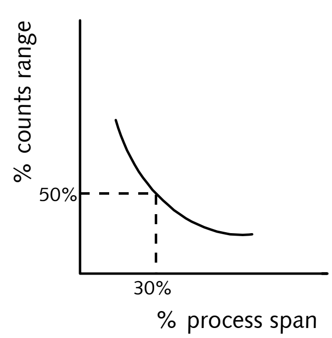


Figure 20: % counts range vs. % process span

Raw level

Raw level displays the level in inches without the time constant or rectangular window filter.

Uncomp Lvl

Uncompensated level displays the level in inches without the time constant or rectangular window filter.

Level

Level displays the process value that is the level or other indication in engineering units, after applying the filter. This value relates to the current loop output.

Process variables

The display values for the **Process variables** screen are:

Counts low

Displays the counts-low that is the temperature and sensor uniformity gain compensated counts from the sensor at the Cal low level. Determination of the Cal low level occurs during the initial calibration procedure.

Counts high

Displays the counts-high that is the temperature and sensor uniformity gain compensated counts from the sensor at the Cal high level. Determination of the Cal high level occurs during the initial calibration procedure.

Max level

Displays the maximum level that is the value, in process units, as entered in the **Initial setup** screens. Use this to calculate the measurement span.

Min level

Displays the minimum level that is the value, in process units, as entered in **Initial setup** screens. Use this to calculate the measurement span.

Temp comp gain

Temperature compensation gain displays the current value of the temperature compensation gain. Use this to adjust for inherent sensor output change with temperature.

Uniformity gain

Uniformity gain displays the current of the uniformity gain. Use this to force all level sensors to output the same counts at a given radiation field. Most level applications do not use uniformity gain and have it set as default value of 1.0.

Source decay gain

Source decay gain displays the current value of the source decay gain. Use this to compensate for the natural decay of the radiation source, which produces a lower field over time.

Stdz gain

Displays the current value of the standardize gain that adjusts with each standardize procedure.

HV setting

HV setting displays the HV setting feature that is the set point for sensor high voltage.

Aux channel chain

The display values for the **Aux channel chain** screen are:

Aux raw counts

The Auxiliary raw counts field displays the frequency-input counts from optional auxiliary input.

Filt counts

Filtered counts displays the filtered auxiliary counts. The filter dampening value is the number to enter for the auxiliary input filter time constant.

Min/Max history

The min/max history displays the minimum and maximum value for parameters since the last min/max reset. The display values are:

Temp min/max

Temperature minimum and maximum displays the internal temperature of the scintillator sensor in the LSTH model level transmitter. This does not apply to ion chamber detectors, models LNTH and LJTH.

Sensor min/max

The sensor minimum and maximum field displays raw uncompensated counts from the detector.

Aux in min/max

Auxiliary minimum and maximum displays auxiliary input (if used) counts.

Last reset

Displays the date of the last min/max reset.

Resetting the minimum and maximum history

You can reset the minimum and maximum history values so that they record from the time of the reset.

To reset the minimum and maximum history

Procedure 10: Resetting the minimum and maximum history

1. From the **Main menu**, select **Advanced Fxns**
2. From the **Advanced Fxns** menu, select **Min/max history**
3. From the **Min/max history** screen, select **Reset min/max**
4. When prompted, select **Yes** to reset the min/max values. Or select **No** to cancel
5. Press F2 to save.

New hardware or EEPROM corrupt (applies only to LSTH)

The transmitter contains two electrically erasable programmable read only memory (EEPROM) chips. The EEPROMs store all data specific to that sensor/electronics pair for the installation. The locations of the EEPROMs are:

- On the CPU board
- On the sensor board

Each EEPROM contains a backup of the other EEPROM. The system monitors both EEPROMs at power-up to assure an accurate backup.

Note: The HART screens mentioned in this section are accessible but not functional for ion chamber detector models, LNTH and LJTH.

If you install a new CPU board or sensor assembly (which includes the sensor board), the EEPROM backups on the CPU and sensor boards do not match. The software signals the discrepancy with the error message, New Hardware Found. The transmitter does not automatically perform a backup in case the discrepancy is not due to new hardware, but some corruption of the EEPROM.

Note: Only use the **New hardware** functions if you replace either the CPU board or sensor assembly and the other is to remain on the same installation.

This function is not necessary if installing a completely new detector assembly. The new detector assembly includes the CPU board and the sensor assembly.

Proper response to "New hardware found" message if new hardware HAS been installed

When you install a new CPU board or a new sensor assembly, you must verify installation in the **New hardware** screen. This function enables new backups of the EEPROMs.

This message never appears on systems with ion chambers, models LNTH and LJTH.

If a new CPU board has been installed

Procedure 11: New Hardware Found message with new CPU board

1. From the **Main menu**, select **Advanced Fxns**
2. From the **Advanced Fxns** menu, select **New hardware**
3. From the **New hardware** menu, select **New CPU board**
4. The prompt, Verify New CPU Board Installed displays. Select **Yes** to allow new backups on the EEPROMs or select **No** to cancel.

If a new sensor assembly has been installed

Procedure 12: New Hardware Found message with new sensor

1. From the **Main menu**, select **Advanced Fxns**
2. From the **Advanced Fxns** menu, select **New hardware**
3. From the **New hardware** menu, select **New Sensor**
4. The prompt, Verify New Sensor Installed displays. Select **Yes** to allow new backups on the EEPROMs or select **No** to cancel.

Proper response to "New hardware found" message if new hardware HAS NOT been installed CPU EEPROM Corrupt message Sensor EEPROM Corrupt message

If there has not been an installation of a new CPU board or sensor assembly and the error message, New Hardware Found, displays, then one of the EEPROMs is probably corrupt. You normally can repair the corruption with the EEPROM backup.

This message will never appear on systems with ion chambers, models LNTH, and LJTH.

CAUTION!

If you suspect that an EEPROM is corrupt, we recommend you call Ohmart Field Service for advice before performing the following procedure.

To repair the corruption from the EEPROM backup

Procedure 13: Repairing corrupted EEPROM

1. From the **Main menu**, select **Advanced Fxns**
2. From the **Advanced Fxns** menu, select **New hardware**
3. From the **New hardware** menu, select **No new hardware**
4. At the prompt, Do You Want To Reconcile Differences?, select **Yes** to allow restoration from backups on the EEPROMs. Or select **No** to cancel.

Test modes

Five independent test modes are available. These test modes are:

1. mA Out test mode
2. Sensor test mode
3. Aux Inp test mode
4. Relay test mode
5. Temperature test

In the test modes, the transmitter stops measuring the process material and allows manual adjustment of critical variables for troubleshooting. The test modes enable independently. However, you can use them in combination to test multiple variable effects. All of the test modes time out automatically after one hour if you do not manually exit.

CAUTION!

While in a test mode, the transmitter is not measuring process and so its current output does not reflect the process value. If your DCS is controlling from the transmitter's current output, be sure to remove the system from automatic control before entering a test mode. The software screens prompt you to do so before entering test mode.

Milliamp output test mode

Use the milliamp output test mode to manually force the current output to a specified value. This is useful for verifying the current loop calibration. Instructions to calibrate the current loop are available in the "Calibration" chapter of this manual.

Note: While in milliamp test mode, the HART communication may post a Status error. This is expected and not an indication of a failure. If the message, Status Error—Ignore Next xx Occurrences? displays, select **Yes** to ignore the Status Error.

Start milliamp output test mode

Procedure 14: Start mA output test mode

1. From the **Main menu**, select **Advanced Fxns**
2. From the **Advanced Fxns** menu, select **Test mode**
3. From the **Test mode** menu, select **mA Out test mode**
4. From the **mA Out test mode** menu, select **Enter mA test mode**
5. At the prompt, enter the value of the current output you want to force
6. At the prompt, select **Yes** to start the test mode and send new data
7. The transmitter continues functioning in milliamp test mode until it times out after one hour, or until you choose **Exit mA test mode**.

Exit milliamp output test mode

Procedure 15: Exit mA output test mode

1. From the **Main menu**, select **Advanced Fxns**
2. From the **Advanced Fxns** menu, select **Test mode**
3. From the **Test mode** menu, select **mA Out test mode**
4. From the **mA Out test mode** menu, select **Exit mA test mode**
5. At the prompt, select **Yes** to exit the test mode.

Sensor test mode

The sensor test mode simulates the sensor output at a user-defined number of raw counts. This is before application of the following:

- Temperature compensation
- Sensor uniformity gain
- Standardize gain

The true sensor output is ignored while the transmitter is in sensor test mode.

Sensor test mode is extremely useful for verifying the electronics' and software response to input counts without having to perform the following:

- Change the process
- Shield the source
- Vary the radiation field

While in sensor test mode, after entering the desired number of counts, it may be useful to look at the **Process chain** screen to view the variables affected by the raw counts value. To view the **Process chain** screen, back out of the test mode screens pressing the LEFT ARROW. The transmitter continues to operate in sensor test mode until it times out after one hour or until you choose **Exit test mode**.

Start sensor test mode

Procedure 16: Start Sensor test mode

1. From the **Main menu**, select **Advanced Fxns**
2. From the **Advanced Fxns** menu, select **Test mode**
3. From the **Test Mode** menu, select **Sensor test mode**
4. From the **Sensor test mode** menu, select **Enter test mode**
5. At the prompt, enter the value of the new counts you want to force
6. At the prompt, select **Yes** to start the test mode and send new data
7. The transmitter continues functioning in sensor test mode until it times out after one hour, or until you choose **Exit test mode**.

Exit sensor test mode

Procedure 17: Exit Sensor test mode

1. From the **Advanced Fxns** menu, select **Test mode**
2. From the **Test mode** menu, select **Sensor test mode**
3. From the **Sensor test mode** menu, select **Exit test mode**
4. At the prompt, select **Yes** to exit the test mode.

Auxiliary input test mode

The auxiliary input test mode simulates the auxiliary input frequency at a user-defined number of counts. The effect of auxiliary input counts depends on the auxiliary input mode. Examples are:

- Temperature probe
- Flow meter
- Second transmitter

While in auxiliary input test mode, after you enter the desired number of counts, it may be useful to look at the **Process chain** screen to view the variables affected by the auxiliary input counts value. To view the **Process chain** screen, back out of the test mode screens using the LEFT ARROW. The transmitter continues to operate in auxiliary input test mode until it times out after one hour or until you choose **Exit auxiliary input test mode**.

Start auxiliary input test mode

Procedure 18: Start Auxiliary test mode

1. From the **Main menu**, select **Advanced Fxns**
2. From the **Advanced Fxns** menu, select **Test mode**
3. From the **Test Mode** menu, select **Aux Inp test mode**
4. From the **Aux Inp test mode** menu, select **Aux Inp test mode**
5. At the prompt, select **Yes** to adjust counts
6. Input the Aux counts that you want to force
7. At the prompt, select **Yes** to start test mode and send new data

   The transmitter continues functioning in auxiliary test mode until it times out after one hour, or until you choose **Exit Aux test mode**.

Exit auxiliary input test mode

Procedure 19: Exit Auxiliary test mode

1. From the **Advanced Fxns** menu, select **Test mode**
2. From the **Test mode** menu, select **Aux Inp test mode**
3. From the **Aux Inp test mode** menu, select **Exit Aux test mode**
4. At the prompt, select **Yes** to exit the test mode.

Relay test mode

Relay test mode enables the user to manually toggle the relay on or off to test the contacts. This is useful for verifying the functioning of alarm annunciators.

Start relay test mode

Procedure 20: Start Relay test mode

1. From the **Main menu**, select **Advanced Fxns**
2. From the **Advanced Fxns** menu, select **Test mode**
3. From the **Test Mode** menu, select **Relay test mode**
4. From the **Relay test mode** menu, select **Enter mA test mode**
5. At the prompt, select **Energize relay** or **De-energize relay**

   The transmitter continues functioning in Relay test mode until it times out after one hour, or until you choose **Exit relay test**.

Exit relay test mode

Procedure 21: Exit Relay test mode

1. From the **Advanced Fxns** menu, select **Test mode**
2. From the **Test mode** menu, select **Relay test mode**
3. From the **Relay test mode** menu, select **Exit relay test**.

Temperature test mode

The temperature test mode enables the user to manually force the LSTH sensor temperature probe output to a specified value. This is useful for verifying the scintillator sensor temperature compensation. This does not have any effect on LJTH or LNTH systems.

Start temperature test mode

Procedure 22: Start Temperature test mode

1. From the **Main menu**, select **Advanced Fxns**
2. From the **Advanced Fxns** menu, select **Test mode**
3. From the **Test mode** menu, select **Temperature test mode**
4. From the **Temperature test mode** menu, select **Enter Temp. test**
5. At the prompt, enter the value of the new temperature you wish to force

   The transmitter continues functioning in Temperature test mode until it times out after one hour, or until you choose **Exit Temp. test mode.**

Exit temperature test mode

Procedure 23: Exit Temperature test mode

1. From the **Advanced Fxns** menu, select **Test mode**
2. From the **Test mode** menu, select **Temp. test mode**
3. From the **Temp. test mode** menu, select **Exit Temp. test mode**
4. At the prompt, select **Yes** to exit the test mode.

Other advanced functions

Checking the sensor voltage, poll address, equipment version, serial numbers, and temperature coefficients

When performing diagnostics, it may be important to know the following information:

- Sensor voltage
- Poll address
- Version of firmware on the FLASH installed on the level transmitter
- Hardware version number
- Equipment serial numbers
- Temperature coefficients

Sensor voltage (LSTH only)

Sensor voltage displays the scintillator (model LSTH) sensor voltage. It does not apply to ion chamber detectors models LNTH and LJTH.

Poll address

Poll address displays the HART poll address of the transmitter. Each transmitter in a current loop must have a unique poll address. This value is meaningful only when multiple transmitters connect on the same loop.

Firmware version

Firmware version displays the firmware version number.

Hardware version

Hardware version displays the hardware version number.

CPU Serial Number

CPU Serial Number displays the CPU serial number.

Sensor Serial Number

Sensor Serial Number displays the sensor serial number.

View temperature coefficients (LSTH only)

The algorithm that compensates for variations in measurement output with changes in temperature uses temperature coefficients. The Ohmart factory determines the coefficients through rigorous testing. You cannot change these values through normal operation. This does not apply to ion chamber models LJTH and LNTH.

Checking the sensor voltage, poll address, version, and serial numbers

Procedure 24: Checking equipment version and serial numbers

1. From the **Main menu**, select **Advanced Fxns**
2. From the **Advanced Fxns** screen, select **Other advanced**
3. From the **Other advanced** screen, select one of the following:
    - Sensor voltage
    - Poll addr
    - Firmware ver
    - Hardware ver
    - CPU Serial No.
    - Sensor Serial No.
    - View Temp. coefs

Select gauge type

Ohmart's nuclear density gauges use much of the hardware and software of the Ohmart HART Level transmitters. If your level transmitter indicates PV or Density as the process variable, it was set incorrectly for a level type application. Select gage type enables the users to set the software to operate as either a density or a level gage.

Procedure 25: Select gage type

1. From the **Main menu**, select **Advanced Fxns**
2. From the **Advanced Fxns** menu, choose **Select gage type**
3. From the **Select gage type** menu, select **Level**
4. If using a HART hand-held communication device, press F2 to send.

Select gauge location

The local gauge refers to a gauge that has its sensor electronics and processing electronics all contained in the same housing. Set a gauge to remote if the sensor electronics and processing electronics are in separate housings and the process signal connects to the auxiliary input of the processing electronics. If you are using a Remote HART Processor, refer to "Remote retrofit" on page 149 for more information.

Procedure 26: Select gage location

1. From the **Main menu**, select **Advanced Fxns**
2. From the **Advanced Fxns** menu, choose **Select Gage Locati**
3. From the **Select Gage Locati** menu, select either **Local** or **Remote**
4. If using a HART hand-held communication device, press F2 to send.

Chapter 5: Diagnostics and repair

Software diagnostics

The level transmitter system can alert users to potential problems by:

- Posting messages on the HART screens
- Energizing the output relay
- Distinctly changing the current loop output
- Tracking the current status and history in the Gauge status screens

Four classes of alarms are available to track the status and history in the Gauge status screens. These alarms are:

1. Diagnostic
2. Analog
3. Process
4. X-ray

Diagnostic alarm

Provides information about the level transmitter system and alerts the user when periodic procedures are due.

Analog alarm

Sets the current loop mA output to either 2mA or 22mA when the detector outputs zero counts.

Process alarm

The process alarm allows the relay output to trip when the process level is either above (high limit) or below (low limit) a setpoint.

X-ray alarm

Distinctly changes the current loop mA output in response to a marked increase in the radiation field. This prevents control problems when external radiographic sources are in the area for vessel inspections.

A summary of the alarm-type outputs is in the table below.

Table 12: Alarm type outputs

Alarm type	Option to trigger relay	Display HART message	Current loop output affected	Gauge status and gauge history
Diagnostic	Yes	Optional	No	Yes
Analog	No	No	Yes	No
Process	Yes	No	No	No
X-ray	Yes	No	Yes	No

Note: "Appendix I: Initial Factory Setup" provides detail on setting up the alarm functions.

Gauge status

Use the **Gauge Status** screens under the Main menu to check status and historical information.

Diagnostic alarms and HART messages

Diagnostic conditions that are *currently* in alarm alert the user by three possible means:

1. Diagnostics screens in the **Gauge status** menu
2. HART messages that appear when a HART device connects if the diagnostic condition is set to **On** in the **Initial setup** screens
3. Relay output if it is set as a diagnostic alarm relay, and if the diagnostic condition is set to **On** in the **Initial setup** screens

Note: Refer to the table on page 74 for a summary of all diagnostic alarm conditions and recommended actions.

Gauge status diagnostics screens

To check the status of the system you can use the **Diagnostics** screen from the **Gauge status** menu to scroll through a series of checks. This screen indicates only the status: historical occurrences are stored in the **Diagnostic history** screens from the **Gauge status**, **View history** menus.

Some conditions are self-repairing, for example RAM and EEPROM corruption. Therefore, these may appear in the history screens but not in the diagnostic screens.

You can view the status of *all* diagnostic alarms in the **Diagnostics** screen from the **Gauge status** menu

Acknowledging diagnostic alarms

If a condition is in alarm, you can acknowledge it (turn it off) in the **Diagnostics** screen from the **Gauge status** menu. The following alarms are exceptions to this rule:

- Source wipe due
- Shutter check due
- Standardize due

These exceptions acknowledge when the function performs.

> **Note:** If the relay is set as a diagnostic alarm, you must acknowledge all diagnostic alarms to reset the relay.

Checking and acknowledging the diagnostic alarms with Gauge status

Procedure 27: Checking and acknowledging diagnostic alarms

1. From the **Main menu**, select **Gauge status**
2. From the **Gauge status** menu, select **Diagnostics**
3. The first diagnostic condition displays. Press F4 to view all the conditions
4. If a diagnostic condition is in alarm, you can either:
   - Clear the alarm by choosing Acknowledge alarm
   - Or ignore the alarm by pressing NEXT
5. The message, Current Status Complete, displays after viewing all of the conditions.

Diagnostic alarm messages

Active alarm messages may appear on the HART device if the alarm condition is toggled on. You can toggle individual alarm conditions On or Off in the **Diagnostic alarm** screens from the **Initial setup**, **Alarms**, **Mode configuration** menus.

When a HART device initially connects to the level transmitter, any conditions in alarm display on the screen.

Summary of diagnostic alarm conditions

Table 13: Diagnostic alarm conditions

Diagnostic check on Gauge status screen	Normal /Error condition s	HART message	Alarm acknowledgment / Recommended action
RAM status	Pass / Fail	RAM corrupt	RAM memory corruption has occurred and has been resolved internally. Repeated triggering of this alarm indicates a possible hardware problem—consult Ohmart Field Service.
Sensor EEPROM status (LSTH only)	Pass / Fail	Sensor EEPROM corrupt	Non-critical memory corruption has occurred on the sensor pre-amp board EEPROM and may not have been resolved internally. To check if the problem is recurring, after acknowledging the alarm, cycle power to the unit. If alarm occurs again, it indicates a hardware problem. Perform the procedure " Repairing corrupted EEPROM" on page 58.
Real time clock test	Pass / Fail	Real time clock fail	The clock has failed which may result in miscalculation of timed events. (If the transmitter has not been powered up for more than 28 days, the time and date should be reset.) To resolve, try to reset the time and date. If the time and date do not reset, call Ohmart Field Service.
Sensor temp probe test (LSTH only)	Pass / Fail	Sensor temp probe fail	The sensor temperature probe may not be functioning, which will result in erroneous measurements. Verify by checking the sensor temperature on the **Advanced Fxns** / **Process chain** / **Primary channel** screen. If the temperature reads –0.5°C constantly, the probe is broken and the sensor assembly may need to replacement. Call Ohmart Field Service.
Standardize due?	No / Yes	Standardize due	A standardize procedure is due. Alarm is acknowledged automatically by the system when a process standardize procedure is completed under the **Calibrations** /**Process stdz** screen.
Source wipe due?	No / Yes	Source wipe due	A source wipe is due. Alarm is acknowledged by logging a shutter check under **Initial setup** / **System parameters** / **Source function** screen. See page 86 for details.
CPU EEPROM status	Pass / Fail	CPU EEPROM corrupt	Non-critical memory corruption has occurred on the CPU board EEPROM and may not have been resolved internally. To check if the problem is recurring, after acknowledging the alarm, cycle power to the unit. If alarm occurs again, it indicates a hardware problem. Perform the procedure " Repairing corrupted EEPROM" on page 58.
Alarm type 1	Not used		Not used in standard software. Consult Ohmart special software
Alarm type 2	Not used		Not used in standard software. Consult Ohmart special software
Shutter check due?	No / Yes	Shutter check due	A source holder shutter check is due. Alarm is acknowledged by logging a shutter check under **initial setup** / **system param**eters / **source functions** screen. See page 86 for details.
New hardware found? (LSTH only)	No / Yes	New hardware found	The CPU board detects a configuration mismatch. The CPU board or sensor assembly may have been replaced, or one of the EEPROM configurations is erroneous. Refer to page 57 for more information.
Sensor status?	Pass / Fail	Sensor fail	Less than one count seen in the last 10 seconds. (Configurable by Field Service.) Indicates the sensor is malfunctioning.
Process out of range?	No / Yes	Process out of measurement range	The current process value is not within the limits set by the Max level and Min level in the gauge span settings.
Sensor voltage status (LSTH only)	Pass / Fail	Sensor high voltage fail	The high voltage on the PMT is outside the usable range. Check wiring on CN2.

Analog alarm

If the current loop output (analog output) is stable at either 2mA or 22mA, the analog alarm is set.

The analog alarm is set when the counts from the detector falls below a set threshold, indicating that the detector is not outputting enough counts to make a meaningful measurement. This is, also known as, zero counts.

If the analog alarm is on, check the following:

- ☑ Source holder shutter is in the On or Open position to create the required radiation field
- ☑ Extreme build-up on walls or other material shielding the detector from the radiation field
- ☑ Damage or disconnection of electrical connections from the sensor assembly to the CPU board See the Power Intraconnect Diagram on page 81 for a diagram of the electrical connections on the connector.

Process alarm

The process alarm alerts users when the process level is above a setpoint (high limit) or below a setpoint (low limit). Enter the choice of low or high limit and the setpoint in the **Initial setup** screens. See "Appendix I: Initial Factory Setup" for details.

The process alarm works only with the output relay. No HART messages, gauge status diagnostics, or history information saves for the process alarms.

The level transmitter acknowledges or resets the process alarm when the process value returns back to the setpoint value. Depending on your usage of the process alarm relay, you may want to install a process alarm override switch to manually turn off an annunciator when the level transmitter relay energizes.

X-ray alarm

The x-ray alarm compensates for false indicated process values that occur when the gauge detects external radiographic sources. For example, vessel weld inspections often use portable radiographic (x-ray) sources. X-rays that the gauge detects cause a false low reading and adversely affect any control based on the gauge output.

The x-ray alarm can perform the following actions:

- Alter the current loop output to indicate the alarm condition
- Trip the output relay, if the relay is set up to do so

The level transmitter enters the x-ray alarm condition when it detects a radiation field above a set threshold. The gauge sets the current loop output at its value 10 seconds before the condition. It periodically dithers the output about the average, cycling until the radiation field is back to the normal level or until a time-out period of 60 minutes.

Figure 21 illustrates the current loop output. You can set the parameters of the output. Refer to "Appendix I: Initial Factory Setup".

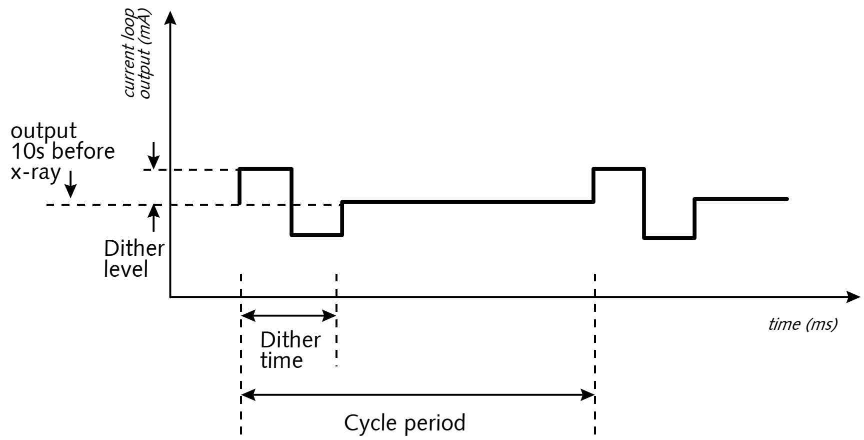


Figure 21: X-ray interference alarm output

History information

Information about critical events stores in the **Diagnostic history** screens from the **Gauge status**, **View history** menus. You can view the newest and oldest trigger records of the following events:

- RAM corrupt
- Sensor EEPROM corrupt (LSTH only)
- FLASH corrupt
- Real time clock fail
- Sensor temperature fail (LSTH only)
- Standardize due
- Source wipe due
- New hardware found (LSTH only)
- CPU EEPROM
- Alarm type 1
- Alarm type 2
- Shutter check due
- Sensor fail
- Process out of range
- Sensor voltage out of spec (LSTH only)

Use this information to determine if a problem has recently occurred and internally repaired. An example of this would be an EEPROM corruption.

Hardware diagnostics

Figure 22 may be helpful in finding the following items on the CPU circuit board:

- Test points
- Fuses
- Jumpers
- Connectors

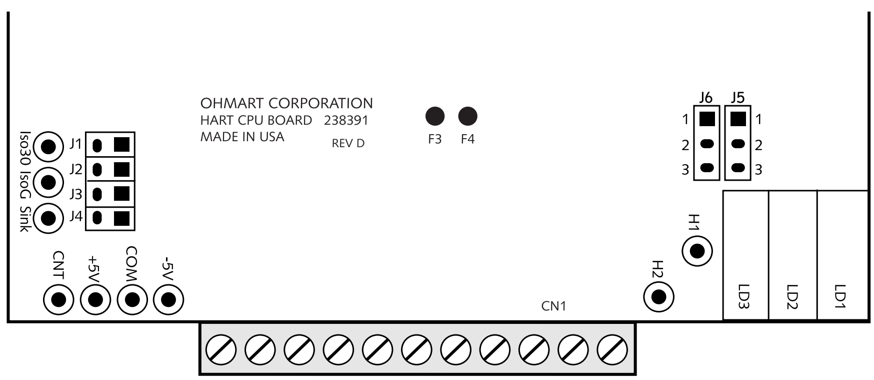


Figure 22: CPU board simplified component layout

Test points

You can access test points on the CPU board by pulling the sensor assembly slightly out of the housing.

Table 14: Test point labels and descriptions

Test point label	Description
H1	HART connection
H2	HART connection
-5V	–5V power supply test point reference to logic ground
5V	+5V power supply test point reference to logic ground
COM	Logic ground
CNT	Counts—raw input signal coming from preamp. Referenced to isolated ground
Iso 30V	Isolated power
IsoG	Isolated ground
Sink	Loop current test point 200mV/mA loop current. Referenced to isolated ground

Jumpers

Jumpers J5 and J6 on the CPU board set the current loop source or sink mode. (The HART level transmitter does not use Jumpers J1–J4.). Do not change the jumpers from the current setting without consulting Ohmart Field Service.

The jumpers for the current loop power source or sink mode are set as follows:

Table 15: Jumper settings

Mode	Jumper setting
Source mode (transmitter current loop is self-powered)	J5 1-2, J6 1-2
Sink mode (transmitter current loop is DCS-powered)	J5 2-3, J6 2-3

LED indicators

Check the basic functioning of the HART level transmitter at the instrument with LED indicators on the CPU board. They are visible when you remove the explosion-proof housing pipe cap.

See the following table on page 80 for a summary of the LED indications.

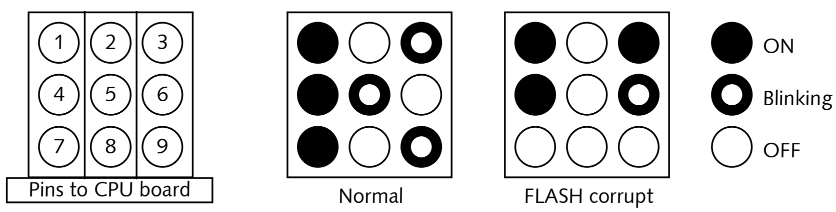


Figure 23: LED indicators

FLASH corrupt LED pattern

The FLASH chip stores the gauge software. The transmitter does not operate if the FLASH chip is corrupt. A HART device that connects to the transmitter displays the message, No Device Found. In this situation, the LED bank displays a distinctive pattern shown in the figure above.

Call Ohmart Field Service to report this condition. It is possible to perform a remote upload of new software to the FLASH chip.

LED summary table

Table 16: LED summary table

LED	Description	Normal condition	Error condition	Recommendation
1 +5	+5 DC voltage level to electronics	ON—LED 1 is hardwired to +5 DC	OFF—Electronics are not receiving +5 DC voltage required for functioning	Verify +5V on test points. Check fuse on CPU board. Check power supply. Check power input terminals 1, 2.
2 Mem	Memory corruption (EEPROMs, FLASH)	OFF	1 blink: CPU EEPROM corrupt 2 blinks: Sensor EEPROM corrupt 3 blinks: Both EEPROMs corrupt 4 blinks: RAM corrupt 5 blinks: Memory mismatch ON solid: combination of errors	Check software diagnostics. Call Ohmart Field Service.
3 HART	HART communication indicator	ON—Blinks when receiving HART messages	None	Check HART device connection on loop and HART device functioning.
4 +30	Analog output loop voltage	ON	OFF—30V not present on 4–20mA output. 4–20mA output and HART communications are bad.	Check loop wiring and jumpers J5, J6 Replace CPU board.
5 CPU	Central processing unit on CPU board "heartbeat"	Blinks at rate of one time per second	LED does not blink. CPU not functioning.	Check power input. Replace CPU board.
6 Aux	Auxiliary input frequency signal indicator	Blinks if auxiliary input present OFF if no auxiliary input present	None	Check auxiliary input wiring terminals 21 & 22 with a meter for frequency signal. Check auxiliary input equipment.
7 HV	Sensor high voltage	ON—High voltage is in spec	OFF—High voltage is out of spec	Call Ohmart Field Service
8 Relay	Relay condition indicator	ON—When relay is energized. OFF—When relay is de-energized LED 8 is hardwired to relay	None	Check against relay output terminals 12, 13, and 14. If no relay output, replace CPU board.
9 Field	Radiation field indicator	Cycles in proportion to radiation field intensity at detector. ON for 10 seconds for each mR/hr, then off for 2 seconds. (Can use LED 5 that blinks 1 time/sec to time LED 9 for field indicator.)	None	A 1 mR/hr (2,580nC/kg/hr) field is usually required for a measurement. Check for closed source shutter, buildup, and insulation.

Troubleshooting

The following flow charts may be useful to determine the source of a problem. They cover these topics:

- HART communication problems
- Level transmitter not responding
- Measurement not correct

Hardware troubleshooting is available at the board, not the component level. Essentially, only the following three hardware components are field-replaceable:

- CPU board
- Sensor assembly
- AC power supply board

The trouble-shooting flow charts refer to the following diagrams to track the power distribution on the level transmitter system.

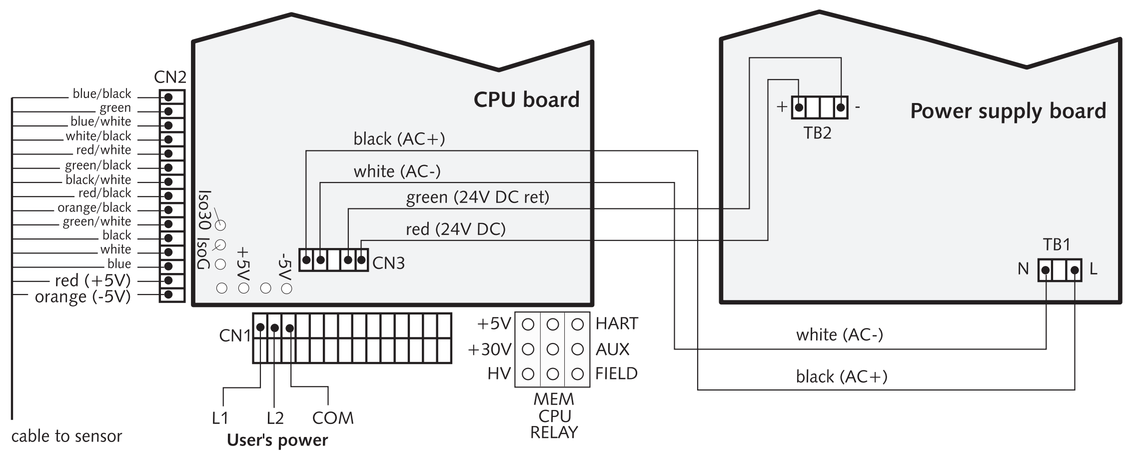


Figure 24: Power intraconnect diagram for LSTH

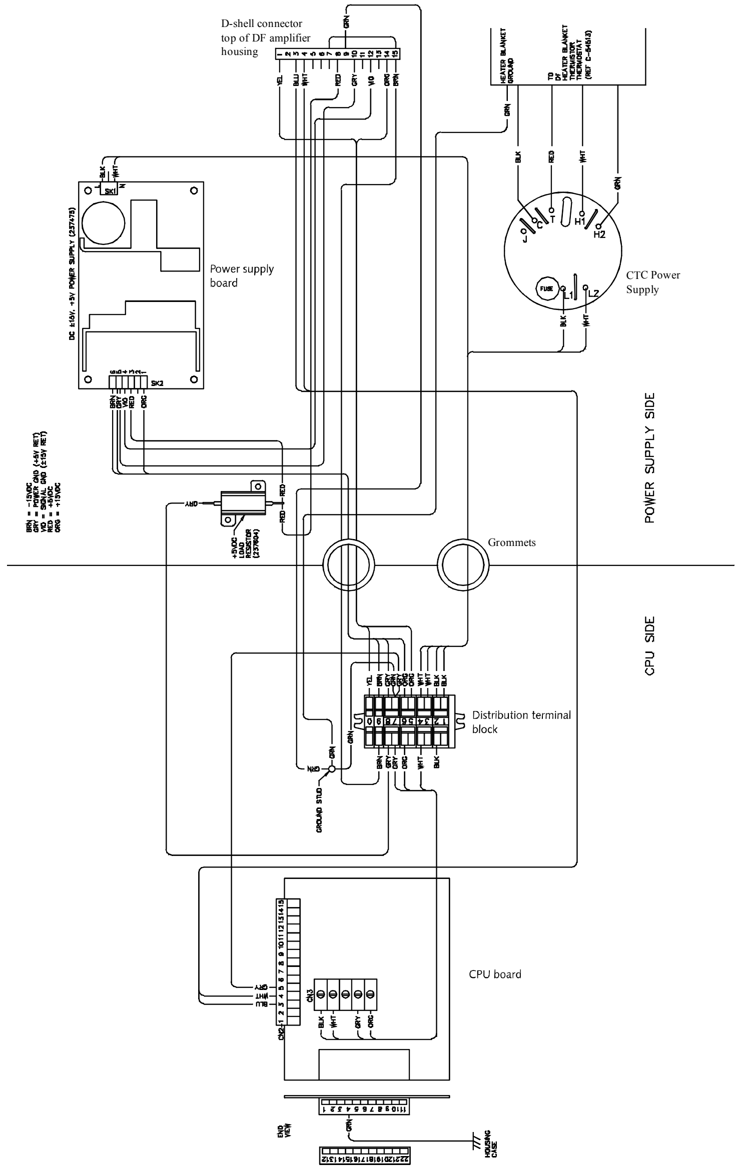


Figure 25: Intraconnect for LNTH and LJTH

Communication problem flowchart

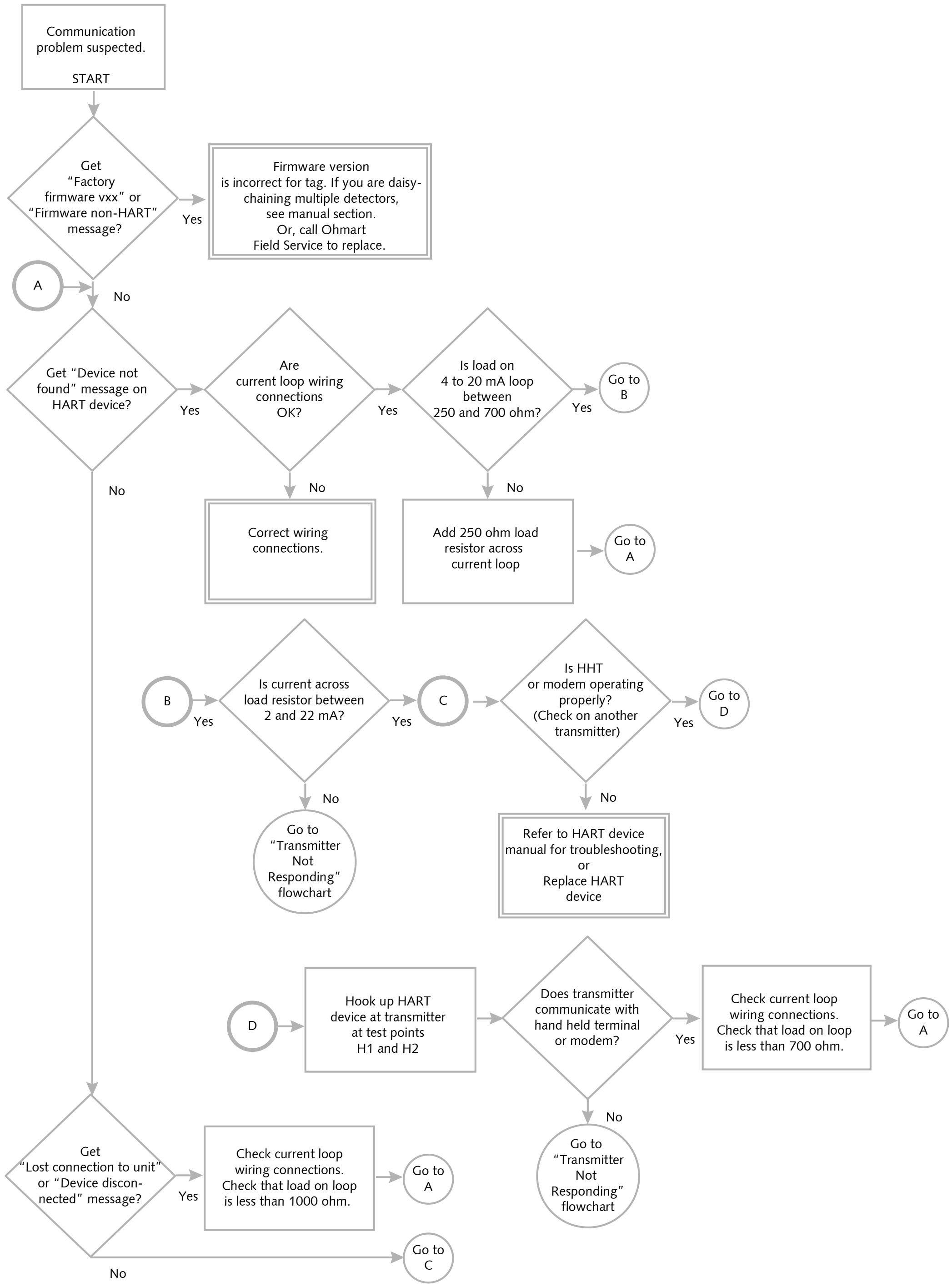


Figure 26: HART Communication flowchart

Transmitter not responding flowchart

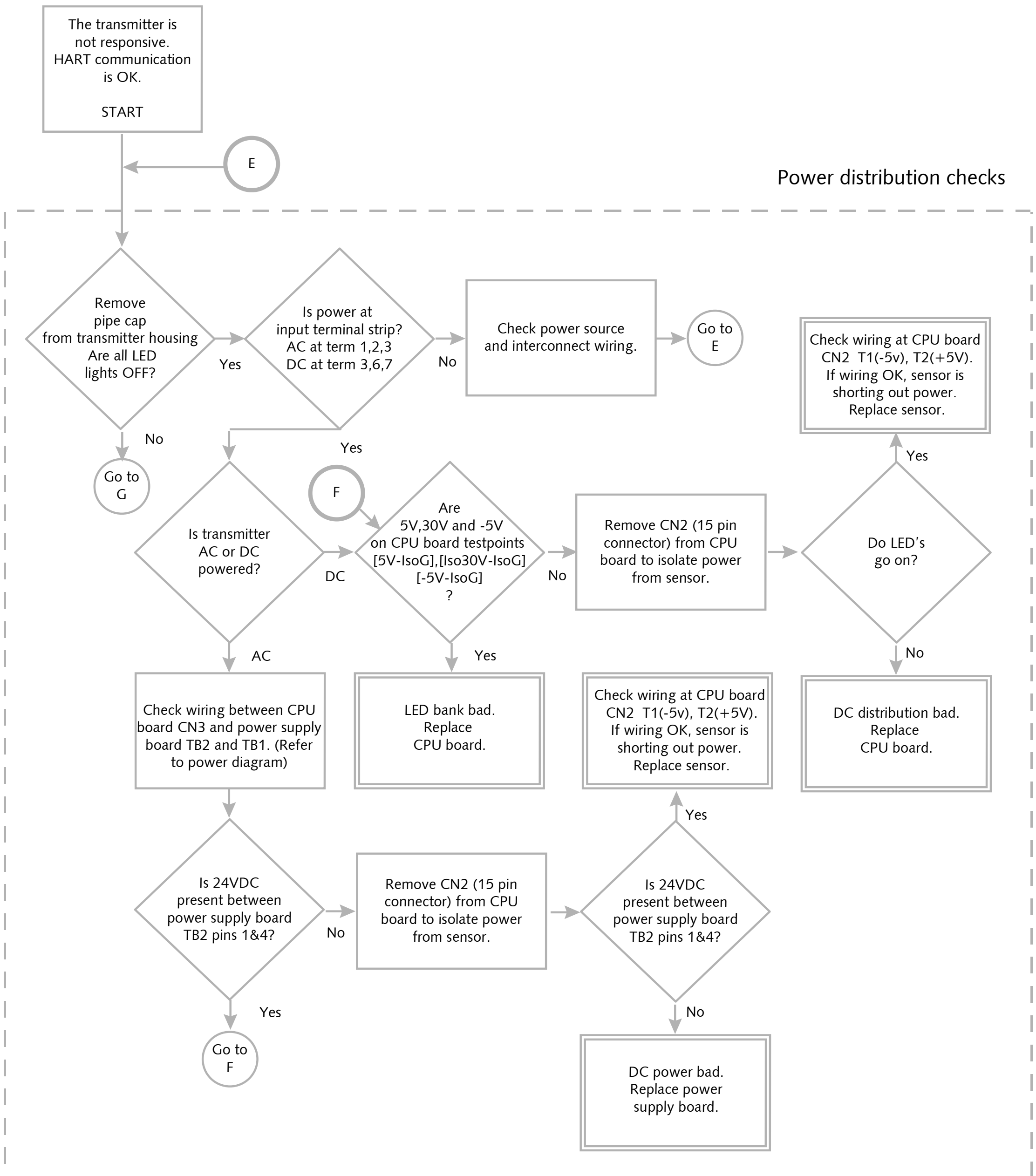


Figure 27: Transmitter not responding flowchart, part 1

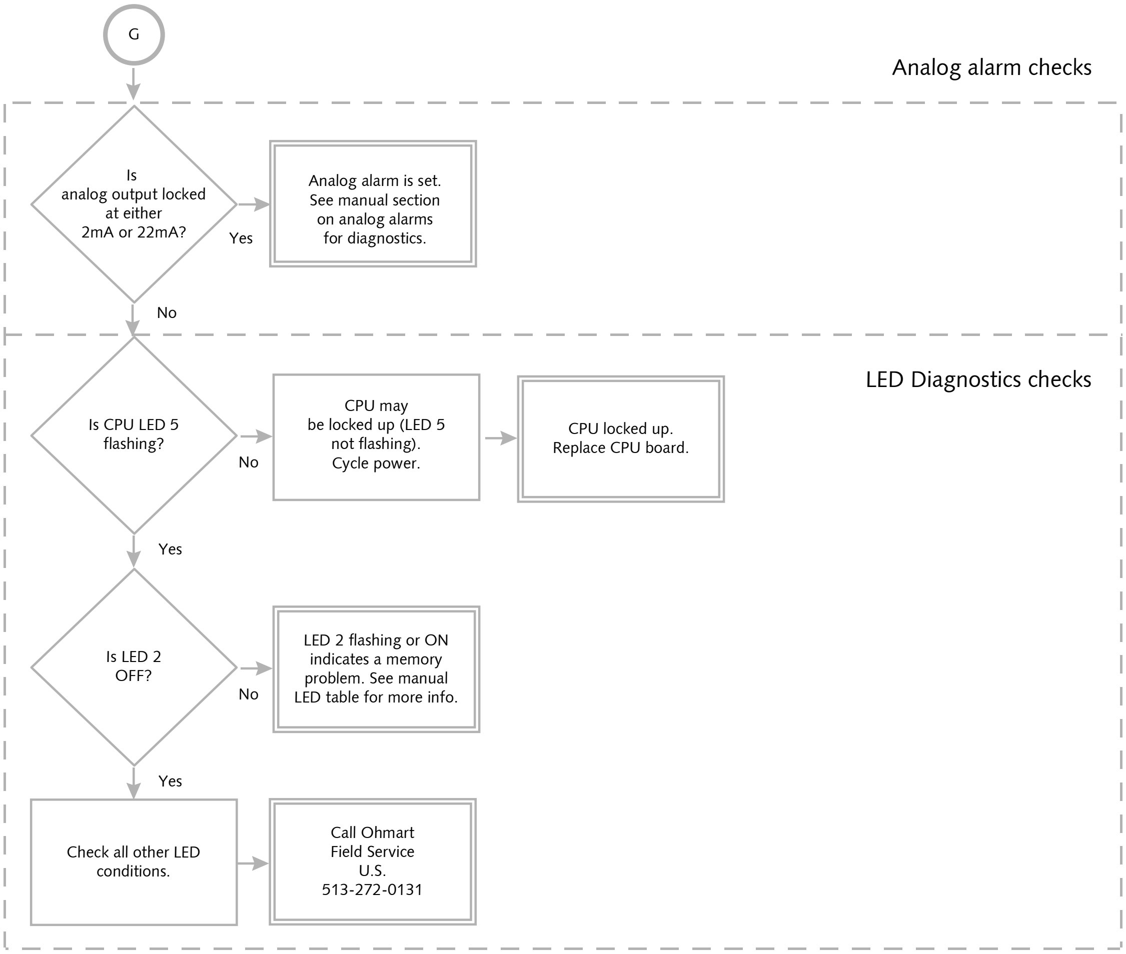


Figure 28: Transmitter not responding flowchart, part 2

Maintenance and repair

Periodic maintenance schedule

Since the Ohmart level transmitter contains no moving parts, very little periodic maintenance is required. We suggest the following schedule to prevent problems and to comply with radiation regulations:

Table 17: Periodic maintenance schedule

Description	Frequency	Procedure
Standardize	As required by process conditions, usually at least once a month	Calibration chapter
Source holder shutter check	Every six months unless otherwise required by applicable nuclear regulatory agency	Radiation safety instructions shipped separately with source holder and following instructions
Source wipe	Every three years unless otherwise required by applicable nuclear regulatory agency	Radiation safety instructions shipped separately with source holder and following instructions

Source wipe and shutter check recording

The Ohmart level transmitter can automatically remind users when a source wipe and shutter check are due, using the diagnostic alarms. If you use this feature, you must record the source wipes and shutter checks in the software to acknowledge the alarm and to reset the timer.

Perform the following procedure after a source wipe or a shutter check.

Refer to the *"Radiation Safety for U.S. General and Specific Licensees, Canadian, and International Users Manual" and "Radiation Safety Manual Addendum of Reference Information".*

Recording a source wipe or shutter check

Procedure 28: Recording a source wipe or shutter check

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **System parameters**
3. From the **System parameters** menu, select **Source function**
4. From the **Source function** menu, select **Record wipe**, or select **Record shut chk**
5. At the prompt, select **Yes** to start recording.

Check when the next source wipe or shutter check is due

Procedure 29: Check due date of source wipe or shutter check

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **System parameters**
3. From the **System parameters** menu, select **Source function**
4. From the **Source function** menu, select **Next wipe/shut due**
5. From the **Next wipe/shut due** menu, select **Next wipe due** to view the due date
6. From the **Next wipe/shut due** menu, select **Next shut chk due** to view the due date
7. Press F4 to exit.

Spare parts

Spare parts are available directly from Ohmart Parts and Repairs Department for U.S. and Canada installations. Installations in other countries purchase spare parts through their local Ohmart representative.

LSTH spare parts

Table 18: LSTH spare parts number

Description	Ohmart part number
AC power supply board	237382
LSTH CPU board	238747
125mA fuse on CPU board	238661
2.5A fuse on CPU board	238662
HART Hand-held Terminal, or HART Modem kit	236907 237857

LJTH* spare parts

Table 19: DTH spare part numbers

Description	Ohmart part number
LJTH CPU board	239258
DF Amplifier	200216
Power supply 90–270VAC in	237475
CTC-6, temp control 115VAC power supply	227283
CTC-6, 230 temp control VAC power supply	227284
Thermistor for temp control	227470
Thermostat (safety)	227485
Heating blanket (amplifier housing)	214530
LJTH, 115VAC complete tested electronics assembly	237446
LJTH, 230VAC complete tested electronics assembly	237447
125mA fuse on CPU board	238661
2.5A fuse on CPU board	238662
HART Hand-held Terminal, or HART Modem kit	236907 237857

* For heated LJTH models, see LNTH spare parts list, Table 20.

LNTH spare parts**

Table 20: LNTH spare part numbers

Description	Ohmart part number
LNTH CPU board	238747
DF Amplifier	200216
Power supply 90–270VAC in	237475
CTC-6, 115VAC power supply	227283
CTC-6, 230VAC power supply	227284
Thermistor for temp control	227470
Thermostat (safety)	227485
Heating blanket (amplifier housing)	214530
LNTH, 115VAC complete tested electronics assembly	238552
LNTH, 230VAC complete tested electronics assembly	238553
125mA fuse on CPU board	238661
2.5A fuse on CPU board	238662
HART Hand-held Terminal, or HART Modem kit	236907 237857

**These parts also apply to the heated LNTH (model H-LNTH) and the heated LJTH (model H-LJTH).

Field repair procedures

Very few parts are field repairable, but you can replace entire assemblies or boards. Use great care to prevent damage to the electrical components of the gauge. Ohmart recommends appropriate electrostatic discharge procedures.

CAUTION!

NEVER open the black injection-molded plastic housing that contains the sensor scintillator and photomultiplier tube components. They are sealed and tested at the factory to prevent radiation and light from leaking into the housing. No part in the sensor housing is field repairable. Opening the housing may permanently damage the sensor.

Replacing the CPU board

You may have to replace the CPU board if there is damage to one of its components. Before replacing the CPU board, check the troubleshooting flowcharts or call Ohmart Field Service to be sure a replacement is necessary.

In LSTH models, the sensor EEPROM contains a backup of the CPU board EEPROM. After physically replacing the CPU board, you must perform a memory backup to update the CPU board EEPROM with the information in the sensor board EEPROM. Perform the memory back up in the **New hardware** screen, from the **Advanced Fxns** menu.

Procedure 30: Replacing the CPU board

1. At the DCS, remove level transmitter from automatic control loop
2. If possible shut off power to the level transmitter at an external junction
3. When working near the source holder, it is a good practice to “turn the source off” by turning the source holder shutter to the **OFF** position
4. At the transmitter housing, remove pipe end cap. Use caution—it is heavy
5. Locate the CPU board and remove the two 11-pin pluggable terminal blocks at CN1 to disconnect the interconnect wiring
6. Unscrew the bolt on the L-bracket. Slide the detector assembly out of the pipe housing
7. If the level transmitter uses AC-power, remove the 5-pin pluggable terminal block at CN3 to disconnect the CPU board power wiring from the AC power supply
8. Remove the 15-pin pluggable terminal block at CN2 (located underneath the CPU board) to disconnect the wiring to the sensor assembly
9. Threw screws hold the CPU board to the sensor assembly. On the LSTH models, it mounts into a slot in the black plastic sensor housing
   - Unscrew the CPU board from the plastic sensor housing
   - Slide the CPU board out from the slot in the plastic sensor housing

CAUTION! LSTH Model

NEVER open the black plastic sensor housing. No part of the sensor is field repairable. Opening the housing may damage its seals, making it inoperable.

Procedure 30: Replacing the CPU board (continued)

> **Note:** Check the jumper settings on the old CPU board. Verify that the new CPU board has the jumpers set up in the same manner.

10. To install the new board perform the following:
    - Slide the new board into the slot on the plastic sensor housing, just behind CN1 and in front of the two front-mounting screws
    - Screw the board into the sensor housing using the standoffs
    - Plug in all removable terminal strips in the reverse order removed
    - Plug in the interconnect terminal at CN1 last
11. Apply power
12. Check the LED bank. LED 5 should blink, indicating the CPU is functioning
13. Plug a HART device into test points H1 and H2 on the transmitter, if possible. If this is not possible, use your normal HART connection point
14. For the LSTH model only—The HART device should indicate an error message, New Hardware Found

15 FOR the LSTH model only—Using the HART device, move through the **Main menu**, **Advanced Fxns** menu:
- From the **Main menu**, select **Advanced Fxns**
- From the **Advanced Fxns** menu, select **New hardware**
- From the **New hardware**, select **New CPU board**
- At the prompt, select **Yes** to verify that the new CPU board is installed

16. The software automatically performs the appropriate backups with the new CPU board and the existing sensor
17. After checking the new CPU board, place the detector assembly back into the pipe housing
    - Secure the mounting bracket to the inside of the housing with the bolt
    - Replace the pipe cap
18. Return the source holder shutter to the **ON** position to establish a radiation field and resume normal operation of the level transmitter.

Requesting field service

To request field service within the U.S. and Canada; call 513-272-0131 from 8:00 A.M. to 5:00 P.M. Monday through Friday. For emergency service after hours, call 513-272-0131 and follow the voice mail instructions.

Returning equipment for repair to Ohmart

When calling Ohmart to arrange repair service, have the following information available:

- ☑ Product model that is being returned for repair
- ☑ Description of the problem
- ☑ Ohmart Customer Order (C.O.) Number
- ☑ Purchase order number for the repair service
- ☑ Shipping address
- ☑ Billing address
- ☑ Date needed
- ☑ Method of shipment
- ☑ Tax information

Returning equipment for repair

Procedure 31: Returning equipment for repair

1. Call Ohmart Nuclear Products Repair at 513-272-0131 between Monday and Friday, 8:00 A.M. to 5:00 P.M. United States Eastern Standard Time
2. Ohmart assigns the job a material return authorization (MRA) number

   Please note: Ohmart reserves the right to refuse any shipment that does not have a MRA number assignment.

3. Indicate the MRA on the repair service purchase order
4. Clearly mark the shipping package with the MRA number
5. Send the confirming purchase order and the equipment to:
   Ohmart Corporation
   Attention: Repair Department
   4241 Allendorf Drive
   Cincinnati, OH 45209-1599 USA

   Note: You must first contact Ohmart and receive a material return authorization number (MRA) before returning any equipment to Ohmart. Ohmart reserves the right to refuse any shipment not marked with the MRA number.

Appendix I: Initial factory setup

Perform all setup functions from the **Initial setup** menu. These functions include the following:

- Process parameters
- System parameters
- Alarms
- Auxiliary inputs
- Spans setup

Perform setup before the initial calibration, since some parameters are necessary for calibration. Some of these parameters are:

- Units
- Data collect times

Process parameters

Units

Level units

The following engineering units are available for a level measurement:

- In—inches
- ft—feet
- cm—centimeters
- mm—millimeters
- m—meters
- %—percent
- Spcl—special (used in conjunction with Custom units, below)

Custom units

You can program a custom unit if the unit you require is not in the standard list. Choose the unit **Spcl** (Special) from the **Units** screen. Enter the numeric conversion factor in the form:

x custom units / inch

Setting the process units for density applications

Procedure 32: Setting the process units for density

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **Process parameters**
3. From the **Process parameters** menu, select **Process units**
4. From the **Process units** menu, select **Level units**
5. From the **Level units** screen, scroll through the list and choose the correct level unit for your process by pressing F4 to enter. You will need to enter a custom unit if the unit you want is not in the list. See the procedure for setting custom units in this section
6. After selecting the units, press F2 to send the information to the transmitter. This ensures that other setup and calibration functions you perform use the desired engineering units.

Setting custom units

Procedure 33: Setting custom units

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **Process parameters**
3. From the **Process parameters** menu, select **Process units**
4. From the **Process units** menu, select **Custom units**
5. From the **Custom units** screen, select **Conversion to length**
6. Enter the conversion factor in factor in custom units per inch
7. Press F4 to enter
8. Press the LEFT ARROW to move back to the **Process units** menu
9. From the **Process units** menu, select **Level units**
10. In the **Level units** screen, select **Spcl** as the units
11. If using a hand-held HART Communicator, press F2 to send the units to the transmitter. This ensures that other setup and calibration functions use the correct engineering units.

Calibration parameters

Data coll interval

Data collection interval is the time in seconds over which the system collects a process measurement. Use this interval time to collect data for:

- Initial calibration
- Linearizer curve
- Standardization

Warn % span cal

Warning percentage span calibration is the difference between the two initial calibration points (cal low level and cal high level) as a percent of level span that causes a warning to appear. For a good calibration, it is important for the two initial calibration points to be as far apart as possible. The default value is 10%. The user typically does not need to changes this value for most applications.

Process stdz type

Process standardize type determines how you enter the actual process value of a standardize sample. If this is set as Use Lab sample value, the software screens prompt entry of the sample value during a standardize. If this is set as Use Default value, the software always uses the Default standardize level as the sample value.

Default std

Default standardize is the default level value in engineering units that you use in the standardization procedure. At standardization, enter the actual level of the process material to override this default.

Stdz interval

Standardize interval is the interval in days between standardize alarms. The level transmitter alarms to indicate that a standardize procedure is due if the diagnostic alarm, Standardize due, is toggled on.

Setting the calibration parameters

Procedure 34: Setting the calibration parameters

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **Process parameters**
3. From the **Process parameters** menu, select **Cal parameters**
4. From the **Cal parameters** menu, select the calibration parameters to view or edit, as needed. Refer to the help screens (F1) or page 97 in this manual for descriptions. View or edit the following parameters:
   - Data coll interval
   - Warn % cal span
   - Process stdz type
   - Default std
   - Stdz interval
5. If using a hand-held HART Communicator, press F2 to send the updated calibration parameters to the transmitter.

Filtering

This feature enables change to the response time of the system by increasing or decreasing the averaging time that is used to filter the noise in the signal. An increased time for averaging enables the accumulation of a greater number of readings and therefore produces a greater statistical accuracy. However, this is at the expense of response time to changes in the process.

Type (RC exponential or rectangular window)

The level transmitter offers a choice of signal filters, RC exponential or rectangular window. The level transmitter has a sample rate of about 1 sample/second, but process variables generally change measurably on the order of minutes. Electrical and source noise occur on the order of seconds, so they can be filtered out with a low pass filter, leaving only the change in the process variable in the signal.

RC exponential

RC exponential filtering simulates the traditional Resistance/Capacitance filtering. It provides an infinite impulse, in which all of the previous samples contribute less and less to the average, but all contribute somewhat. The most recent samples are weighted most heavily in computing the average. Compared to rectangular window filtering, RC exponential filtering provides a quicker response to step changes in the process but has a larger noise band.

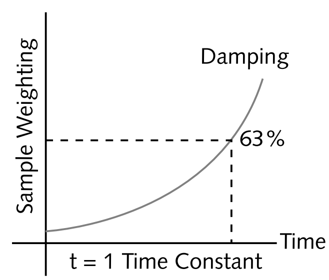


Figure 29: RC exponential filtering

Rectangular window filtering

Rectangular window filtering computes an average based only on a specified (finite) number of samples. All samples are weighted equally in the average. Although it provides a slower step response (since the most recent measurements are weighted the same as those further back in time), it produces a less noisy signal. Generally, rectangular window linear averaging by itself produces results similar to combining RC exponential filtering with the fast cutoff feature.

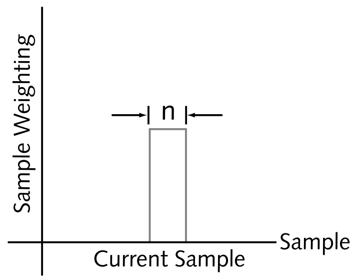


Figure 30: Rectangular window filtering

Damping

The type of filter you choose determines the damping function.

With the RC exponential method, the damping entry is equivalent to a time constant, that is, the amount of time (in seconds) that it takes for the gauge reading to achieve 63.2% of a step change in process. A range of integer values from 1–600 seconds is possible for this time constant entry.

With the rectangular window filtering, the damping entry determines how many samples to use when calculating the average, responding to 100% of a process step change. The maximum damping entry is 100 with this type of filtering.

Fast response cutoff

Fast response cutoff temporarily bypasses the RC or digital filtering when the change in process exceeds this value (in engineering units) between successive samples. This enables the level transmitter to respond immediately to large step changes while filtering the smaller variations in the signal caused by noise and normal process variations. To turn off the fast cutoff filter, set the value to zero.

Selecting a filter type, damping, and fast cutoff

Procedure 35: Selecting a filter type, damping, and fast cutoff

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **Process parameters**
3. From the **Process parameters** menu, select **Filtering**
4. From the **Filtering** menu, select **Filter type**
5. On the **Filter type** screen, the currently used filter type displays as either RC Exp Filter or Rect Window Filter. To change the filter type, select either **RC Exp Filter** or **Rect Window Filter**. Press F4 to enter
6. From the **Filtering** menu, select **Damping**
7. From the **Damping** screen, enter the damping desired and F4 to enter. Refer to the help screens (F1) or page 99 in this manual for details
8. From the **Filtering** menu, select **Fast cutoff**
9. From the **Fast cutoff** screen, enter the cutoff value desired and press F4 to enter. Refer to the help screens (F1) or page 99 in this manual for details

   Note: To turn off Fast cutoff, enter 0 as the value.

10. If using a hand-held HART Communicator, press F2 to send the updated filtering parameters to the transmitter.

Span settings

The spans for the process, current loop, and any optional auxiliary input are set in the **Spans** screen from the **Initial setup**, **Process parameters** menus.

Process span

Process span **is** the anticipated lowest and highest level (Min and Max level) measurement with the gauge. The level transmitter calibrates within these settings. These define the endpoints for the calibration and linearizer curve. This does not define the span for the output current loop. Refer to the “Current Loop Span” procedure in this section.

Note: The Min and Max Level values for the process span are essential to proper calibration of the system. You must enter the Min and Max level for process span before you perform an initial calibration. You must perform a new initial calibration procedure if the values for the process span Min or Max levels change.

Modify the span setting if the level transmitter moves from its intended location, or is measuring on a different span. It is a good practice to verify that the setting is correct before performing an initial calibration.

Setting process span

Procedure 36: Setting the process span

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **Process parameters**
3. From the **Process parameters** menu, select **Spans**
4. From the **Spans** menu, select **Process span**
5. From the **Process span** screen, set both the minimum and maximum values for the measurement span
6. Press F2 to send the setting to the transmitter.

Current loop span

The current loop output can be set to be either “forward acting” or “reverse acting” by choosing the appropriate values of 4mA Level and 20mA Level. A forward acting output is proportional to the level and a reverse acting output is inversely proportional to the level. See Table 21for an example of settings for process values of 0% and 100%:

The current loop span is the lowest and highest level to be indicated by the 4–20mA current loop (analog output). These settings do not have to be the same as the process span settings (Min level and Max level), but must be within the boundaries set for the process span. The screens prompt entry of a 4mA Level and a 20mA Level.

Table 21: Setting process values of 0% and 100%

Forward acting (proportional)		Reverse acting (inversely proportional)	
4mA Level	**20mA Level**	**4mA Level**	**20mA Level**
0%	100%	100%	0%

Procedure 37: Setting the current loop span

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **Process parameters**
3. From the **Process parameters** menu, select **Spans**
4. From the **Spans** menu, select **Current loop span**
5. From the **Current loop span** menu, select **4mA Level**
6. In the **4mA Level** screen, enter the minimum value for the measurement span
7. From the **Current loop span** menu, select **20mA Level**
8. In the **20mA Level** screen, enter the maximum value for the measurement span
9. Press F2 to send the setting to the transmitter.

System parameters

The system parameters define settings for the internal operation of the level transmitter and the radiation source.

Time

Current time in HH:MM:SS as set in the real time clock. The time maintains during power failure for up to 28 days. It is important to enter the correct time and date, because they are used for several internal calculations. Time reverts to 00:00:00 on clock failure.

Date

Current date in MM/DD/YY (month, day, year) format. The date reverts to 00/00/00 on failure.

Setting the time and date

Procedure 38: Setting the time and date

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **System parameters**
3. From the **System parameters** menu, select the **Time and Date**
4. From the **Time and Date** menu, select **Time**
    - Enter the current time
    - Press F4 to save the time setting
    - Press the LEFT ARROW key to return to the previous **Time and Date** screen
5. From the **Time and Date** screen, select **Date**
    - Enter the current **Date**
    - Press F4 to save the date setting
6. If using a hand-held HART Communicator, press F2 to send the updated parameters to the transmitter.

Source type

Use the Source type feature to view or enter the isotope in the source holder that produces the radiation signal. The Ohmart factory enters this parameter based on information received at the time of the order. You can check the isotope type against the source holder label.

Procedure 39: Setting the source type

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **System parameters**
3. From the **System parameters** menu, select **Source type**
4. In the **Source type** screen, select one of the following source types:
   - Cs 137
   - Co 60
   - Am 241
   - Cf 252
   - No source
5. Press F4 to enter
6. If using a hand-held HART communicator, press F2 to send the updated parameters to the transmitter.

Source function

Wipe Interval

Use the Wipe interval feature to view or enter the interval in days between successive source wipe diagnostic alarms. Check with current applicable regulations.

Record wipe

Use the Record wipe feature to record the date and time when you perform a source wipe. This resets the diagnostic alarm “source wipe due.” For more information, see the “Diagnostics and Repair” chapter.

Shut chk Interval

Use the Shutter check interval feature to enter the number of days between successive shutter check diagnostic alarms. Check with current applicable regulations for recommendations on shutter check intervals.

Record shut chk

Use the Record shutter check feature to record the date and time when you perform a shutter check. This resets the diagnostic alarm “shutter check due.” For more information, see the “Diagnostics and Repair” chapter.

Next wipe/Shut due

Use the Next wipe and Shutter check due features to view or enter the due date for the next source wipe and shutter check. For more information, see the “Diagnostics and Repair” chapter.

Tag

The tag is a unique eight-digit identifier for instrument. If provided at order, this parameter is entered at Ohmart factory prior to shipment. Otherwise, the user may enter it on this screen.

Setting the tag identifier

Procedure 40: Setting the tag identifier

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **System parameters**
3. From the **System parameters** menu, select **Tag**
4. In the **Tag** screen, enter the eight digit identifier for the instrument
5. Press F4 to enter
6. Press F2 to send the updated parameters to the transmitter.

System information

Message

Use this text field to record information or messages. For example, this is where you can record a message to operators or notes about the gauge.

Procedure 41: Setting the system information message

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **System parameters**
3. From the **System parameters** menu, select **System info**
4. From the **System info** menu, select **Message**
5. In the **Message** screen enter messages or notes for the operator
6. Press F4 to enter
7. If using a hand-held HART communicator, press F2 to send the updated parameters to the transmitter.

Descriptor

This is a shorter message field to record information or messages.

Procedure 42: Setting the descriptor

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **System parameters**
3. From the **System parameters** menu, select **System info**
4. From the **System info** menu, select **Descriptor**
5. In the **Descriptor** screen enter a short message or note for the operator
6. Press F4 to save
7. If using a hand-held HART Communicator, press F2 to send the updated parameters to the transmitter.

Setting up alarms

Four types of alarms are available:

1. Diagnostic
2. Analog
3. Process
4. X-ray

The “Diagnostics and Repair” chapter thoroughly explains use and acknowledgement of alarms. When you set up alarms, the following options are available:

- Which alarm type triggers the output relay
- Which diagnostic messages appears on the HART display screens
- The output level of the analog alarm
- Specialized parameters of the x-ray alarm

Diagnostic alarm setup

Diagnostic alarms give information about the condition of the level transmitter and can provide reminders to perform periodic maintenance procedures. The reminders appear as messages on the HART screens, when a HART device connects to the level transmitter. In addition, if the level transmitter relay is set as a diagnostic alarm, the condition trips the relay on.

In the setup, there is a list of every diagnostic alarm condition that can toggle On or Off. If the condition flag is Off, that condition does not cause the diagnostic alarm relay to trigger and no HART message appears. The following table lists the available diagnostic alarms conditions. See the “Diagnostics and Repair” chapter, page 74 for more details.

Table 22: Diagnostic alarm conditions

RAM corrupt	Standardize due	CPU EEPROM corrupt
Sensor EEPROM corrupt (LSTH only)	Source wipe due	Alarm Type 1
Flash corrupt	New hardware found (LSTH only)	Alarm Type 2
Real time clock	Sensor fail	Shutter check due
Sensor temp (LSTH only)	Sensor high voltage fail (LSTH only)	Process out of measurement range

Setting the diagnostic alarm conditions

Procedure 43: Setting the relay as a diagnostic alarm

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **Alarms**
3. From the **Alarms** menu, select **Mode configuration**
4. From the **Mode configuration** menu, select **Diagnstic alarm**
5. If using a hand-held HART communicator, from the **Diagnstic alarm** menu, select **Diagnstic Gp1** (Diagnostic Group 1). If using Ohmart View, proceed to the next step
6. From the **Diagnstic Gp1** screen, scroll through the list of diagnostic conditions that can be used to activate the relay
   - Toggle the conditions **On** or **Off** with the F2 key
   - Press F4 to enter
   - Press the LEFT ARROW key to return to the **Diagnstic alarm** screen
7. If using a hand-held HART Communicator, from the **Diagnstic alarm** menu, select **Diagnstic Gp2** (Diagnostic Group 2)
8. From the select **Diagnstic Gp2** screen, scroll through the list of diagnostic conditions and toggle the conditions **On** or **Off**
9. If using a hand-held HART communicator, press F2 to send the setting to the transmitter.

Setting the relay as a diagnostic alarm

Procedure 44: Setting the diagnostic alarm conditions

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **Alarms**
3. From the **Alarms** menu, choose **Set relay function**
4. From the **Set relay function** menu, select **Diagnstic** and press F4 to enter
5. If using a hand-held HART communicator, press F2 to send the setting to the transmitter.

Analog alarm setup

The analog alarm uses the current loop analog output to signify that the sensor is outputting zero counts. In this case, the analog output sets to either 2mA or 22mA, and no longer tracks the process level.

The user can choose the 2mA or the 22mA setting for the analog alarm.

Table 23: Analog alarm conditions

Alarm out 22mA	Alarm out 2mA

Setting the analog alarm output

Procedure 45: Setting the analog alarm output

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **Alarms**
3. From the **Alarms** menu, select **Mode configuration**
4. From the **Mode configuration** menu, select **Analog alarm**
5. From the **Analog alarm** menu, select **Alarm output**
6. From the **Alarm output** menu, select either **22mA** or **2mA**
7. Press F4 to enter
8. If using a hand-held HART communicator, press F2 to send the change to the transmitter.

Process alarm setup

Use the process alarm setup to make the relay output a high or low process alarm. For a low limit, a process level below a set point energizes the relay; for a high limit, a process level above a set point energizes the relay.

Process alarms only work in conjunction with the output relay. No HART messages post that relate to the process alarm.

You cannot use a relay as a diagnostic or x-ray alarm if you have set it as a process alarm.

Table 24: Process relay set alarm conditions

Relay action limit—High limit	Relay action limit—Low limit	Relay setpoint %

Setting up the process alarm

Procedure 46: Setting up the process alarm

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **Alarms**
3. From the **Alarms** menu, choose **Set relay function**
4. From **Set relay function** menu, select **Process** and press F4 to enter
5. Press the LEFT ARROW key to return to the **Alarms** menu
6. From the **Alarms** menu, select **Mode configuration**
7. From the **Mode configuration** menu, select **Process relay set**
8. From the **Process relay set** menu, select **Relay action**
9. From the **Relay action** screen, select either **High limit** or **Low limit**
10. From the **Process relay set** menu, select **Relay setpoint**
11. From the **Relay setpoint** screen, enter the numeric value of the alarm setpoint in process units and press F4 to enter when finished entering the value
12. If using a hand-held HART communicator, press F2 to send the setting to the transmitter.

X-ray alarm setup

The x-ray alarm compensates for false indicated process values that occur when external radiographic sources the gauge detects. Vessel weld inspections often use portable radiographic sources. Detection of x-rays by the gauge causes a false low reading and adversely affects any control based on the gauge output.

The x-ray alarm distinctly changes the current loop mA output in response to a marked increase in radiation field. It can also trigger the output relay, if set up to do so.

When the gauge detects a radiation field above a set threshold (as a percentage of the cal low counts value), it sets the current loop output at its value 10 seconds before the detection of the x-ray interference. It periodically dithers the output about the average, cycling until the radiation field is back to the normal level or until a time-out period of 60 minutes. See the following figure for a diagram of the current loop output in x-ray interference mode.

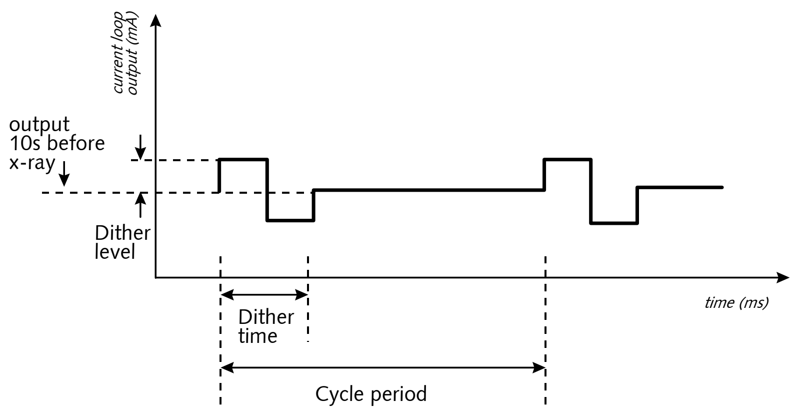


Figure 31: X-ray interference alarm output

In the **Initial setup** screens, you can adjust the parameters shown in Figure 31. The parameters are:

Threshold

Threshold is the percentage beyond the calibration low counts that triggers x-ray interference suppression. Default value 1%.

Dither level

Dither level is the magnitude in mA above and below the average output of the current loop dithering. Default value 1mA.

Cycle period

Cycle period is the repetition rate for presenting the current loop dither in x-ray interference output mode. Default value 1s.

Dither time

Dither time is the percentage of the cycle period to output the dither. Default value 1%.

Table 25: X-ray alarm conditions

Threshold	Dither level
Dither time	Cycle period

Setting up the x-ray alarm parameters

Procedure 47: Setting up the x-ray alarm parameters

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **Alarms**
3. From the **Alarms** menu, select **Mode configuration**
4. From the **Mode configuration** menu, select **Xray alarm**
5. Edit the following values as necessary:
    - Threshold
    - Dither level
    - Cycle period
    - Dither time
6. If using a hand-held Communicator, press F2 to send the changes to the transmitter.

Setting the relay as an x-ray alarm

Procedure 48: Setting the relay as an x-ray alarm

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **Alarms**
3. From the **Alarms** menu, choose **Set relay function**
4. From the **Set relay function** menu, select **X-ray**
5. Press F4 to enter
6. If using a hand-held HART Communicator, press F2 to send the setting to the transmitter.

Auxiliary input settings

The auxiliary input is an option for the HART level transmitter to receive a frequency signal. With special software, the frequency signal incorporate into the final output.

The software provides special settings for three typical uses of a frequency input:

- Summation mode
- NORM compensation
- Vapor pressure compensation

Note: Refer to “Appendix II: Special Applications”, for complete application information on using the following compensation methods:

- Summation
- NORM
- Vapor pressure

Input filter

Input filter is the auxiliary input signal with application of the time constant. The filter type (RC or rectangular window) applied to the auxiliary input is the same as the primary channel.

Setting the auxiliary input filter

Procedure 49: Setting the input filter

1. From the **Main menu**, select **Auxiliary input**
2. From the **Auxiliary input** menu, select **Filter TC**
3. In the **Filter TC** screen, input the value for the filter time constant
4. Press F4 to enter
5. If using a hand-held HART Communicator, press F2 to send the setting to the transmitter.

Summation mode

The HART level transmitter can have as an input a raw sensor output from another slave level gauge (which cannot be used in the HART current loop). The master level transmitter receiving the input uses the incoming signal to modify its output. For example, you may use this feature to make the master HART level transmitter read the sum of two level gauges.

Note: Refer to “Appendix II: Special Applications”, page 119, for complete application information on using summation mode for multiple level detectors.

Notes

Appendix II: Special applications

This chapter provides application specific information for special installations.

If your application is not in this chapter, you may find application specific information on the certified drawings. The certified drawings are in the special information pocket in this manual. If you have other application questions, contact Ohmart Field Service in the U.S. or Canada at 513-272-0131 or your local rep outside of the U.S. or Canada.

Note: To use the compensation features of the HART gauge, you must be using Ohmart View 2.0 (or higher) or have a HART hand-held communicator programmed with the OHMART COMP device description.

Multiple detectors summation

Some applications require a measurement length longer than the maximum level transmitter detector length.

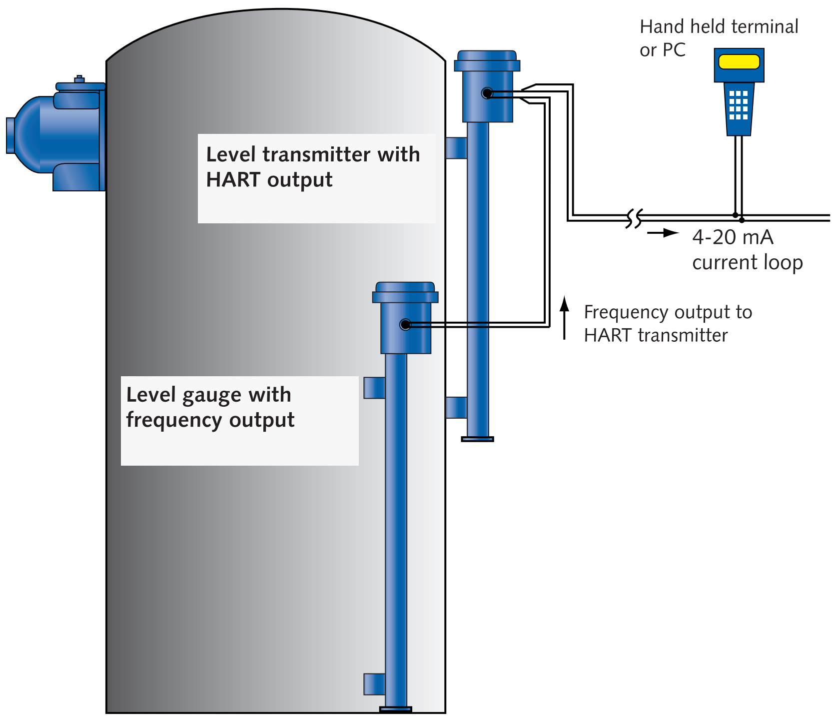


Figure 32: Multiple detectors summation

Special drawings from Ohmart

Identification of applications that require multiple detectors occurs at the time of order. The end user, engineering contractor (or both) receive certified drawings for the exact equipment ordered. Refer to the drawings along with this section of the manual.

Note: If the instructions on the drawings and this manual differ, follow the drawing instructions. They will be specific to your order.

Notes on the frequency output detector

You may not receive a separate manual for the detector that provides the frequency output for the HART level transmitter, especially if ordered as part of a complete system that included a HART level transmitter. The certified drawings and this manual section have sufficient information, in most cases.

Some special notes about the frequency output detector are below:

- Models LSF, LNF, and LJF use much of the same hardware as the models LSTH, LNTH, and LJTH (the HART level transmitter models). They look similar; so verify that you are installing the correct detector as the frequency output slave detector.
- Models LSF, LNF, and LJF use a different version of firmware than LSTH, LNTH, and LJTH. This firmware enables a frequency output instead of the HART output.
- Some spare parts are unique to the frequency output models. See the following tables for the spare part descriptions and part numbers.

LSF spare parts

Table 26: LSF spare parts

Description	Ohmart part number
AC power supply board	237382
LSF CPU board	238748
125 mA fuse on CPU board	238661
2.5 A fuse on CPU board	238662

LJF* spare parts

Table 27: LIF spare parts

Description	Ohmart part number
LJF CPU board	238928
DF Amplifier	200216
CTC-6, 115 VAC power supply	227283
CTC-6, 230 VAC power supply	227284
LJTH, 115 VAC complete tested electronics assembly	238925
LJTH, 230 VAC complete tested electronics assembly	238926
125 mA fuse on CPU board	238661
2.5 A fuse on CPU board	238662

* For heated LJTH models, see LNTH spare parts list, Table 28.

LNF spare parts**

Table 28: LNF spare parts

Description	Ohmart part number
LNF CPU board	238748
DF Amplifier	200216
CTC-6, 115 VAC power supply	227283
CTC-6, 230 VAC power supply	227284
LNF, 115 VAC complete tested electronics assembly	238933
LNF, 230 VAC complete tested electronics assembly	238934
125 mA fuse on CPU board	238661
2.5 A fuse on CPU board	238662

**These parts also apply to the heated LNF (model H-LNF) and the heated LJF (model H-LJF).

Installation requirements

A multiple detector application consists of one HART level transmitter and one (or more) level gauges that output a frequency to the HART transmitter. Follow these installation guidelines:

- Install the detector with the HART output (model LSTH, LJTH, or LNTH) at the top of the vessel. Install the other detector(s) beneath the HART detector.
- The mounting tabs of the detectors define the active, or sensing, length. Offset the detectors vertically so that the end of the top detector's active length corresponds to the beginning of the bottom detector's active length.
- Place all detectors in the radiation beam.

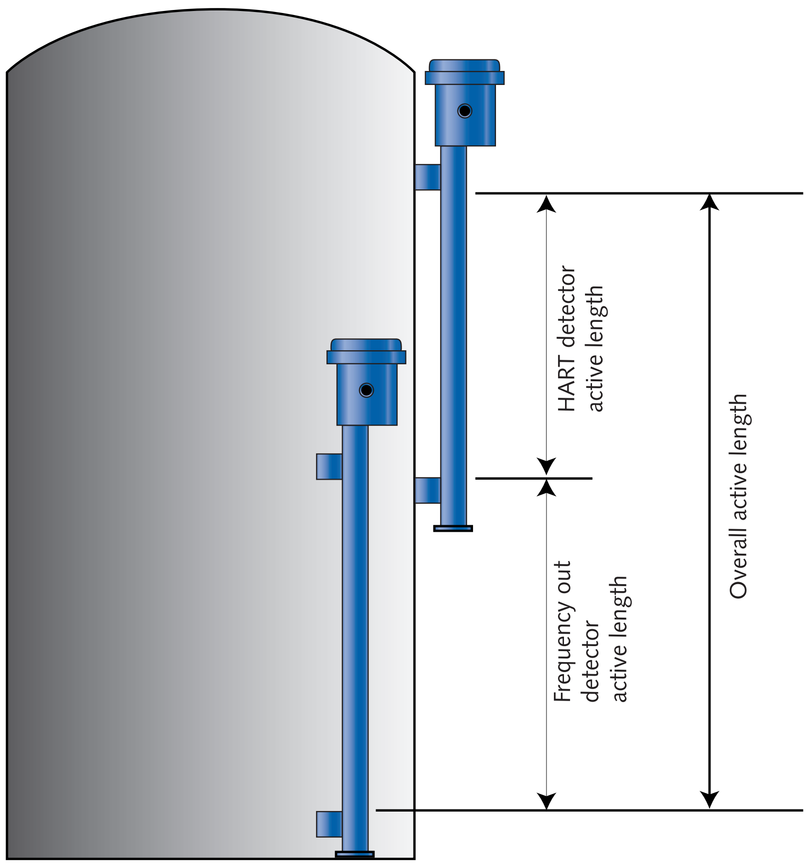


Figure 33: Placement of multiple detectors

Detector wiring

Multiple detectors application require (at a minimum) one frequency output detector and only one HART output detector. The following table lists some typical combinations.

Table 29: Typical combinations for detector wiring

Frequency output detector	HART output detector	Interconnect figure
LJC	LJTH	Figure 34
LN		
LJC	LNTH	
LN		
LJF	LJTH	Figure 35
LNF		
LJF	LNTH	
LNF		
LSF	LSTH	

Interconnect for models with DPC amplifier freq out to HART

Notes for Figure 34:

1. Voltage input is 115 or 230VAC +/–10%, 50 or 60Hz, at 1,050VA maximum power consumption (total load for both detectors.) AC power does not share with transient producing loads. Requires an individual AC lighting circuit. Supply a separate earth ground. Use #14–#22AWG wire.

2. Maximum length of shielded 2-conductor #18AWG cable is 1,000m (3,280 ft). For indoor or conduit use Ohmart part number 202676. For outdoor use, in cable trays, or Class I Division 2 hazardous areas, use cable number 202679.

3. Standard output signal is 4–20mA into 250–1,000 ohms. P1-8 is positive and P1-9 is negative. HART communication protocol (based on Bel 202 FSK standard) is available on these connections. Output isolates to standard ISA 50.1, Type 4, Class U.

4. Hart Hand-held terminal connects across 4–20mA wires to communicate with transmitter. Use terminal number 236907 (Rosemount Model 275 or equivalent). Hand-held terminal can connect across 4–20mA wires at any point.

5. HART modem connects across 4–20mA wires to allow communication between transmitter and an IBM-compatible PC.

6. Relay contacts rates are 10A at 240 VAC or 8A at 24VDC.

7. Attach #18AWG green wire with closed lug terminal to housing using #10-32 x ¼” screw.

8. If using the optional CENELEC external ground, connect earth ground to outside of housing.

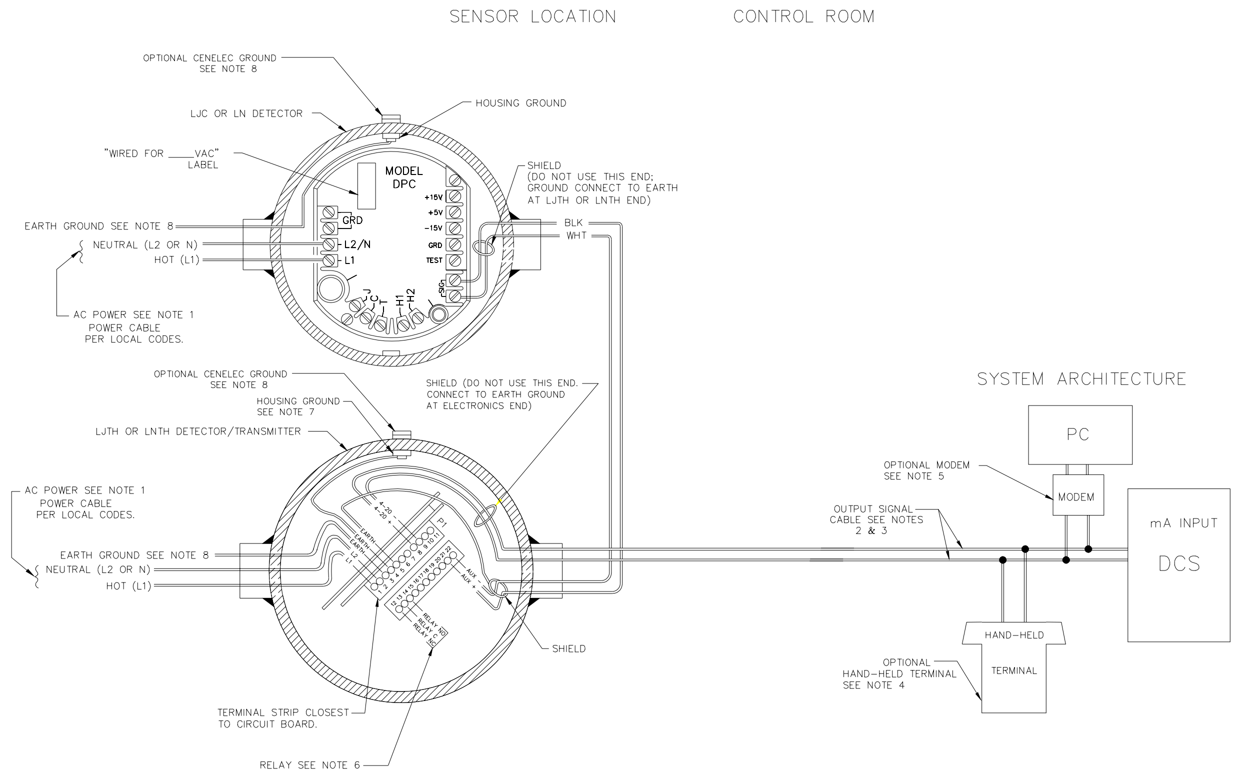


Figure 34: Interconnect—LJC, or LN, with LJTH, or LNTH

Interconnect for models with CPU board freq output to HART

Notes for Figure 35:

1. Voltage input to each detector is 115 or 230VAC +/–10%, 50 or 60Hz, at 60VA maximum power consumption. AC power does not share with transient producing loads. Requires an individual AC lighting circuit. Supply a separate earth ground. Use #14–#22AWG wire.
2. Maximum length of shielded 2-conductor #18AWG cable is 1,000m (3,280 ft). For indoor or conduit use, use Ohmart part number 202676. For outdoor use, in cable trays, or Class 1, Division 2 hazardous areas, use cable part number 202679.
3. Standard output signal is 4 –20mA into 250–1,000 ohms. P1-8 is positive and P1-9 is negative. HART communication protocol (based on Bel 202 FSK standard) is available on these connections. Output isolates to standard ISA 50.1 Type 4, Class U.
4. Hart Hand-held terminal connects across 4–20mA wires to communicate with transmitter. Use terminal number 236907 (Rosemount Model 275 or equivalent). Hand-held terminal can connect across 4–20mA wires at any point.
5. HART modem connects across 4–20mA wires to allow communication between transmitter and an IBM-compatible PC.
6. Relay contacts rates are 10A at 240VAC or 8A at 24VDC.
7. Attach #18 AWG green wire with closed lug terminal to housing using #10-32 x ¼” screw.
8. If using the optional CENELEC external ground, connect earth ground to outside of housing instead of to PI Pin-3.

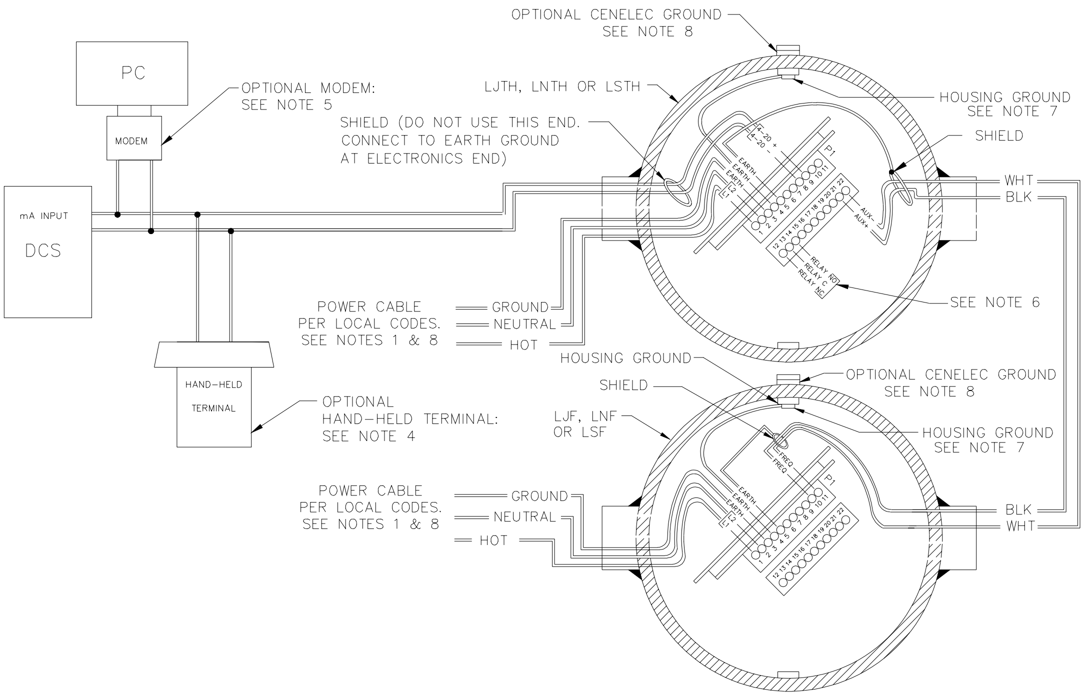


Figure 35: Interconnect - LJF, LNF, or LSF with LJTH, LNTH, or LSTH

Initial settings and calibration requirements

Refer to these sections of this manual for more details:

Table 30: Initial setting and calibration locations

Setting	Manual heading	Page
Select Summation mode in Initial setup	Setting up summation mode	127
Set span for total of all detectors	Span settings	101
Calibrate according to guidelines in calibration chapter	Initial process calibration	33

Setting up summation mode

Procedure 50: Setting up summation mode

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **Auxiliary input**
3. From the **Auxiliary input** menu, select **Compensation**

   The compensation screen displays the current type of auxiliary input

4. From the **Compensation** menu, select **Type**
6. From the **Type** menu, select **Summation**
7. Press F4 to enter
8. If using a hand-held HART communicator, press F2 to send the settings to the transmitter.

Calibrating with multiple detectors summation

The calibration procedures are the same with one or multiple detectors. The summing of the counts from multiple detectors is invisible to the user.

When setting the span, set it for the length that is the total of all the detectors.

> Note: In many cases, you cannot fill or empty the process vessel for calibration. Use the following hints in these situations: With the vessel empty, open the source holder shutter to simulate low level ("set low level") in software. Close the source holder shutter to simulate high level ("set high level" in software.)

NORM (naturally occurring radioactive material) compensation

Products that contain natural radioactive materials (for example, radon) may require special compensation of the level measurement. The radiation emitted by the product material can interfere with the measurement, since the detector cannot differentiate between the radiation from the source and the radiation from the product.

Achieve compensation of the measurement by using a second detector that measures only the radiation emitted by the product material. A primary detector measures the process level measurement. The signal from the secondary detector is input to the primary detector. The primary detector runs an algorithm to subtract the effect of the material's radiation from the source holder's radiation.

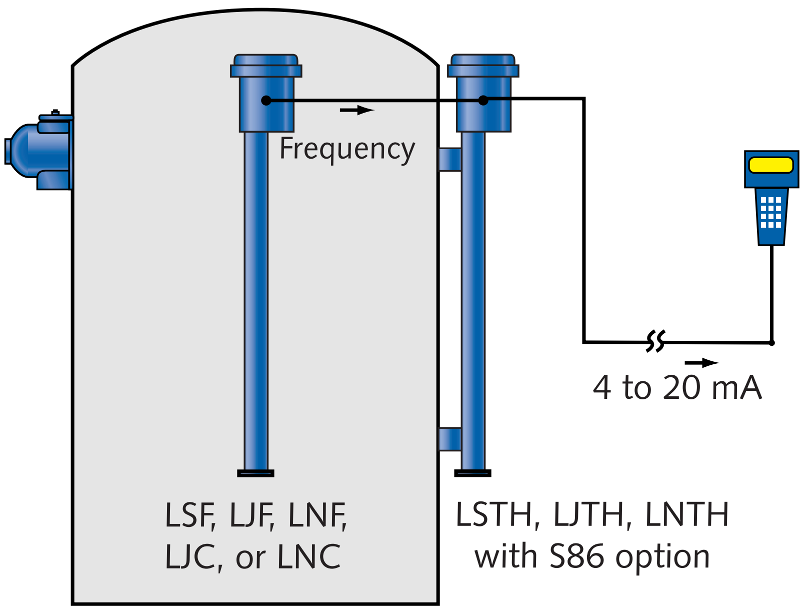


Figure 36: NORM compensation system

Special drawings for NORM Compensation

Ideally, identification of applications requiring NORM compensation occurs at the time of order. The end user, engineering contractor (or both) may have received certified drawings for the exact equipment ordered. Refer to the drawings along with this section of the manual.

Note: If the instruction on the drawings and this manual differ, follow the drawing instructions. They are specific to your order.

Installation requirements

You must install the detectors correctly for NORM compensation to work.

Mount the primary detector so it is in the source holder radiation beam. Mount the secondary detector so that it is NOT in the source holder radiation beam.

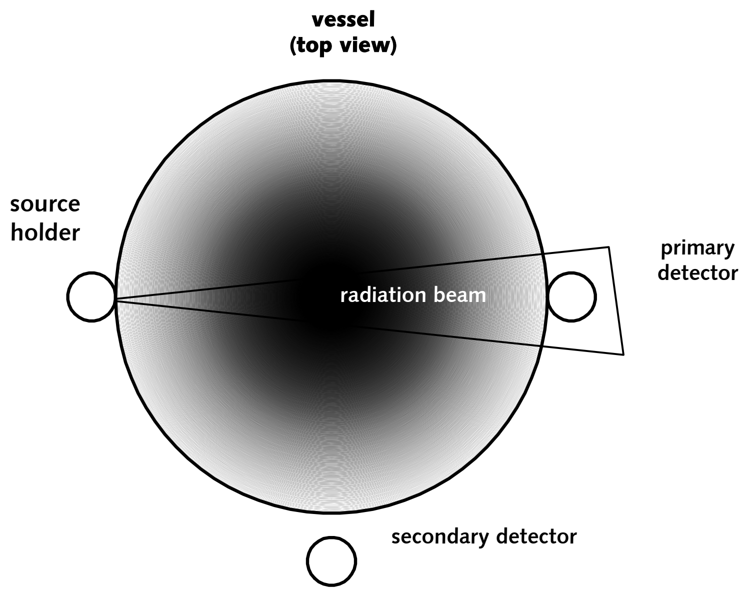


Figure 37: Placement of detectors for NORM compensation

Detector wiring

Wire the secondary detector into the primary detector as shown in Figure 38.

Notes for Figure 38

1. Voltage input to each detector is 115 or 230VAC +/–10%, 50 or 60Hz, at 60VA maximum power consumption. AC power does not share with transient producing loads. Requires an individual AC lighting circuit. Supply a separate earth ground. Use #14–#22AWG wire.
2. Maximum length of shielded 2-conductor #18AWG cable is 1,000m (3,280 ft).
For indoor or conduit use, use Ohmart part number 202676. For outdoors, use in cable trays, or Class 1, Division 2 hazardous areas, use cable part number 202679.
3. Standard output signal is 4 –20mA into 250– 1000 ohms. P1-8 is positive and p1-9 is negative. HART communication protocol (based on Bel 202 FSK standard) is available on these connections. Output is isolated to standard ISA 50.1 Type 4, Class U.
4. Hart Hand-held terminal connects across 4–20mA wires to communicate with transmitter. Use terminal number 236907 (Rosemount Model 275 or equivalent). Hand-held terminal can connect across 4–20mA wires at any point.
5. HART modem connects across 4–20mA wires to allow communication between transmitter and an IBM-compatible PC.
6. Relay contacts rates are 10A at 240VAC or 8A at 24VDC.
7. Attach #18AWG green wire with closed lug terminal to housing using #10-32 x ¼” screw.
8. If using optional CENELEC external ground, connect earth ground to outside of housing instead of to PI Pin-3.

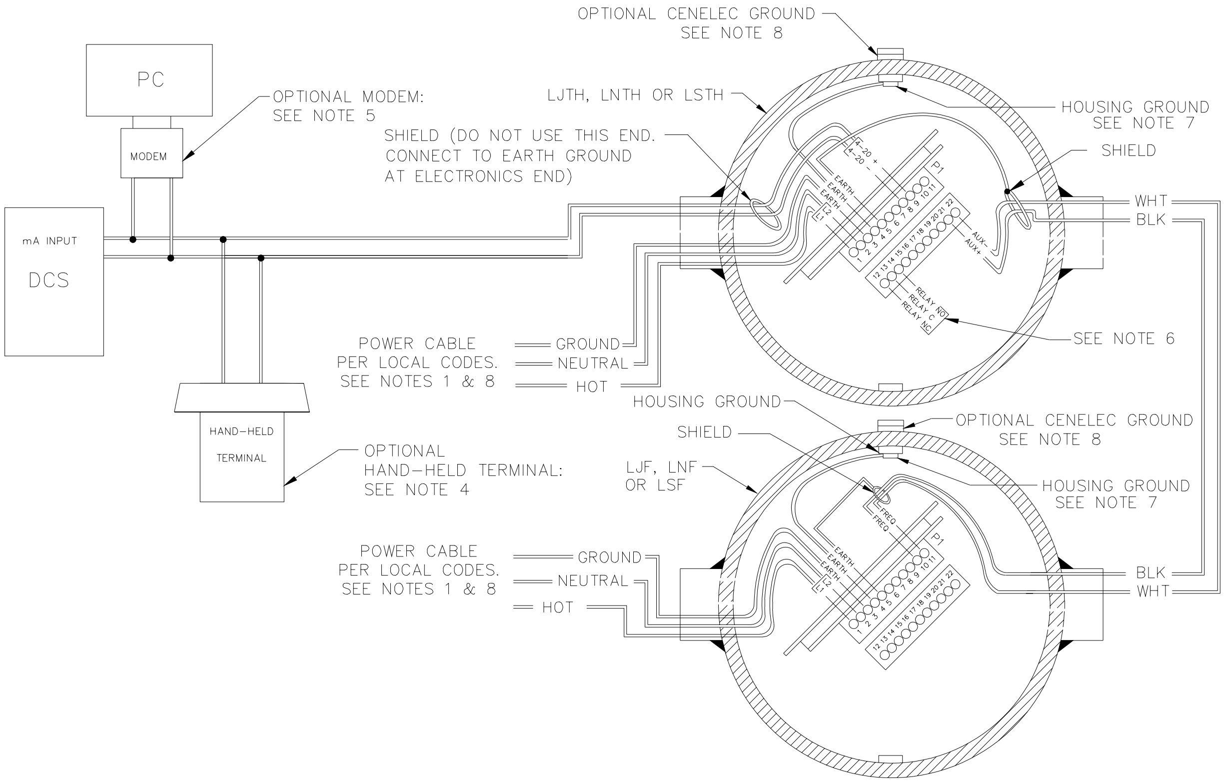


Figure 38: Interconnect—LJF, LNF, or LSF with LJTH, LNTH, or LSTH

Initial settings and calibration requirements for NORM compensation

Specific software settings and calibration procedures are required for NORM compensation.

Setting up NORM compensation

Procedure 51: Setting up NORM compensation

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **Auxiliary input**
3. From the **Auxiliary input** menu, select **Compensation**

   The compensation screen displays the current type of auxiliary input.
4. From the **Compensation** menu, select **Type**
6. From the **Type** menu, select **Compensation**
7. Press F4 to enter.
8. If using a hand-held HART communicator, press F2 to send the settings to the transmitter

Calibrating with NORM compensation

Before calibrating, make sure the NORM compensation option is set up. Refer to Procedure 51.

Note: To calibrate the NORM compensation system, you must be able to fill the vessel to the maximum level with radioactive product.

Procedure 52: Calibrating with NORM compensation

1. Set the product level to maximum
2. Turn the source holder shutter to “OFF” (this ensures that the only radiation picked up by the detector comes from the product and not the source)
3. Perform a data collect of the primary sensor
   - From the **Main menu**, select **Calibrations**
   - From the **Calibrations** menu, select **Data collect**
   - Record the value of the counts from the primary data collect.
4. From the **Main menu**, select **Initial setup**
5. From the **Initial setup** menu, select **Auxiliary input**

6 From the **Auxiliary input** menu, select **NORM**

7. From the **NORM** menu, select **Aux data collect**
8. At the prompt, select **Yes** to take data. Record the value of the counts from the Auxiliary data collect
9. From the **NORM** compensation screen, select **Gain**. Adjust the gain value as follows:
   - Compare the counts from the primary and auxiliary data collects
   - If the auxiliary channel data collect counts are higher than the primary sensor data collect counts, adjust the NORM compensation gain down. Select **Yes** to accept the counts and press F4 to enter
   - If the auxiliary counts are lower than the primary counts, adjust the NORM compensation gain up
10. Repeat the auxiliary data collect and gain adjustment steps until the auxiliary channel counts are within +/–10% of the primary sensor counts
11. If using a hand-held HART communicator, press F2 to send the settings to the transmitter
12. Follow the procedures for performing a Two-point calibration and linearizer curve from the Calibration chapter of this manual. These procedures require changing the product level from minimum to maximum and collecting data
13. Complete the linearization and calibration with the procedures “Calculate linearity” and “Calculate calibration”. See pages 48 and 49.

Vapor pressure compensation

A nuclear level gauge works on the principle that the product shields the detector from the radiation beam, allowing more or less radiation to strike the detector as the product level falls and rises. For an accurate level indication, the variation in the detector output should depend only on the product level.

However, vapor pressure variations in the headspace of the vessel can cause erroneous product level indications. This is because the vapor also blocks some of the radiation. When the pressure is higher, more radiation is blocked; when the vapor pressure is lower, less is blocked. Therefore, even at the same product level, the detector can receive varying amounts of radiation, depending on the head vapor pressure.

You can compensate for this by using a point detector (model DSTH) to separately measure the radiation passing through the vapor space. This detector signal and the signal from the continuous level detector combine to eliminate the effect of the vapor pressure on the level indication.

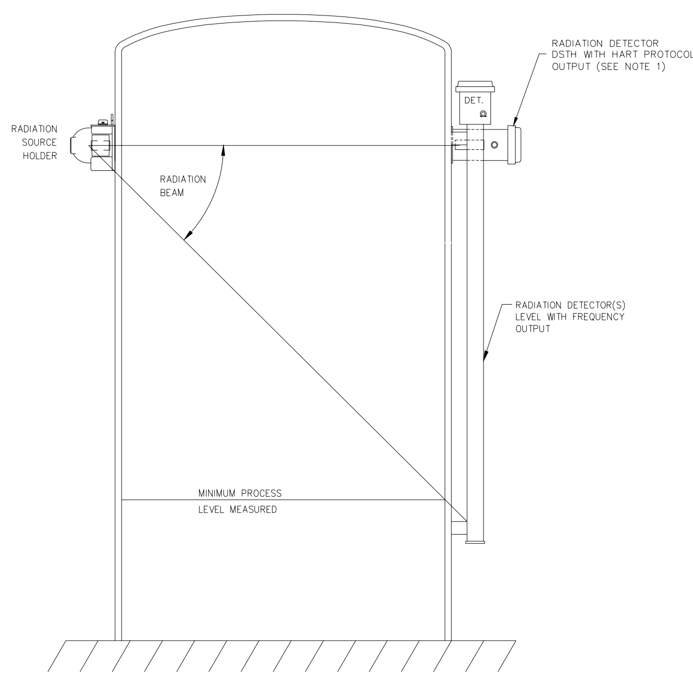


Figure 39: Vapor compensation system

Installation requirements

A vapor compensation system requires two detectors: the point detector (model DSTH) to measure the vapor space, and the continuous level detector to measure the product level.

Both must be in the radiation beam from the source holder. Mount the DSTH so that it is above the highest expected product level.

Detector wiring

The level detector provides a frequency signal to the DSTH. The output of the DSTH is the calibrated, vapor compensated, 4–20mA signal for control and HART communication. Figure 40 illustrates the interconnection between the density gauge and the level gauges.

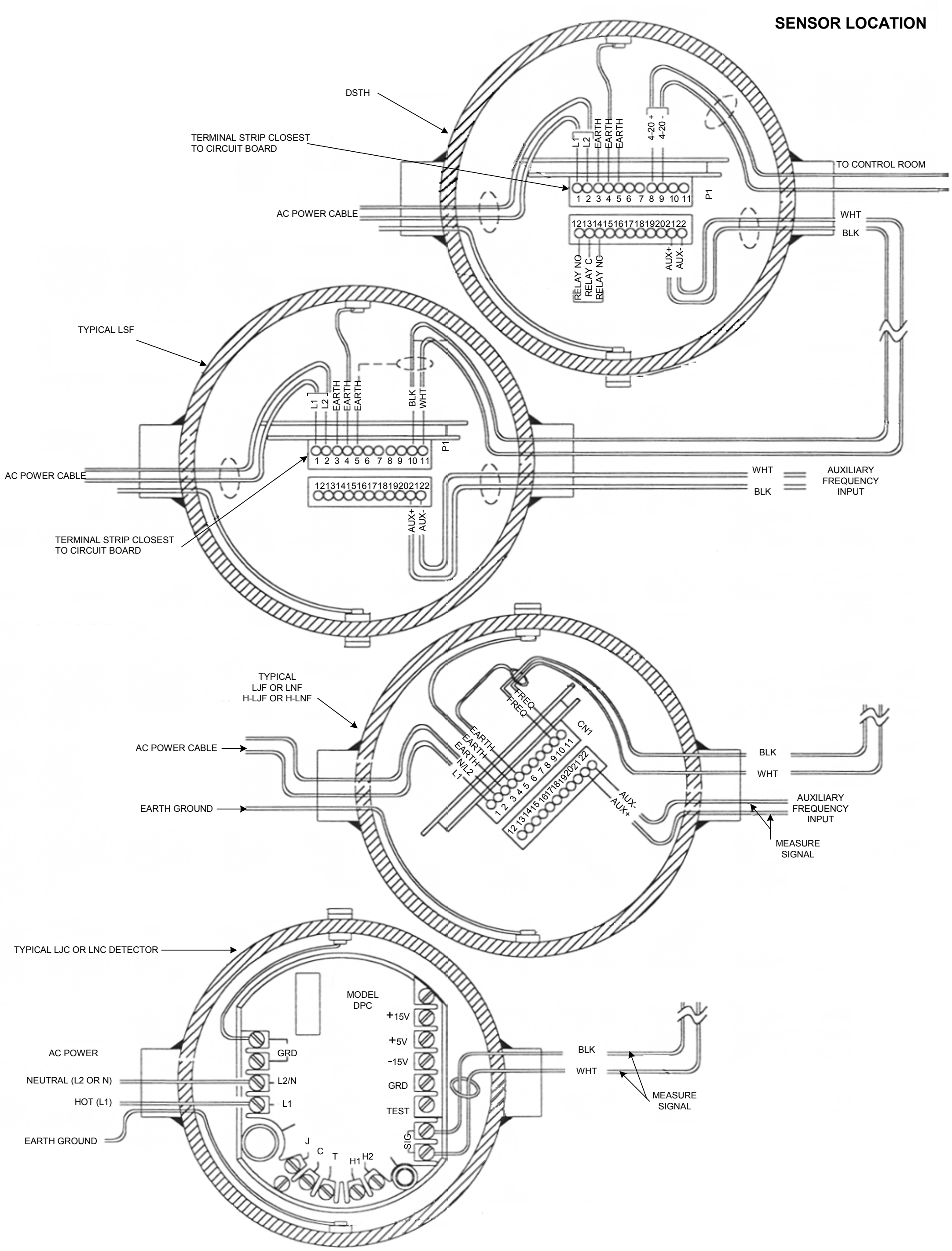


Figure 40: Interconnect DSTH with LSF, LJC, LJF, LNC, LNF

Algorithm for vapor comp

The vapor compensation algorithm adjusts the percent span based on a percent change in vapor density from a reference density. (Refer to the Calibration chapter for a complete discussion of continuous level gauge calibrations.)

Each time the gauge computes a level measurement, a new Cal low counts value calculates, which changes the percent span. The algorithm for calculating the cal low counts is:

New cal low counts=cal low counts * (1–(vc gain * % change in vapor density counts))

Where:

% change in vapor density counts=(reference counts–vapor density counts)/reference counts

Variable definitions

Reference counts

Reference counts are counts from DSTH at reference pressure condition (determined during first step of calibration).

Vapor density counts

Vapor density counts are counts from DSTH at current pressure condition.

VC gain

VC gain is the vapor compensation gain (user enters value during calibration)

Initial settings and calibration for vapor comp

Setting up vapor compensation

Procedure 53: Setting up vapor compensation

1. Perform the following steps to set the DSTH up as a level gauge:
   - From the Main menu, select Advanced Fxns
   - From the Advanced Fxns menu, choose Select Gage type
   - From the Select Gage type menu, select Level
   - Press F2 to send to the transmitter
2. Return to the **Main menu**
3. Perform the following steps to select Vapor compensation:
   - From the **Main menu**, select **Auxiliary input**
   - From the **Auxiliary input** menu, select **Compensation**
   - From the **Compensation** menu, select **Type**
   - From the **Type** menu, select **Vapor**
   - Press F4 to enter. You return to the **Compensation** menu
4. Return to the **Auxiliary input** menu.
5. From the **Auxiliary input** menu, select **Filter TC**
6. Set the filter time constant. For best response, this value should be five seconds. If this value is too large (>10sec), the system response slows, with long settling times on the final output
7. From the **Compensation** menu, select **Vapor**
8. From the **Vapor** menu, select **Gain**
   - Set the Gain to 1.0
   - You adjust it again during the calibration procedure
9. If using a hand-held HART communicator, press F2 to send the settings to the transmitter.

Calibrating with vapor compensation

Before calibrating, make sure the vapor compensation option is set up (see Procedure 53).

Note: To calibrate the vapor pressure compensation system, you must be able to adjust both the product level and the vapor pressure.

Calibrating with vapor compensation

Procedure 54: Calibrating with vapor compensation

1. Set the vapor pressure to a typical pressure (this is the reference pressure). At this point, the product level is not important, as long as the density gauge is not blocked by the product
2. From the **Main menu**, select **Initial setup**
3. From the **Initial setup** menu, select **Auxiliary input**
4. From the **Auxiliary input** menu, select **Vapor**
5. From the **Vapor** menu, select **Aux data collect** (This determines the reference counts for the vapor compensation algorithm.)
6. At the prompt, select **Yes** to take data.

   When data collection is complete, select **Yes** to save the vapor pressure reference counts
7. If using a hand-held HART Communicator, press F2 to send the settings to the transmitter
8. Return to the **Main menu**
9. Follow the procedures for performing a Two-point calibration and linearizer curve from the Calibration chapter of this manual.
   - These procedures require changing the product level from minimum to maximum and collecting data
   - During the calibration and linearization procedure, maintain the reference pressure in the headspace
10. Complete the linearization and calibration with the procedures “Calculate linearity” and “Calculate calibration”. See pages 48 and 49
11. Set the product to the lowest possible level while at the maximum pressure

Procedure 55: Calibrating with vapor compensation (continued)

12. Set the vapor density to its highest possible value
13. Note the level indication (it will likely be upscale)
14. From the **Initial setup** menu, select **Auxiliary input**
15. From the **Auxiliary input** menu, select **Vapor**
16. From the **Vapor** menu, select **Gain**
17. Adjust the vapor compensation gain value until the level indication reads the correct, minimum level value
18. Press F2 to send to the transmitter.

Internal heater kit for applications below –50°C

A heater kit option is available for the LSTH, LJTH, and LNTH, for applications that require a –50°C (–58°F) temperature rating. With the heater option, the internal temperature of the unit rises approximately 30°C (86°F) degrees.

The features of the heater are as follows:

- The heater kit does not affect the functionality of the level detector in any way. There is no requirement for special firmware
- The factory installs the internal heater kit if you order it with the level detector
- Retrofits are available for previously installed equipment
- Two different kits are available, one for 115VAC and one for 220VAC. The part numbers are shown below:

Table 31: Internal heater part numbers

Heater kit power	Ohmart Part Number
115 VAC	239964
220 VAC	239965

Changes to specifications

If you install the heater kit, the power rating changes from the specifications on pages 5–7 of this manual.

LSTH or LSF

With the installation of the heater, the maximum power consumption increases to 30 watts. The unit is either 115VAC±10% or 220VAC±10%, instead of the standard 90–270 VAC range

LJTH, LJF, LNTH, or LNF

With the installation of the heater, the maximum power consumption increases by 15W.

Appendix III: Retrofitting HART electronics to existing equipment

This appendix describes how to retrofit HART communications capabilities onto an existing continuous level gauge.

Two types of retrofits are available:

1. Integral
   The HART support electronics mount and wire in the existing level gauge housing
2. Remote
   The HART support electronics mount in a separate housing. A frequency signal from the level detector is input to the HART electronics.

After upgrading to HART electronics, the detector acts as a stand-alone transmitter, providing a calibrated 4–20mA signal from the detector head.

Preserving information from Smart Pro

If you have existing Smart Pro electronics (Smart Pro or Smart Pro Pac), you can preserve information on setup and calibration from the Smart Pro electronics. This information can transfer to the new transmitter electronics, saving a great deal of time commissioning the gauge.

Note: Smart 1 and Smart 2 electronics users can preserve the information from their systems and transfer it to the HART electronics. We recommend consulting Ohmart Field Service for help on your individual installation.

Note: EDS users cannot transfer information to the HART electronics. You must perform new setup and calibration procedures.

After the new electronics are installed, refer to "Appendix I: Initial Factory Setup" to enter the correct parameters. Proceed to the "Calibration" chapter for instructions to calibrate the gauge.

Use the following table to record data from the Smart Pro:

Table 32: Smart Pro data record

Smart Pro parameter	Smart Pro screen/item	Value	Corresponding HART parameter
Standardize parameter	520/25		-
Standardize parameter	520/26		-
Process low value (Low sample input)	520/32		Cal low level
Process high value (High sample input)	520/33		Cal high level
Cal low counts	520/39		Counts low
Cal high counts	520/40		Counts high
Time constant	527/0		Filter
Fast response filter (chrontrol)	527/1		Threshold
Span	527/2		N/A
Output min	527/10		4mA level
Output max	527/11		20mA level
Linearizer curve On/Off	528/41		N/A
Low product value	528/42		Min level
High product value	528/43		Max level

Use Table 33 to record the linearizer table information. Transferring this information makes a new initial calibration procedure unnecessary. (If you prefer to do a new initial calibration, refer to the Calibration chapter of this manual for instructions.)

To calculate the new value to enter into the HART version linearizer table, divide the Smart Pro value of each point by 100. For example, if the Smart Pro value of point 2 is 630, enter 6.30 as the corresponding HART 5.0% point.

Table 33:Linearizer record

Linearizer table points	Smart Pro Screen/item	Smart Pro Value	HART Linearizer table point (%span)	HART Linearizer table (Smart Pro Value ÷ 100)
0	528/0		0.0%	
1	528/1		2.5%	
2	528/2		5.0%	
3	528/3		7.5%	
4	528/4		10.0	
5	528/5		12.5	
6	528/6		15.0	
7	528/7		17.5	
8	528/8		20.0	
9	528/9		22.5	
10	528/10		25.0	
11	528/11		27.5	
12	528/12		30.0	
13	528/13		32.5	
14	528/14		35.0	
15	528/15		37.5	
16	528/16		40.0	
17	528/17		42.5	
18	528/18		45.0	
19	528/19		47.5	
20	528/20		50.0	
21	528/21		52.5	
22	528/22		55.0	
23	528/23		57.5	
24	528/24		60.0	
25	528/25		62.5	
26	528/26		65.0	
27	528/27		67.5	
28	528/28		70.0	
29	528/29		72.5	

Table 33: Linearizer record (continued)

Linearizer table points	Smart Pro Screen/item	Smart Pro Value	HART Linearizer table point (%span)	HART Linearizer table (Smart Pro Value ÷ 100)
30	528/30		75.0	
31	528/31		77.5	
32	528/32		80.0	
33	528/33		82.5	
34	528/34		85.0	
35	528/35		87.5	
36	528/36		90.0	
37	528/37		92.5	
38	528/38		95.0	
39	528/39		97.5	
40	528/40		100.0	

Integral retrofit

The integral retrofit is possible for LJ models, with either a DF or FA model amplifier.

The ion chamber HART upgrade kit is available from Ohmart. Four kits are available, depending on the model and voltage of the ion chamber. The two model types are:

1. Models with FA amplifiers are 0–10VDC analog output for use with the EDS series electronics
2. Models with DF amplifiers are 0–10kHz output for use with Smart Series electronics

See the following table for kit part numbers.

Table 34: LJ to LJTH conversion kit part numbers

LJ to LJTH conversion kit part numbers		
	FA amplifier	DF amplifier
115V	238238	237925
230V	238239	238236

The kits contains the following parts:

- Assembly drawings
- Electronics assembly (HART CPU board, power supply, CTC temperature controller, and interconnect terminal, all fixed on a mounting plate)
- Electronics housing end cap
- DF amplifier (if the existing detector has a FA amplifier)
- Continuous Level User Manual

Upgrading hardware to HART electronics

Specific instructions for upgrading your existing detector to HART are available on the drawing sent with the kit. General guidelines follow:

Installing and wiring the new HART electronics assembly

Procedure 55: Calibrating with vapor compensation

1. Always turn the source holder shutter to the OFF or CLOSED position when working near the gauge
2. Remove the DPC power supply/temperature controller from the detector
3. Remove the amplifier cover plate
4. If you are upgrading an FA model, install the DF amplifier, included with the kit. Verify the high-meg feedback resistor on the new DF is the same value as the resistor on the FA. Or, remove the feedback resistor on the FA and install it on the new DF amplifier
5. Install the new amplifier cover plate
6. Install the electronics assembly
7. Wire the electronics assembly connector per the provided drawing
8. Generally, the wiring from the detector to the old Ohmart EDS or Smart Series electronics can carry the new HART 4–20mA signal

   Bypass the old electronics so that the new HART 4–20mA signal runs directly to the DCS. If the two wires are spliced at the old electronics, ensure the connection is reliable.

Remote retrofit

You can use a remote retrofit to HART support electronics with any continuous level gauge detector that produces a frequency output of 0–100kHz. Examples of Ohmart level detectors meeting this requirement include:

- LJC
- LNS
- LS

The additional hardware required is an Ohmart model RHP (Remote HART Processor). The RHP is contained in a separate housing and requires power and the input frequency signal from the level detector. It outputs the 4–20mA calibrated-signal that carries the HART communication.

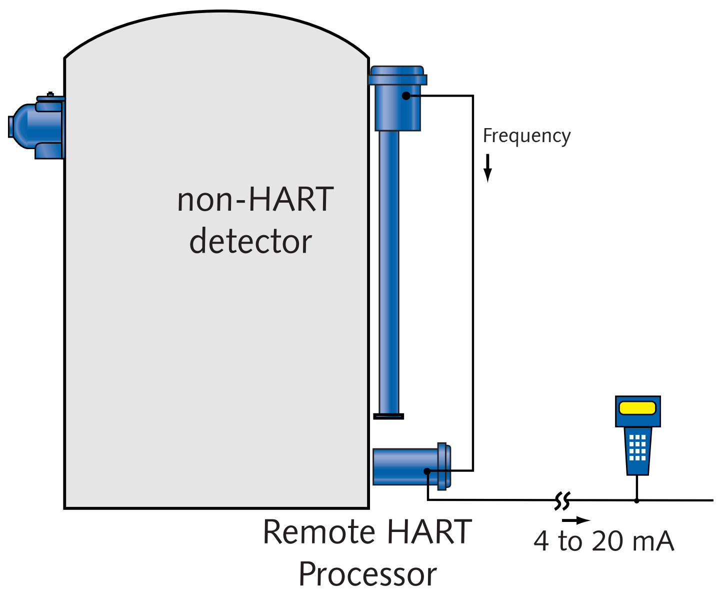


Figure 41: Level system with Remote HART Processor

Remote HART Processor (RHP) specifications

Table 35: Remote HART Processor (RHP) specifications

Power Requirements*	AC	90–270VAC at 50–60Hz, at 20VA maximum power consumption
	DC	10–30 VDC (less than 100mV, 1–1,000Hz ripple) at 10VA
Signal Cable	Wire size	14–22AWG (1.63 to 0.643mm)
	Maximum length (for both detector signal and HART signal)	3,280ft (1,000 m)
	Cable type (for both detector signal and HART signal)	18–22 AWG (1.02–0.643mm) two conductor shielded
	Cable type (4-Wire hookup with DC)	18–22 AWG (1.02–0.643mm) four conductor shielded
Housing	(Pending) CSA & FM	Designed to meet National Electric Code (U.S. & Canada)
	Certification	Class I, Groups A, B, C & D, Division 1 & 2 Class II, Groups E, F & G, Division 1 & 2
	CENELEC Certification	EExd IIC T5, IP-66
	Temperature	–4°F–140°F (–20°C –60°C), option for lower temperatures available, water cooling required above 140°F (60°C)
	Humidity	0–95%, non-condensing
	Vibration	0.5g at 300cps
	Material	Carbon Steel (others optional)
	Weight	42 lb. (19kg)
	Paint	Epoxy Powder Coat
Current Loop Output	Rating	4–20mA, isolated, into 250–1,000ohm
	Power	Jumper selectable source (active) or sink (passive) mode
Relay Output	Software user settable function	Diagnostic alarm or process high or low alarm
	Rating	8A at 250VAC (SPDT Form C)
HART Communication	HART Protocol on current loop output	BEL202 FSK standard
	PC interface	HART modem and Ohmart communications software package
	Optional hand-held interface	HART Communicator model 275 hand-held terminal with Ohmart device descriptions loaded
Serial Communication	Full duplex RS-422/485 port, 2,400 baud	(Not used for normal operation)
Input from Detector	Type	Frequency input (0–100kHz)
Electronics	On-board memory	FLASH and two EEPROMs
	Real-time clock	Maintains time, date, and source decay compensation. Year 2000 compatible
Diagnostics	LED indication	+5V, Memory Corruption, HART, +30V, CPU Active, Auxiliary, High Voltage, Relay & Field Strength

* Power specifications change if an internal heater kit is used. See page 142.

Remote HART Processor installation

The Remote HART Processor can be mounted anywhere meeting its certification specifications and within 1,000 m (3,280 ft) of the level detector.

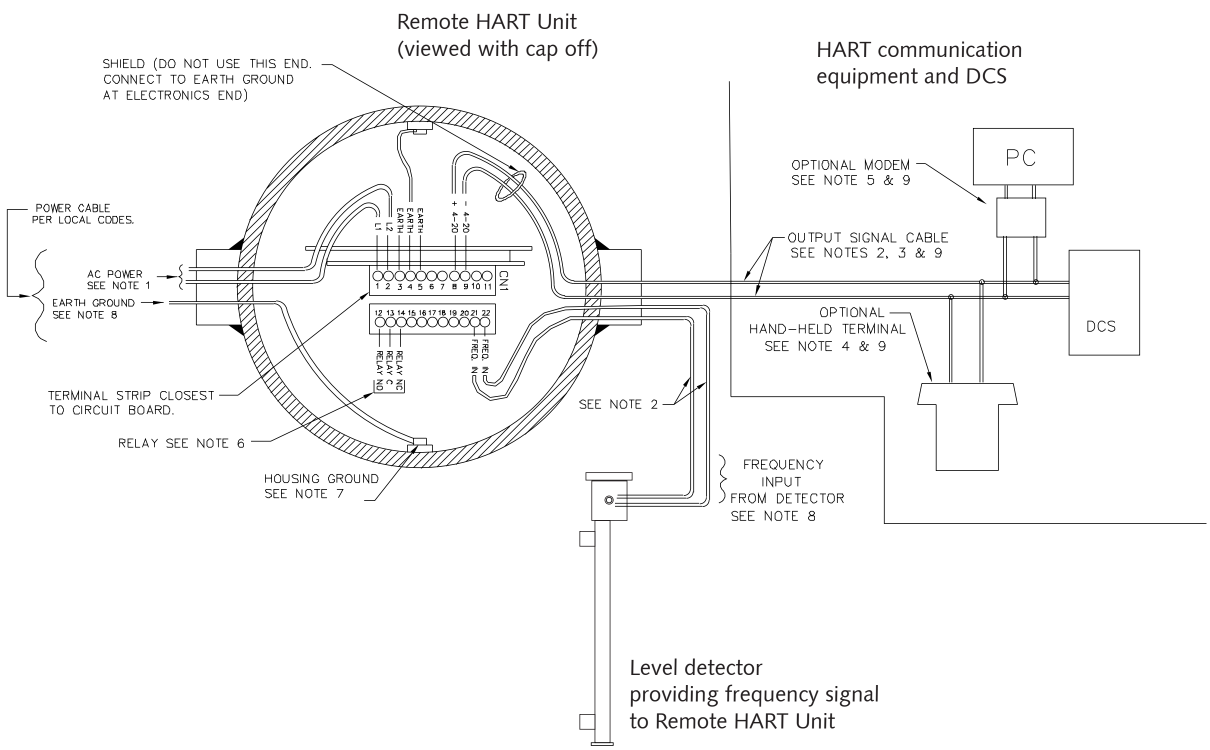


Figure 42: Remote HART Processor interconnect

Software settings required

The Remote HART Processor requires two Advanced Functions parameters to be set from the **Advanced Fxns** menu:

- **Select gage type**, L**evel**
- **Select gage locati**, **Remote**

Setting the gauge location to Remote makes the auxiliary input (from the level detector) the primary channel for calibration.

Calibrating with the Remote HART Processor

As long as the gauge location in Advanced Functions is set to Remote, the level gauge can operate and calibrate as described in this manual.

If your system was using an Ohmart Smart Pro or Smart Pro Pac and was functioning well, you can save time by transferring the calibration data from the Pro to the HART electronics. See the “Preserving Information from Smart Pro” section in this manual.

Appendix IV: HART menus and screens

The following charts illustrate the HART hand-held communicator menus and screens. See the "Ohmart View User Manual" for illustrations of the Ohmart View HART menus and screens.

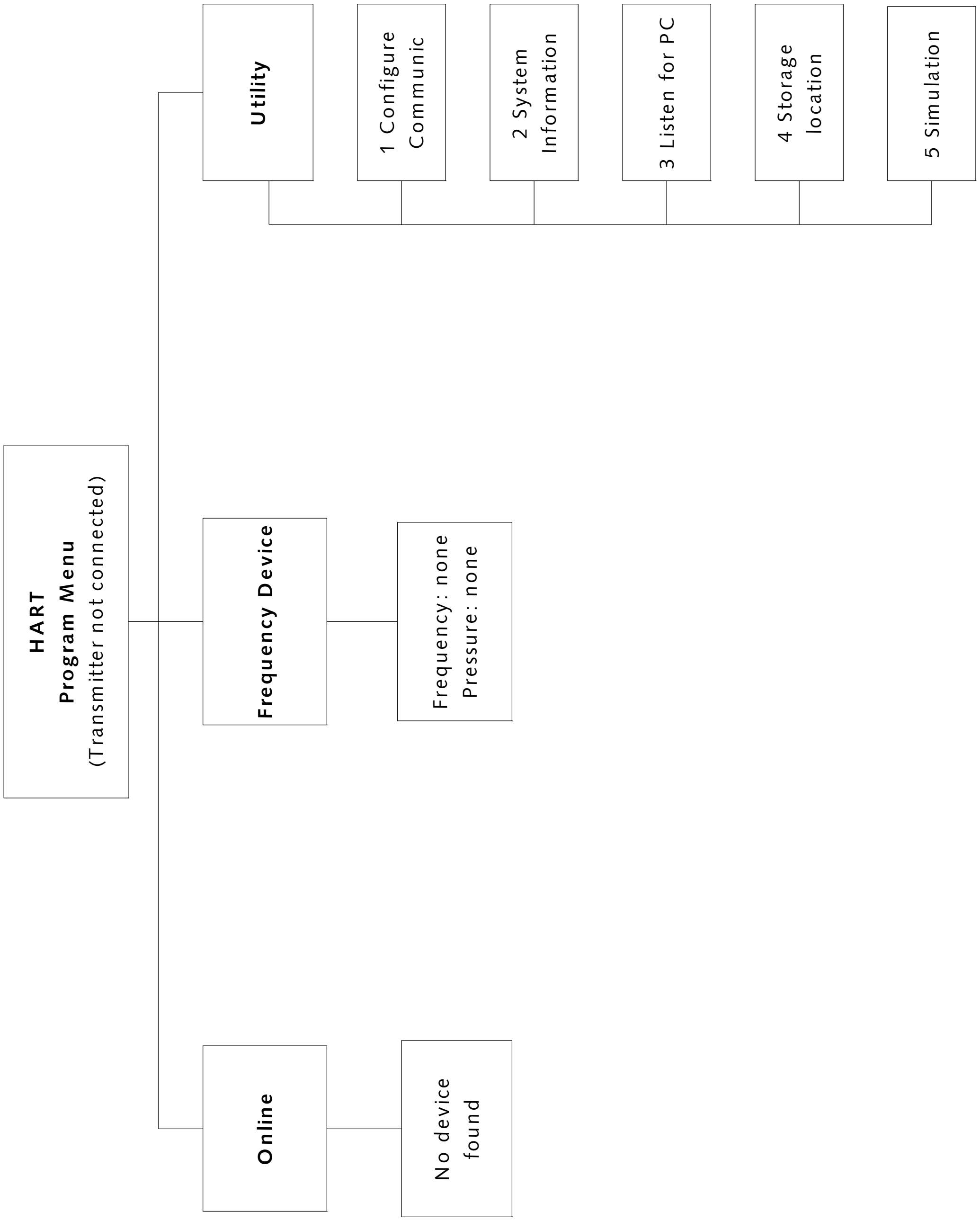


Figure 43: HART screen—Transmitter not connected

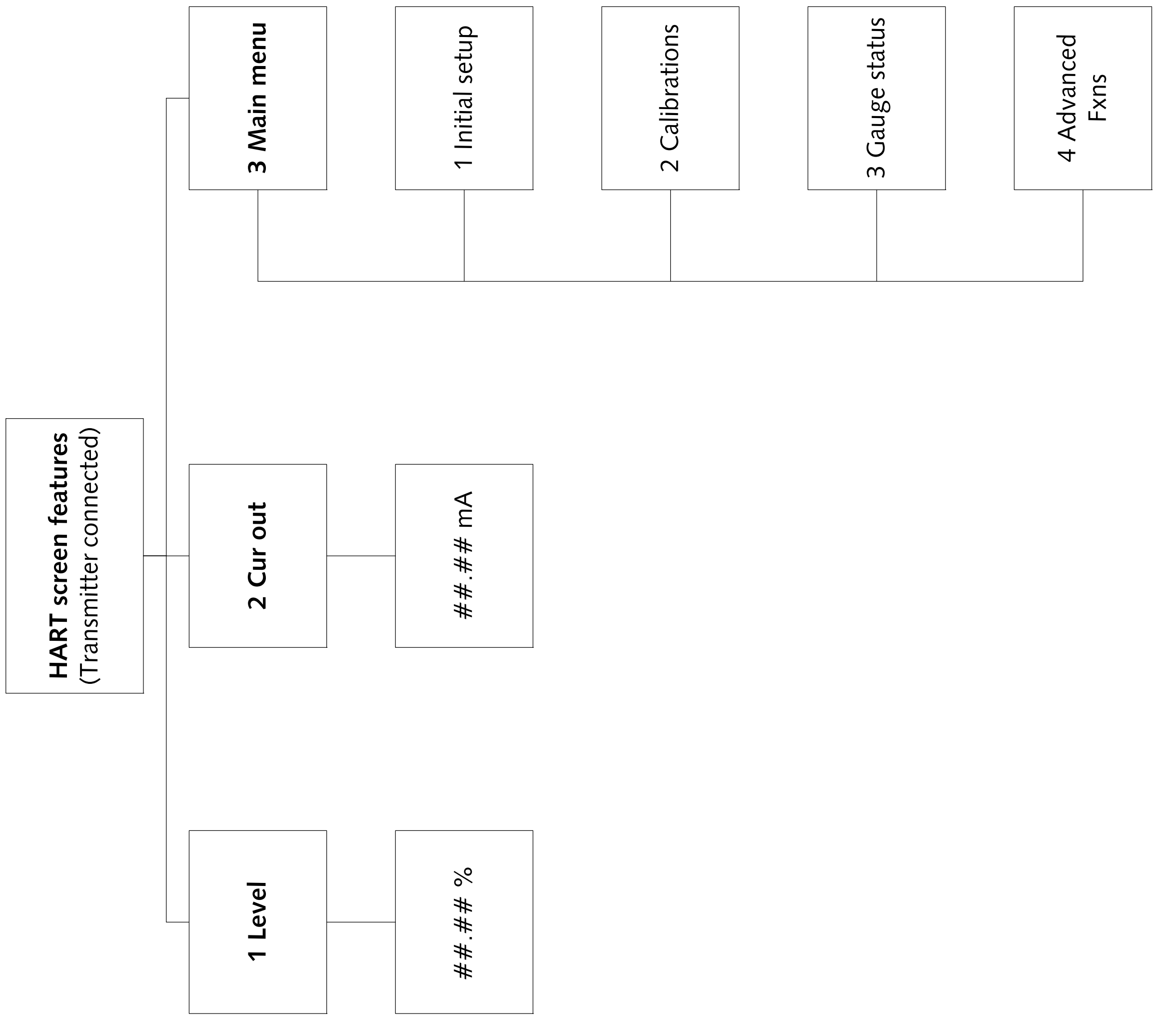


Figure 44: HART screen—Online

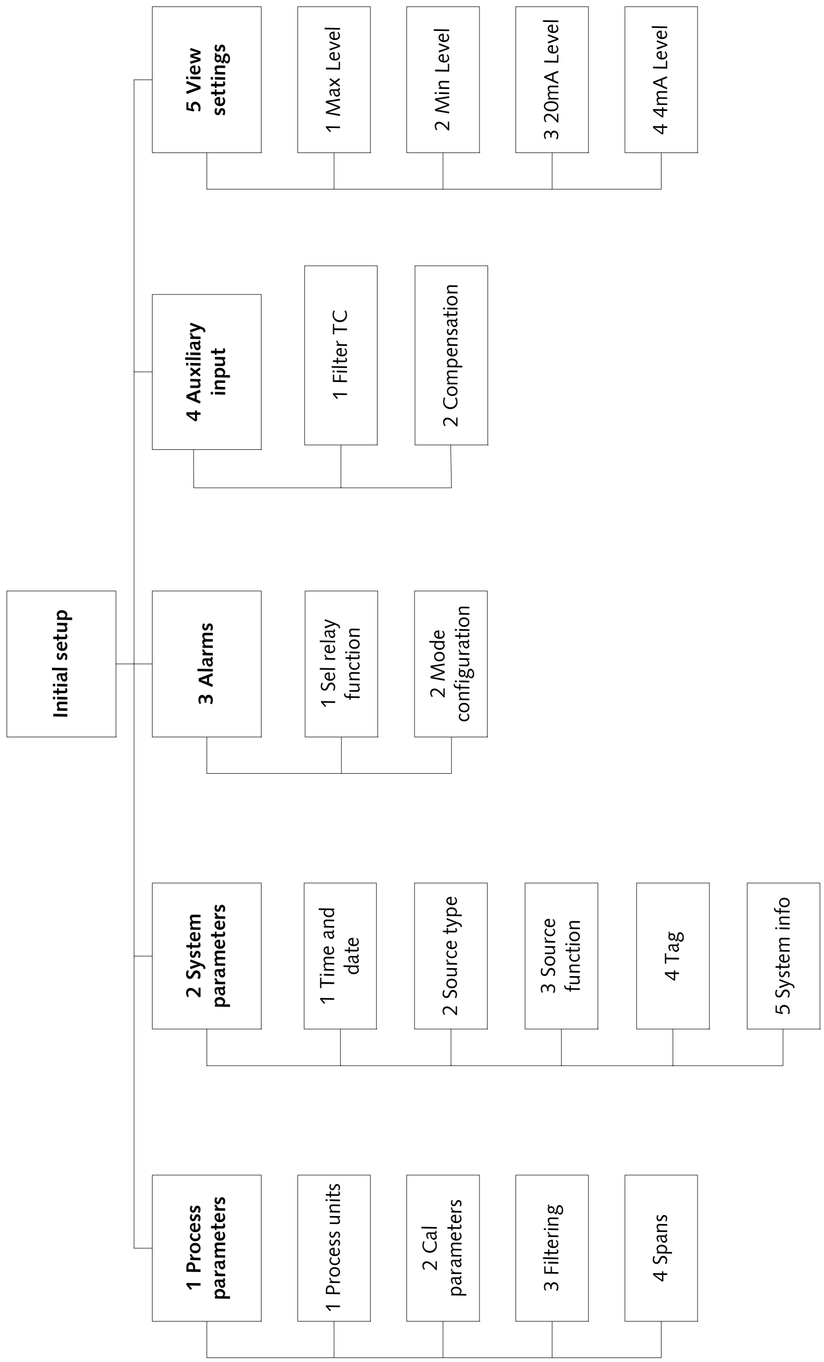


Figure 45: Initial setup

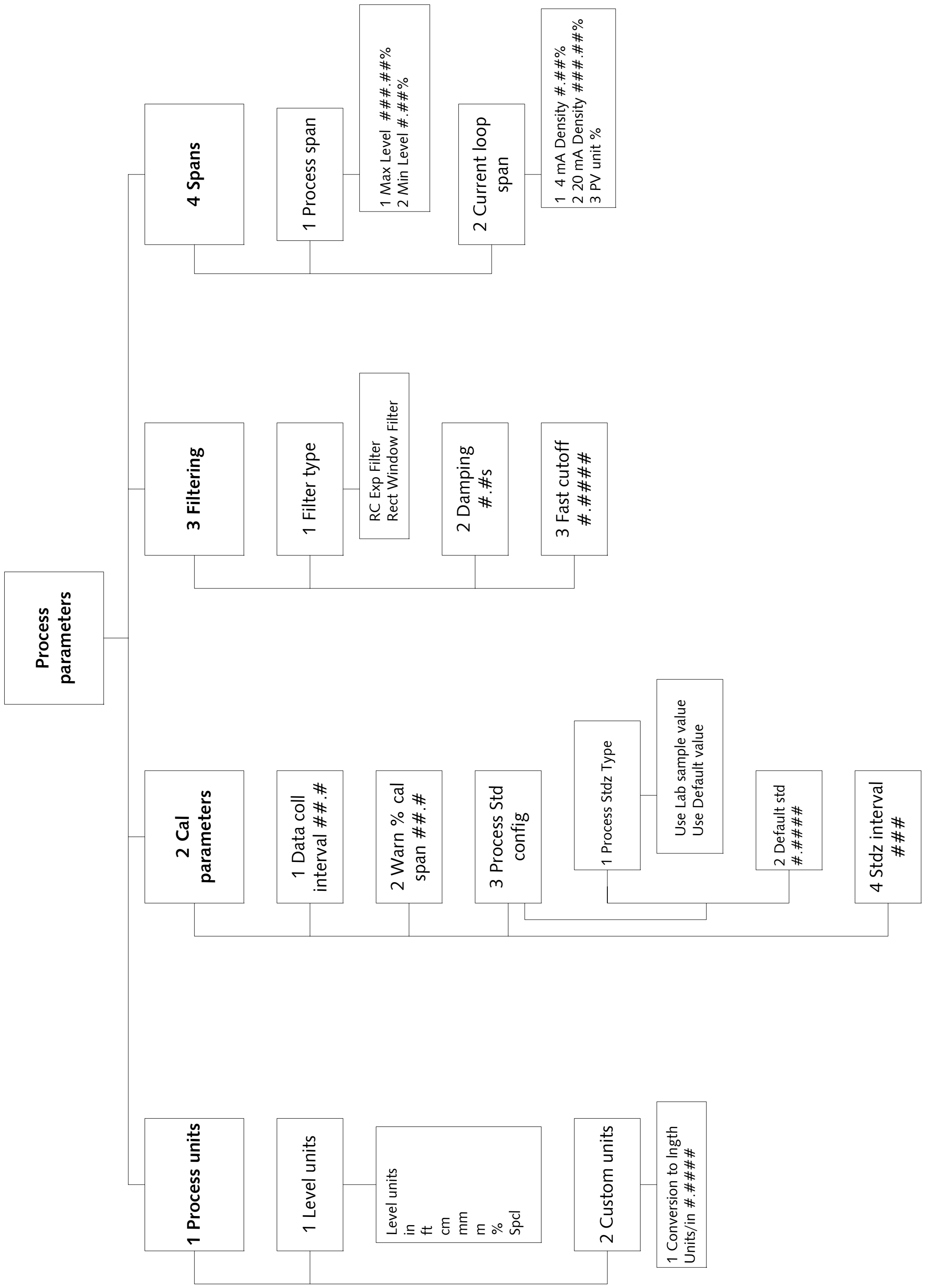


Figure 46: Process parameters

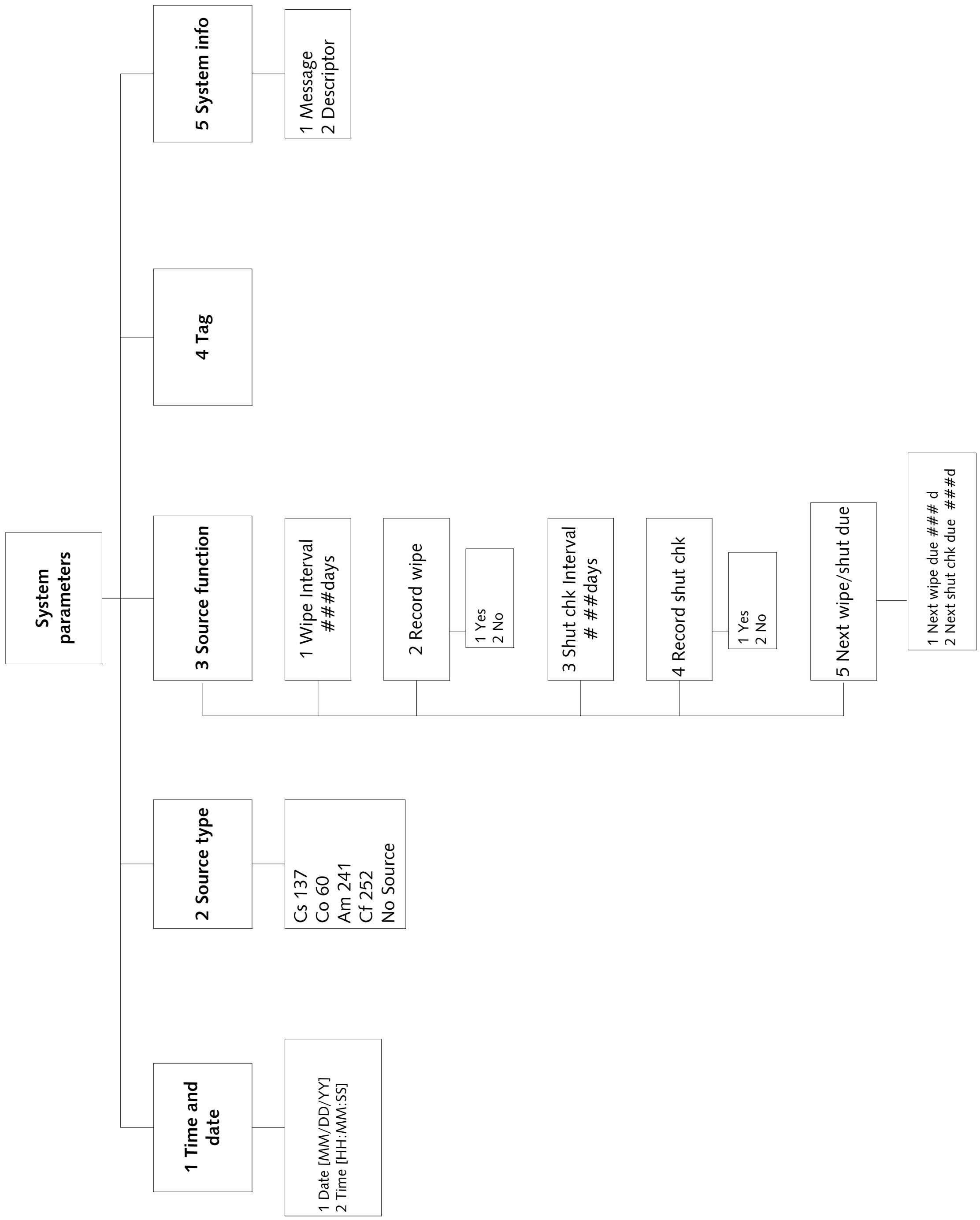


Figure 47: System parameters

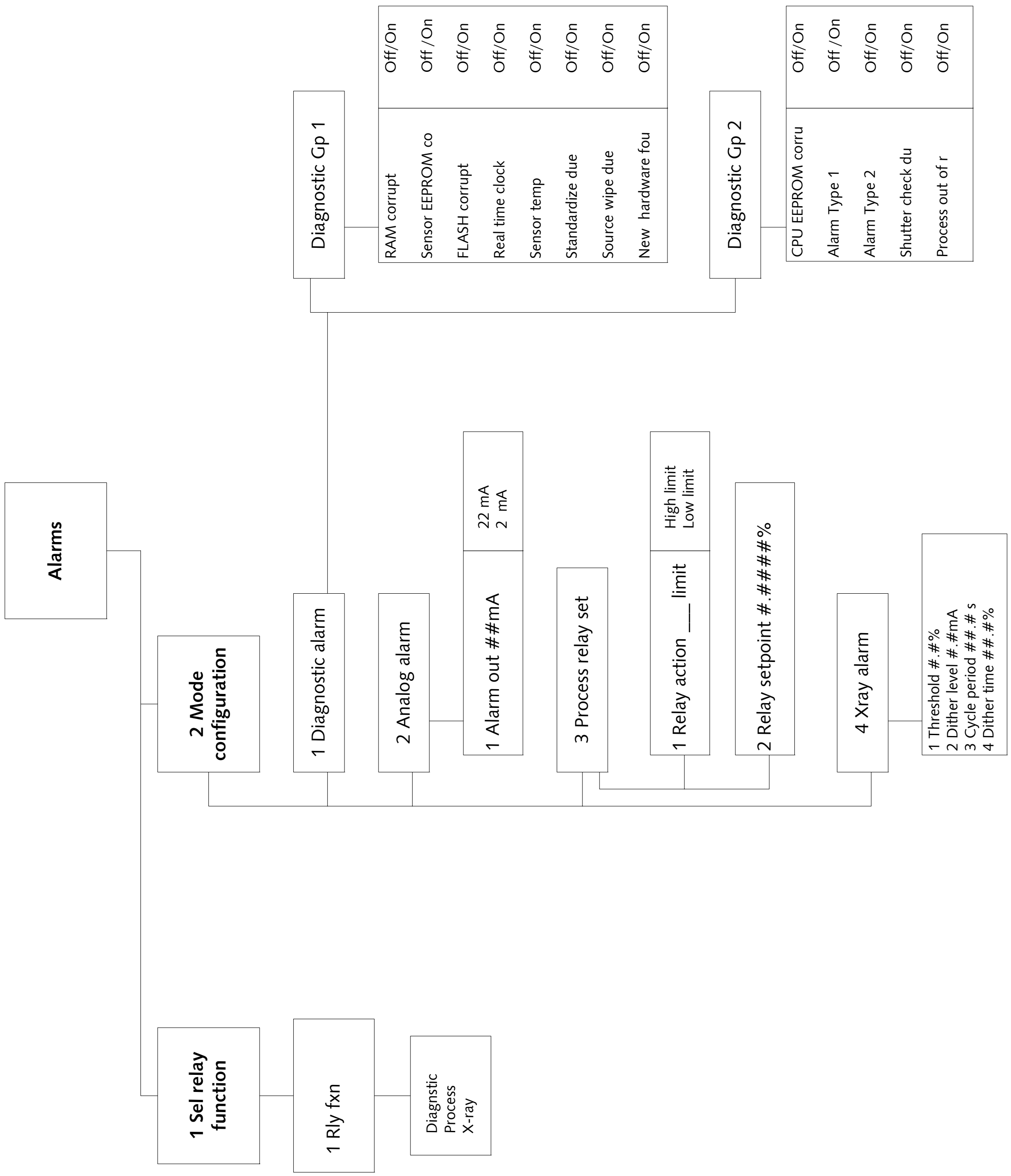


Figure 48: Alarms

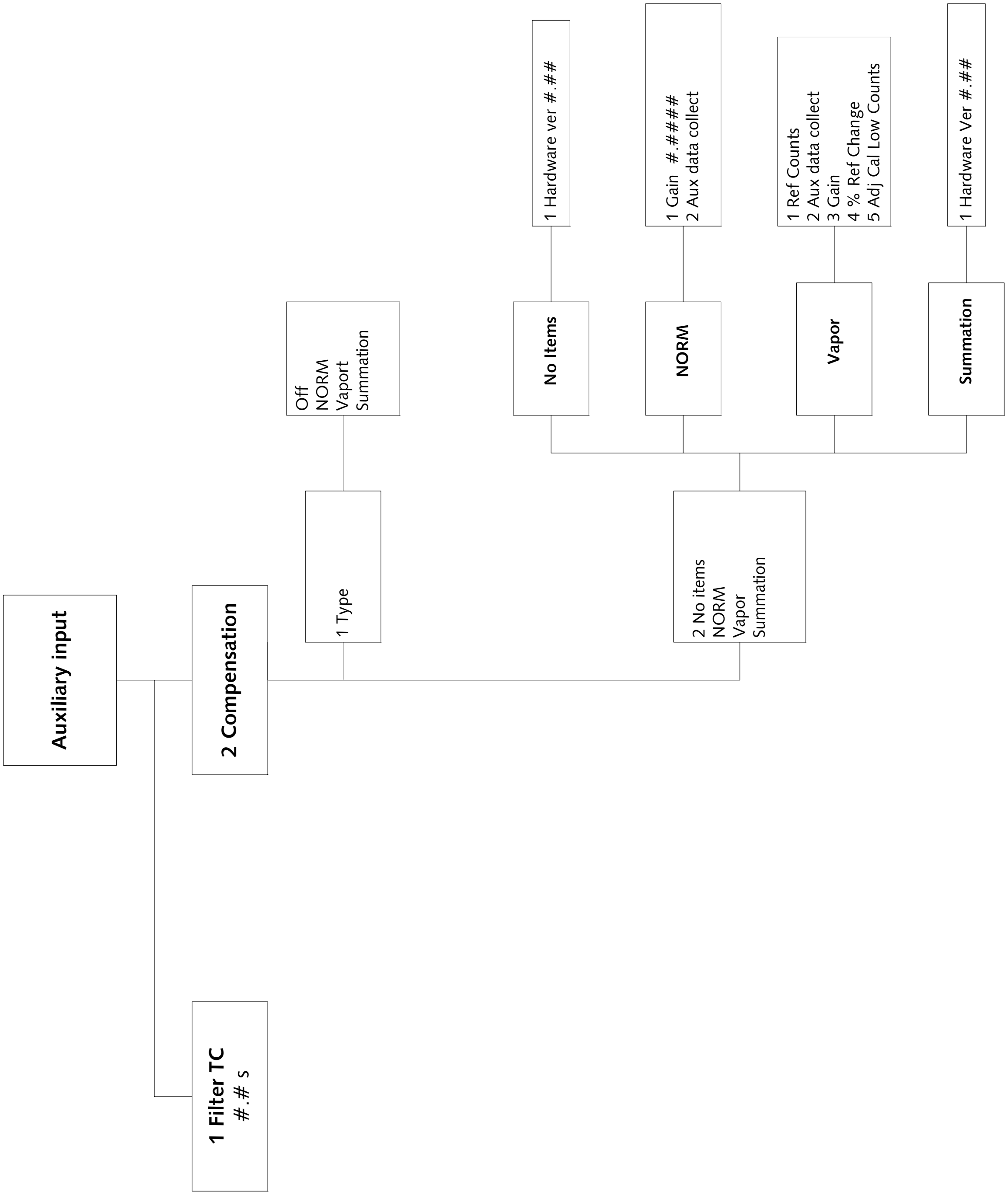


Figure 49: Auxiliary input

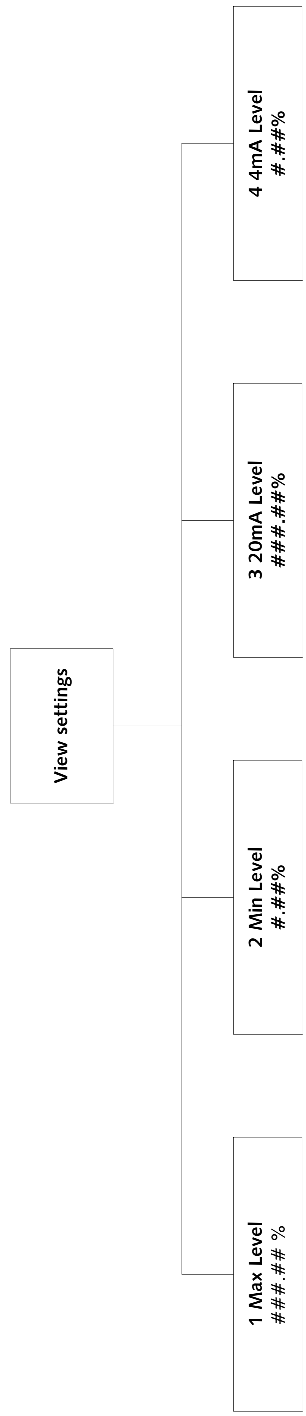


Figure 50: View settings

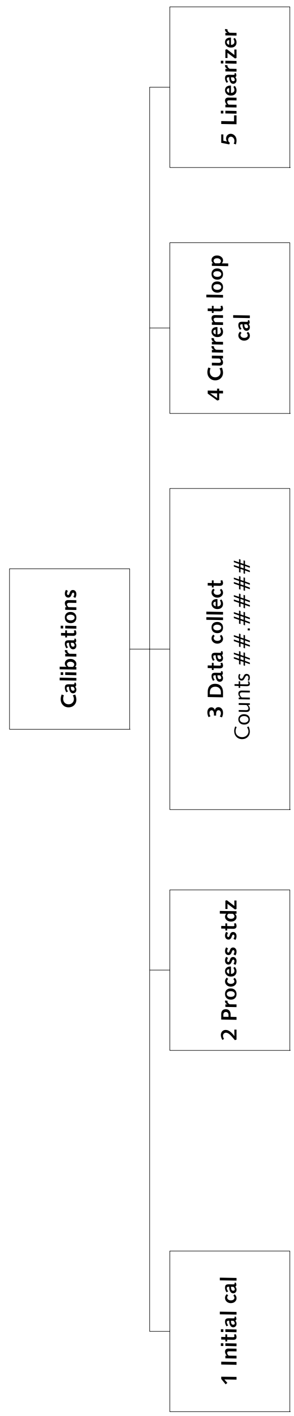


Figure 51: Calibrations

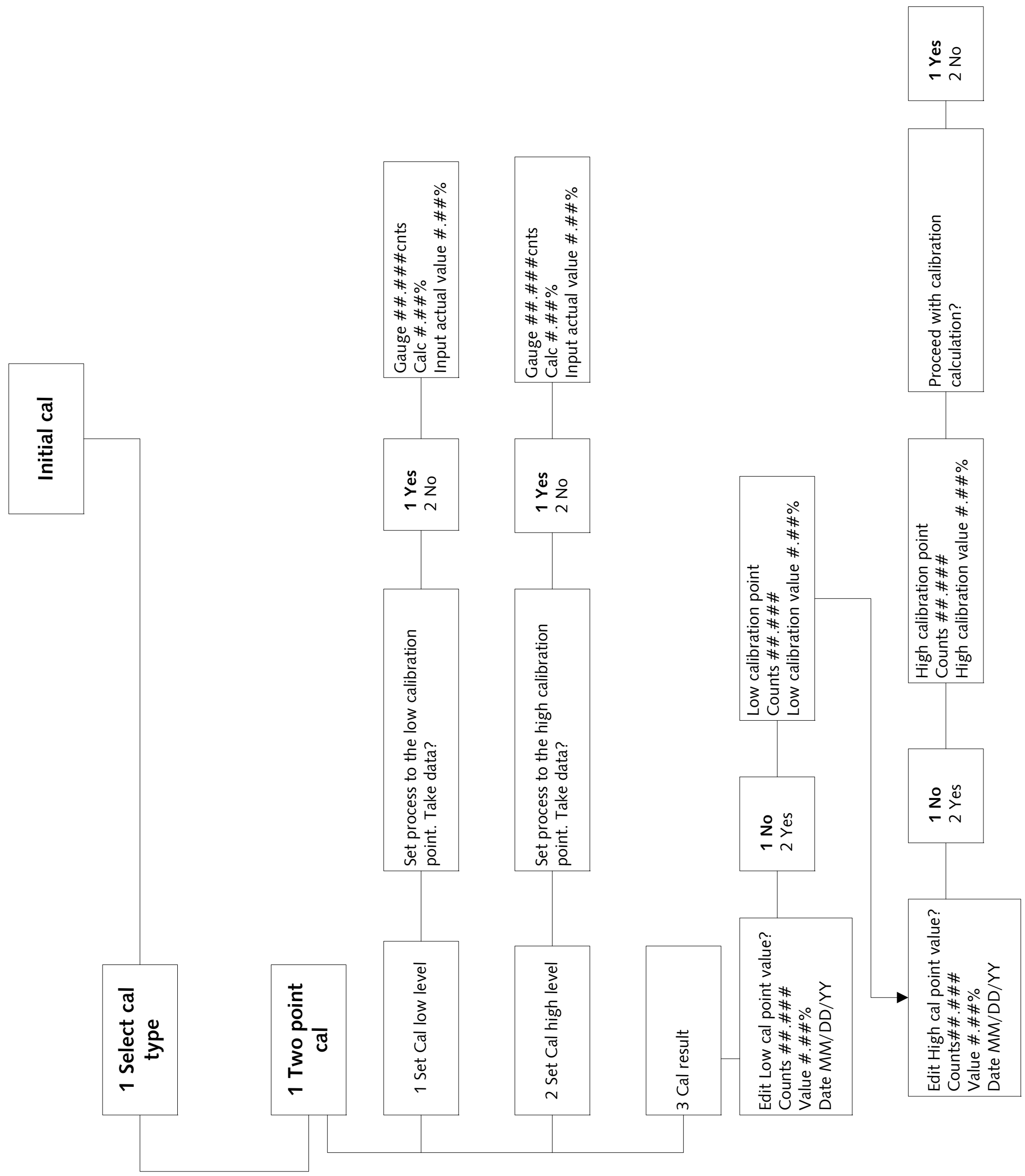


Figure 52: Initial cal

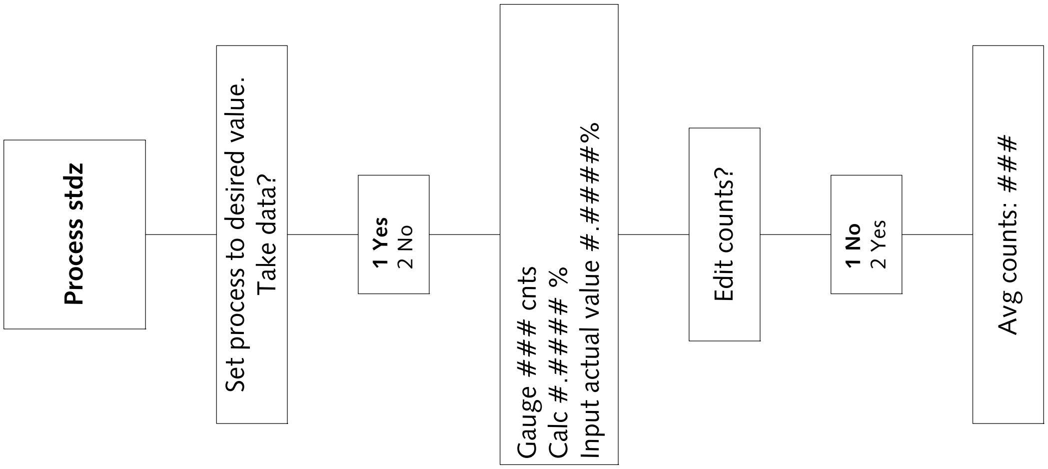


Figure 53: Process stdz

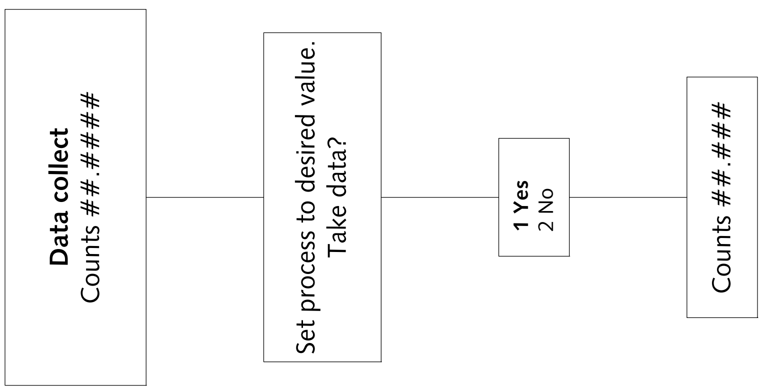


Figure 54: Data collect

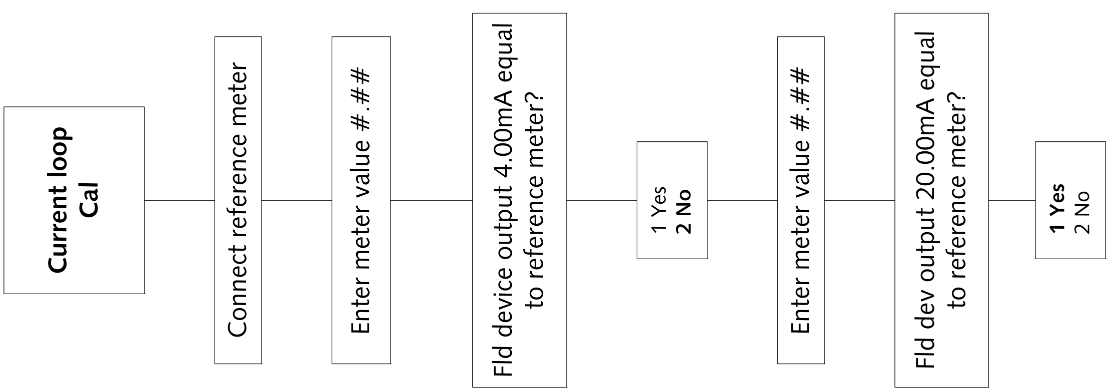


Figure 55: Current loop Cal

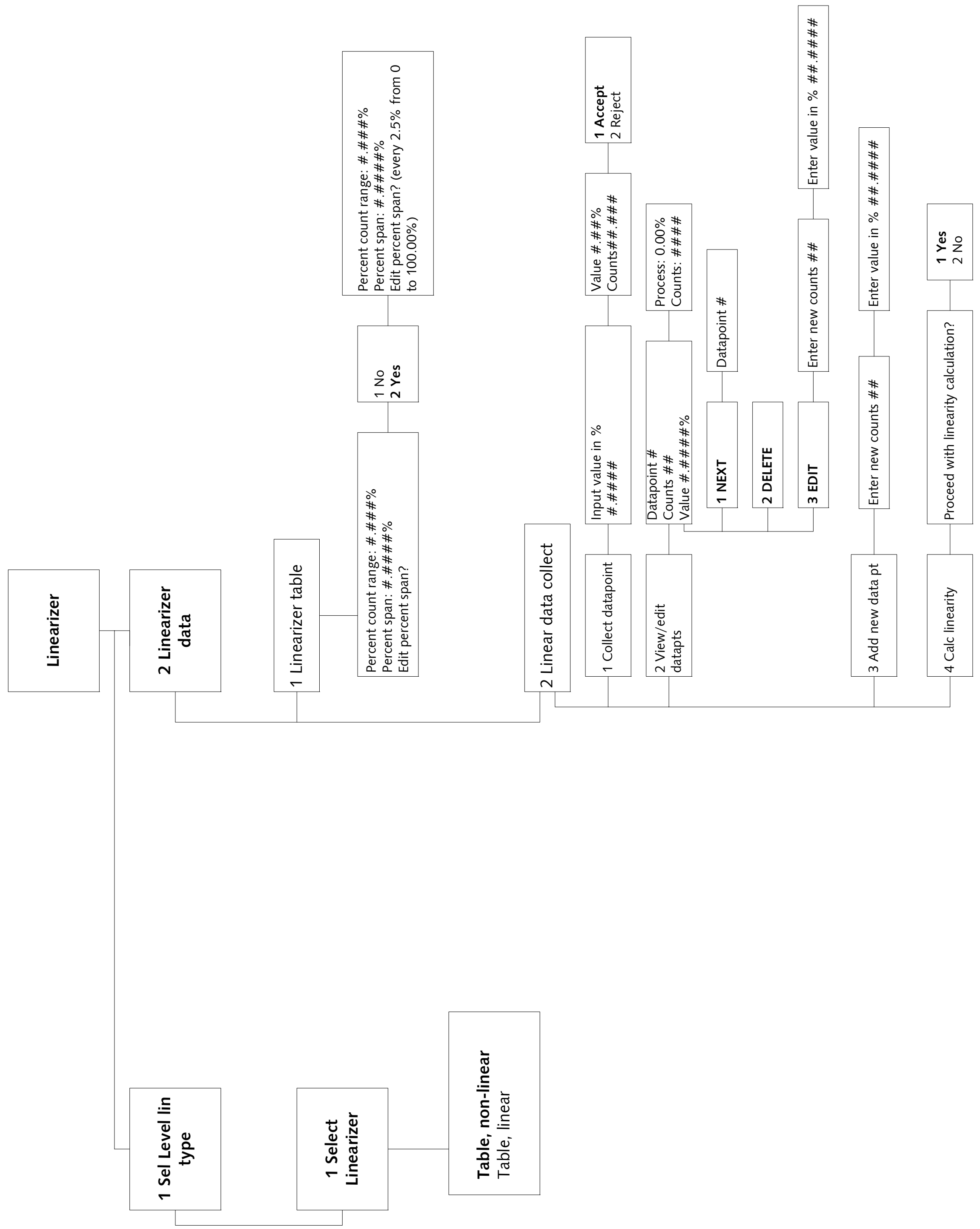


Figure 56: Linearizer

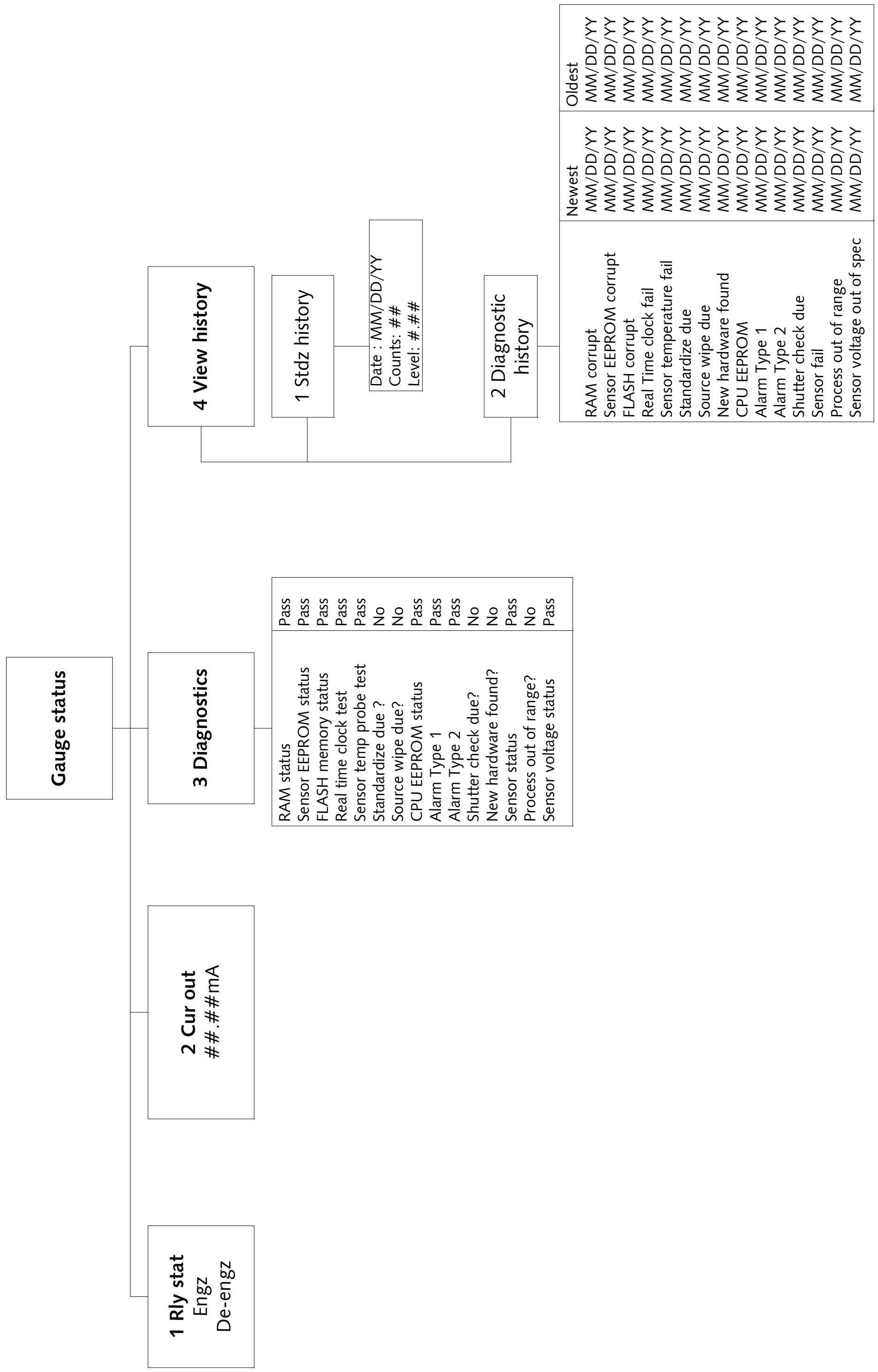


Figure 57: Gauge status

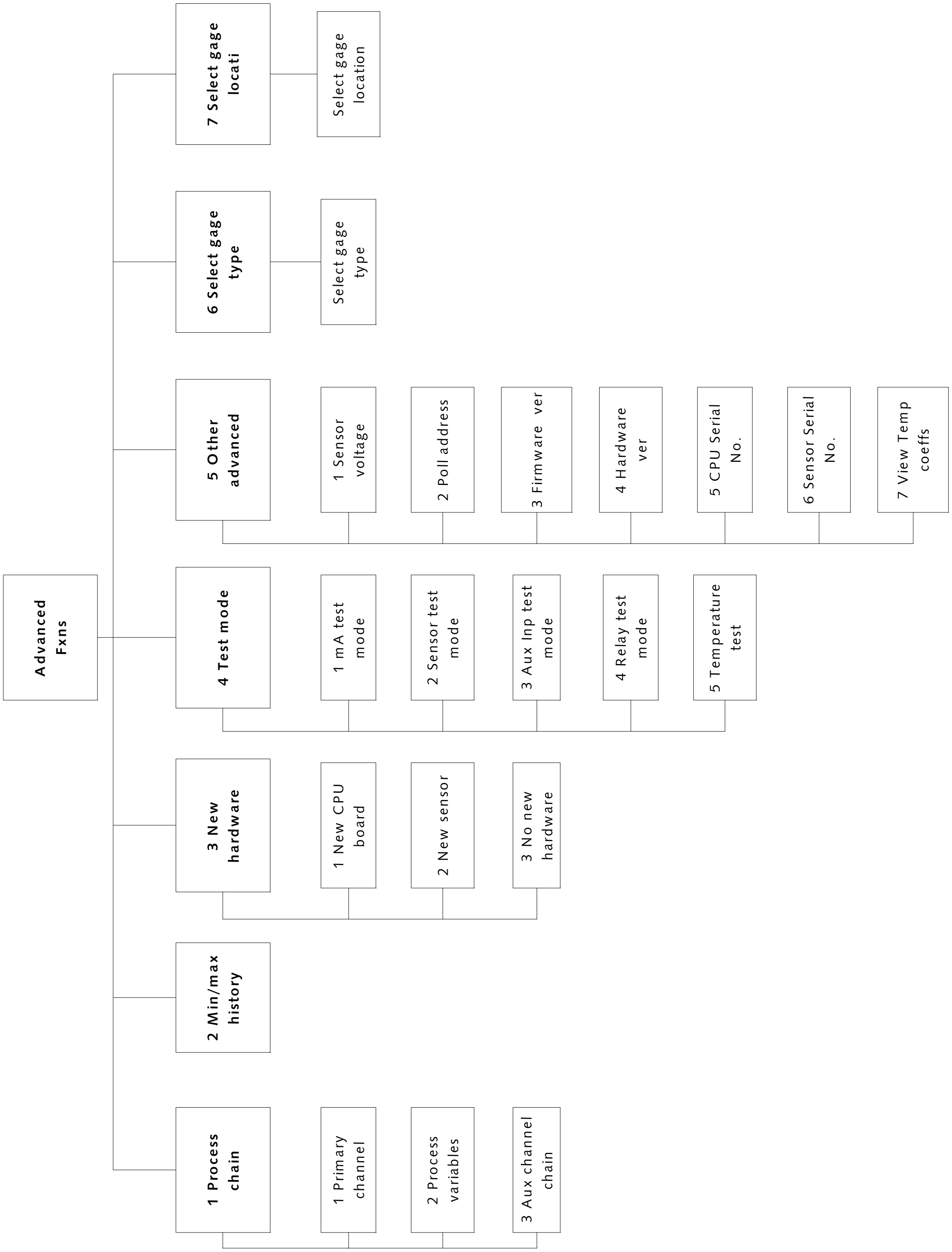


Figure 58: Advanced Fxns

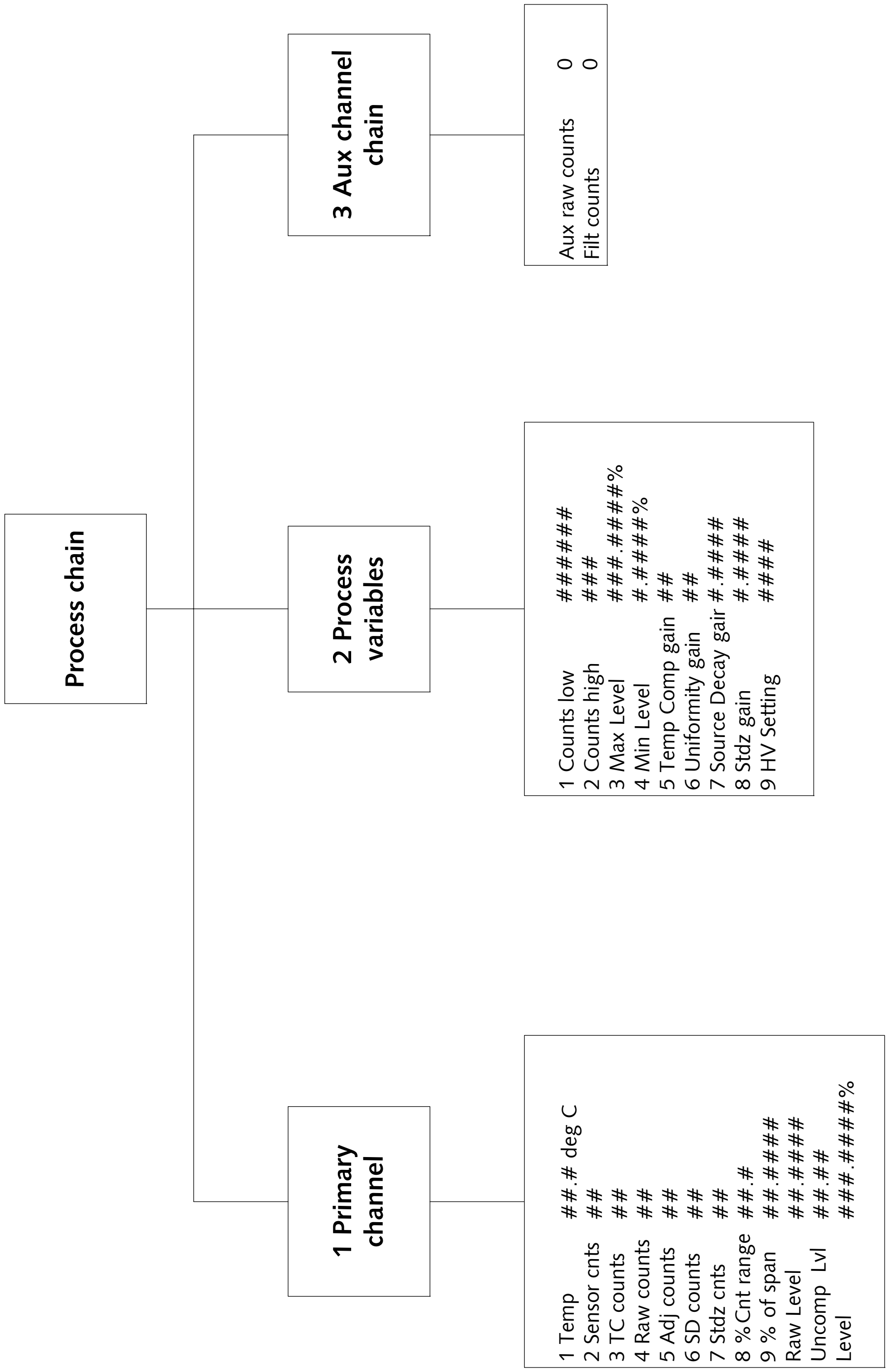


Figure 59: Process chain

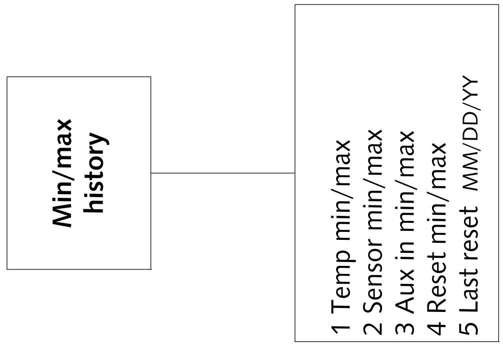


Figure 60: Min/max history

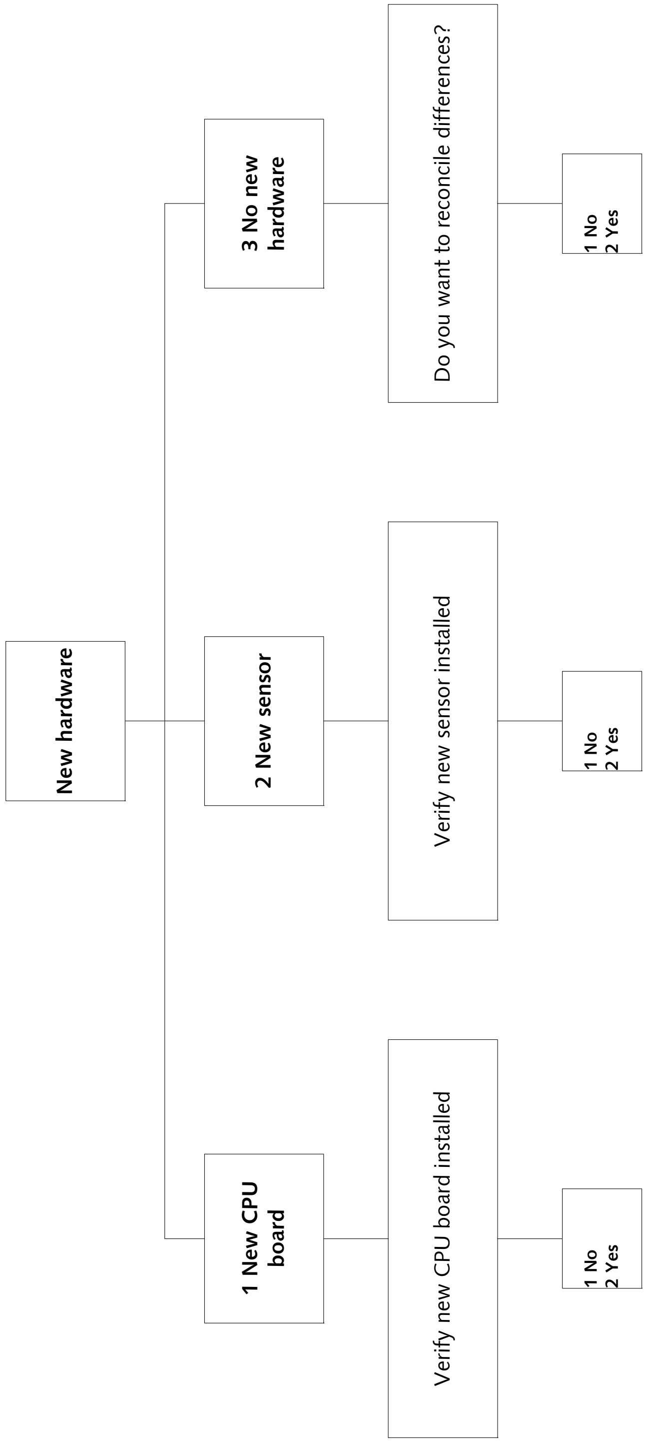


Figure 61: New hardware

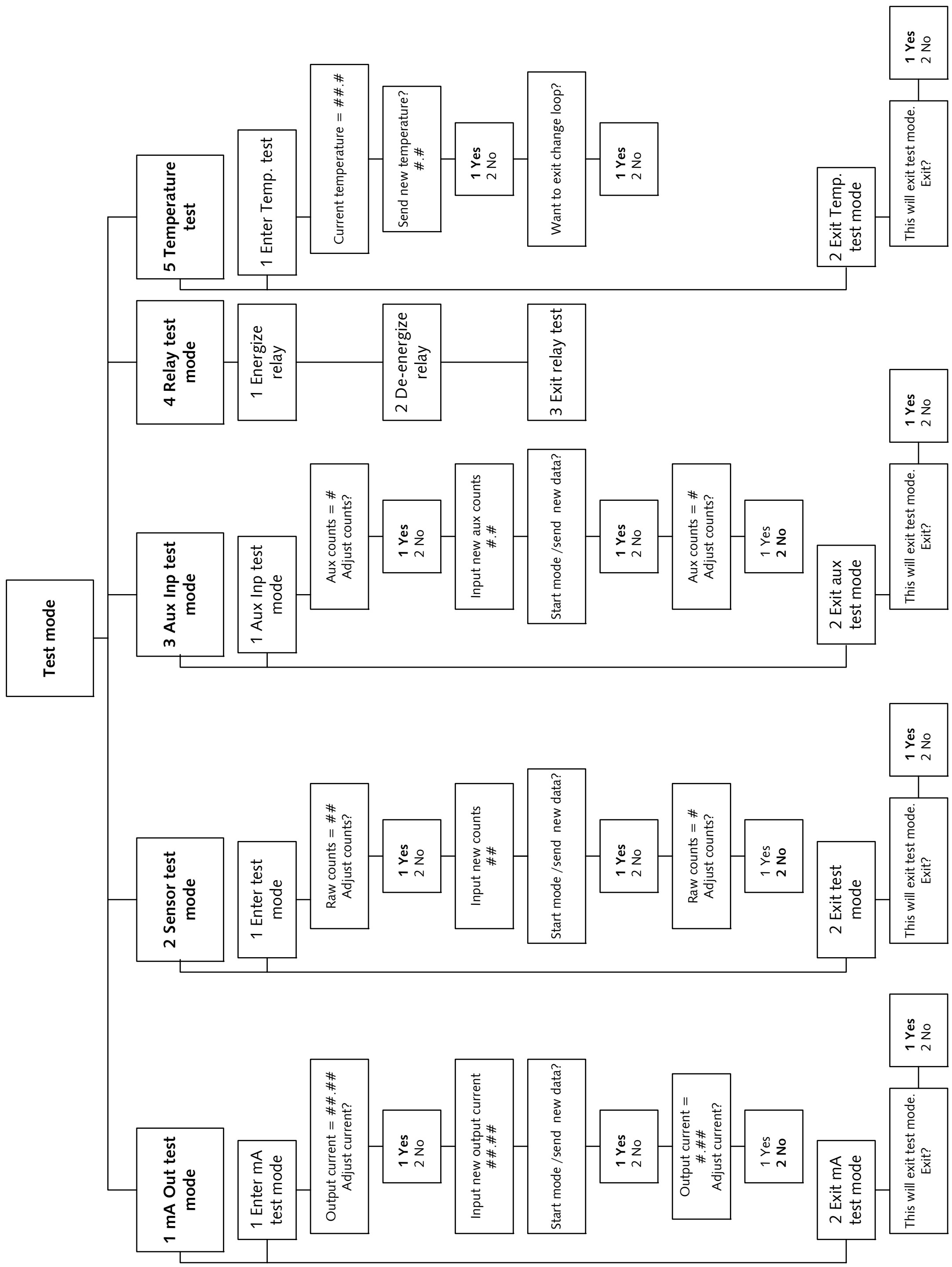


Figure 62: Test mode

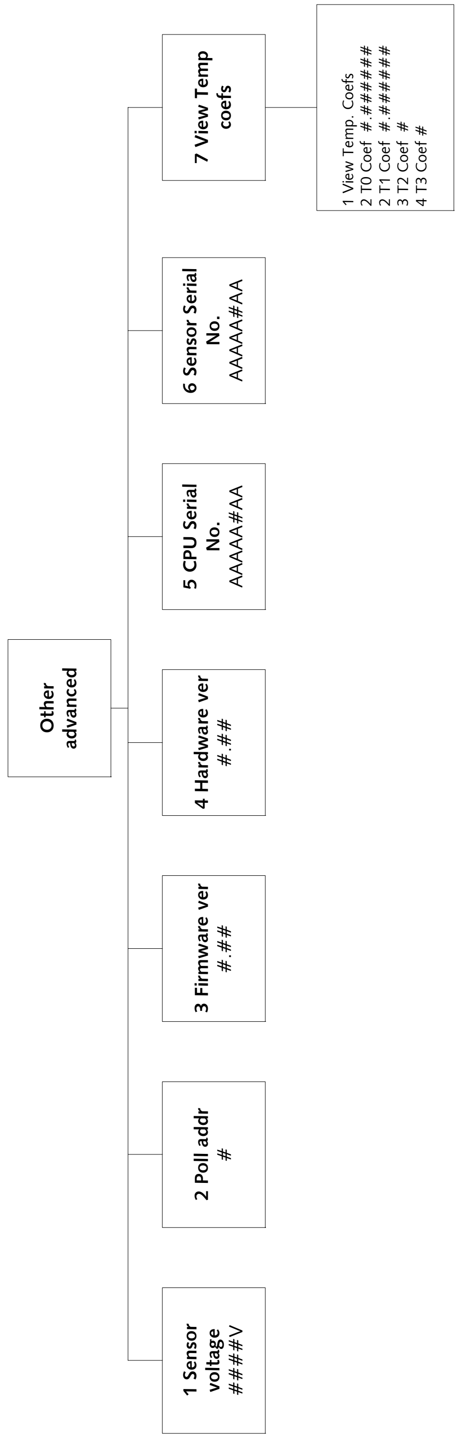


Figure 63: Other advanced

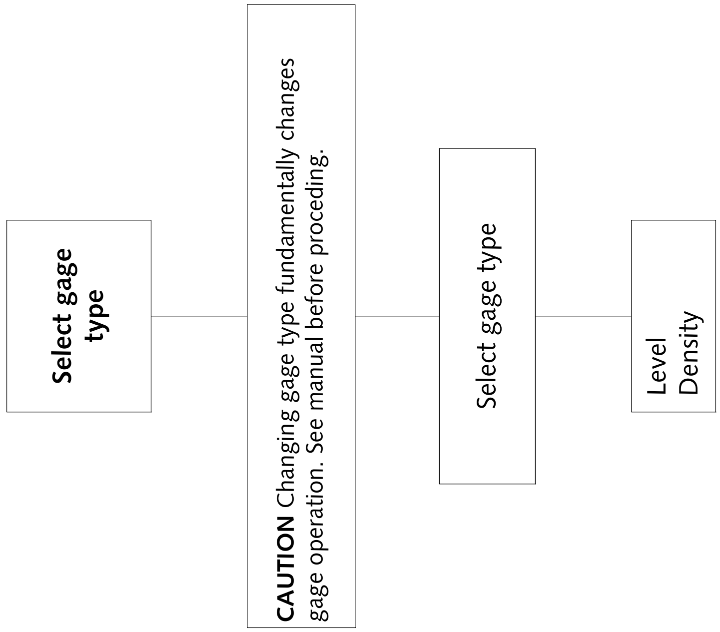


Figure 64: Select gage type

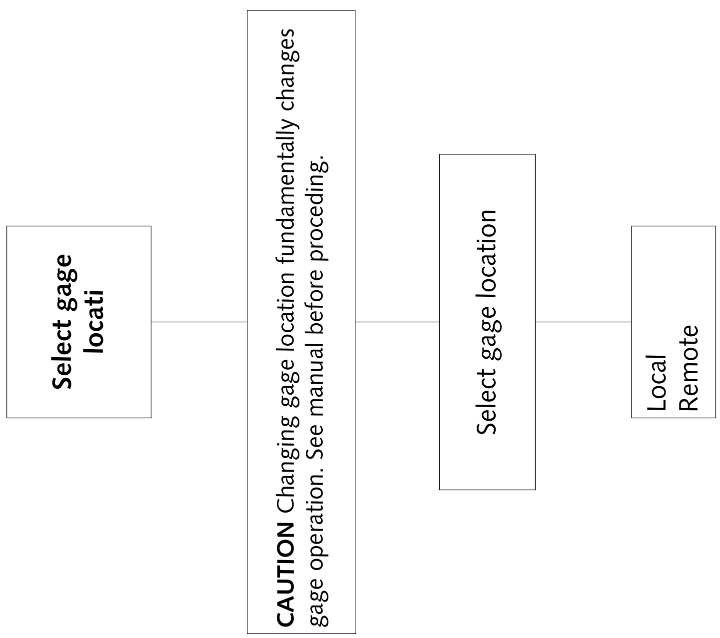


Figure 65: Select gage location

Notes

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