



■ Technical Reference MANUAL

DSTH for HART® Applications measuring density,
percent solids, percent solutions, mass flow,
presence/absence



DSTH Technical Reference Manual

*For HART® applications measuring density, percent solids,
percent solutions, mass flow, presence/absence*

Manual part number 31402-US

Version 1.1

Preface

Revision history

Table 1: Revision History

Version	Description	Date
1.0	Initial release. Formerly 237472.	051201
1.1	Corrected website address for Ohmart/VEGA Corrected copyright and registered marks	061211

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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 the equipment is not used 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.

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HART software screens

Figures 1 and 2 illustrate the Offline and Online HART communication screens. For a complete illustration of all HART hand-held communicator menus and screens, see Appendix V.

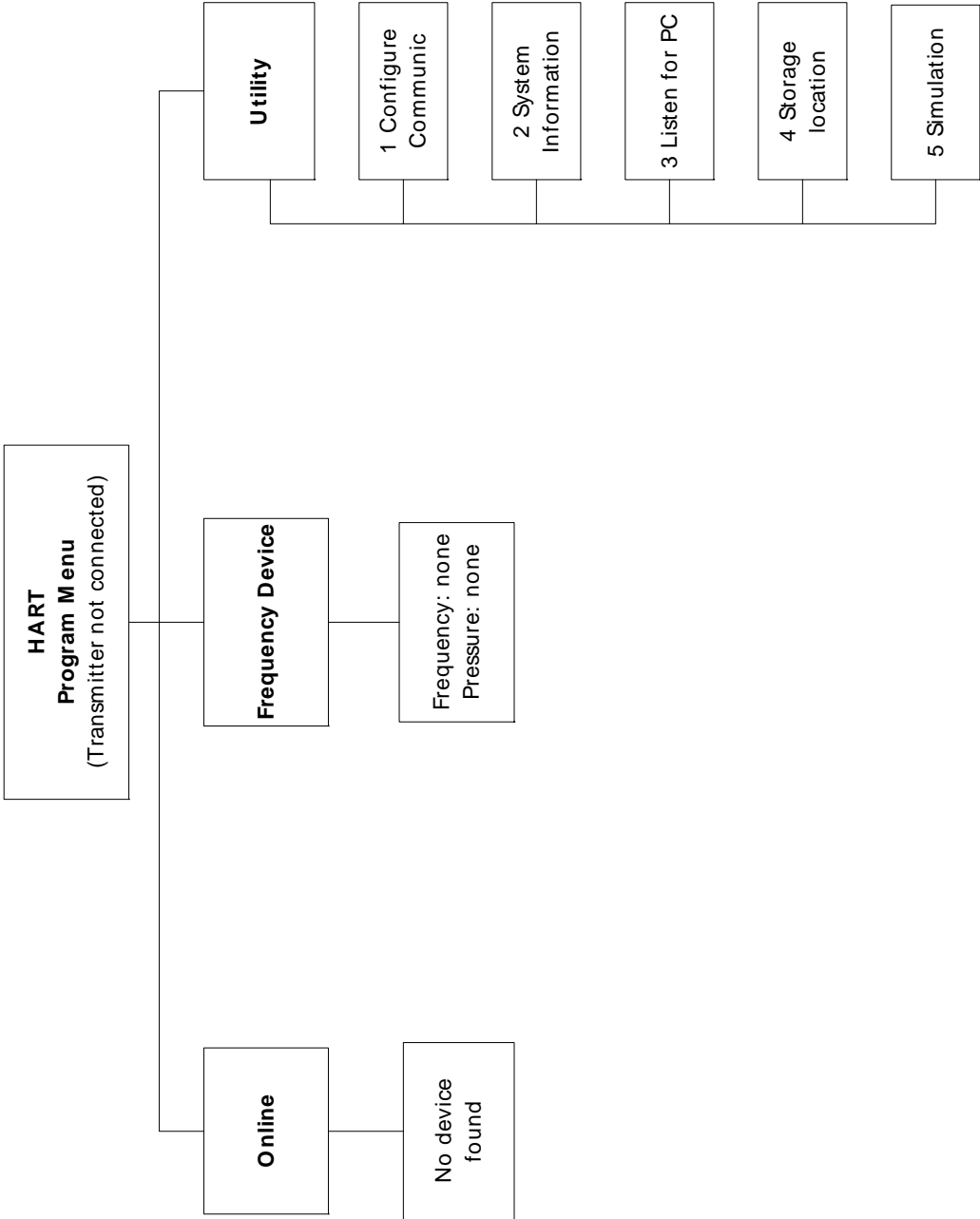


Figure 1: Online screen—gauge not connected

User's comments

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

Manual: DSTH 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

Preface

Notes

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 “*Reference Addendum*” CD. 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 and report 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.

Specifications

Table 3: Specifications list

System Accuracy	±1% of span typical	Accuracy depends on specific application parameters
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	90 to 270VAC at 50 to 60Hz, at 20VA maximum power consumption (30VA max with internal heater for low ambient temp) (100 to 230VAC for CE compliance)
	DC	10 to 30VDC (less than 100mV, 1 to 1000Hz ripple) at 10VA (24VDC for CE compliance)
	Wire size	14-22AWG (1.63–0.643mm)
Signal Cable	Maximum length	3280ft (1000 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, Div 1 & 2 Class II, Groups E, F & G, Div 1 & 2
	CENELEC Certification	EExd IIC T5, IP-66
	Temperature	–4 °F to 140 °F (–20 °C to 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	42lb. (19kg)
Current Loop Output	Paint	Epoxy powder coat
	Rating	4 to 20mA, isolated, into 250 to 1000ohm
Relay Output	Power	Jumper selectable source (active) or sink (passive) mode
	Software user settable function	Diagnostic alarm or process high or low alarm
HART Communication	Rating	10A at 240VAC (SPDT Form C)/8A at 24VDC; ¼ HP at 120VAC
	HART Protocol on current loop output	BEL202 FSK standard
	PC interface	HART modem and Ohmart communications software package
Auxiliary Input Capability	Optional hand-held interface	HART Communicator model 275 hand-held terminal with Ohmart device descriptions loaded
	Types	Frequency input (0 to 100kHz) Analog input
Electronics	Possible function	Optional temperature compensation, mass flow, and others
	On-board memory	FLASH and two EEPROMs
Diagnostics	Real-time clock	Maintains time, date, and source decay compensation. Year 2000 compliant
	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 107.

Typical applications

Density

The DSTH can measure the density (mass per volume) of liquids and slurries through a pipe or vessel wall without contact to the material.

Percent solids

The DSTH can measure the Percent of solids in a carrier, when the known density value of both the carrier and the solids is entered into the software.

Cut detection or interface detection

The DSTH can detect the interface between liquids flowing in a pipe, when the liquids differ in density.

Presence/absence detector

The DSTH can indicate the presence or absence of material on a conveyor. See “Appendix II: Special Applications” for further information.

Where to find help

If you need help finding information, check the Index and Table of Contents within this manual. In addition, the DSTH 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 the 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 4: 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 contact their local Ohmart representative for parts and service.

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

Introduction

- ☑ 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

System overview

The DSTH system consists of three main components:

1. Source holder
2. DSTH detector assembly
3. Communication device (HART modem with PC or HART Communicator model 275)

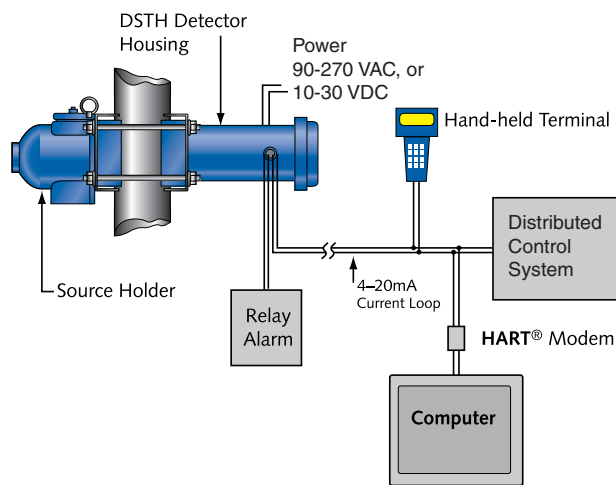


Figure 3: System overview

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 pipe or 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)

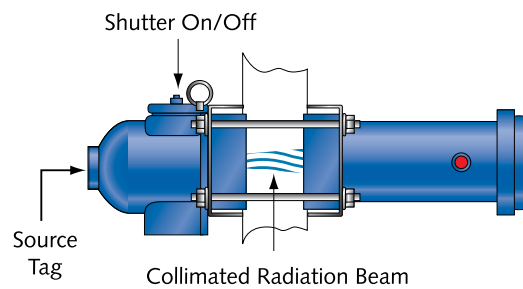
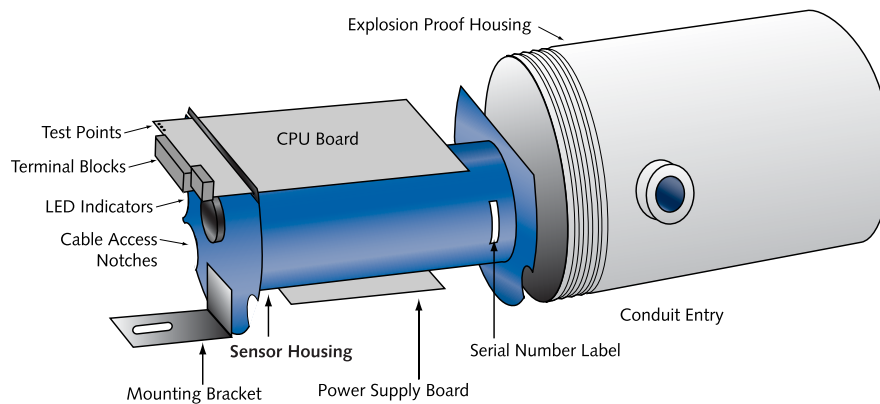


Figure 4: Typical source holder

The following statements describe the functions of the DSTH 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: DSTH exploded view*

Principle of operation

Ohmart's DSTH is a nuclear gauge that receives a narrow beam of radiation, through the process material, from the source holder. The amount of radiation that the detector senses is in proportion to the amount of the material's mass. Since the radiation source and detector are always the same distance apart and the volume of process liquid is constant, the only possible change in mass is the density of the process. The lighter the density of material; the more radiation passes through to the detector. The heavier the density of material; the less radiation passes through to the detector.

Calibration of the DSTH associates the detector readings, known as counts, with the density of the material in engineering units. The output range of the DSTH is a 4–20mA current loop signal, in proportion to the density of the process. See "Appendix I, Table 14" for examples of process value settings.

Communicating with the gauge

The Ohmart DSTH 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 DSTH, there are no requirements for external electronics in the day-to-day operation.

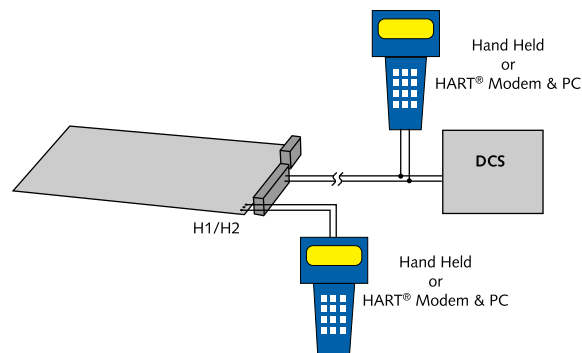


Figure 6: HART connections

Using a universal hand-held terminal

Ohmart's DSTH density gauge is 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 DSTH, you must use Ohmart's DSTH device description (DD) to program the HART communicator. You can purchase a universal hand-held terminal, programmed with the DSTH device, through Ohmart (Ohmart part number 236907).

Use firmware 2.02C when you use the hand-held HART communicator to make temperature and mass flow compensation. See Procedure 57, 58, and 59 for further information concerning temperature and mass flow compensation.

Using Ohmart View Software on a PC

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

- Modem
- Cables
- Software
- User 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

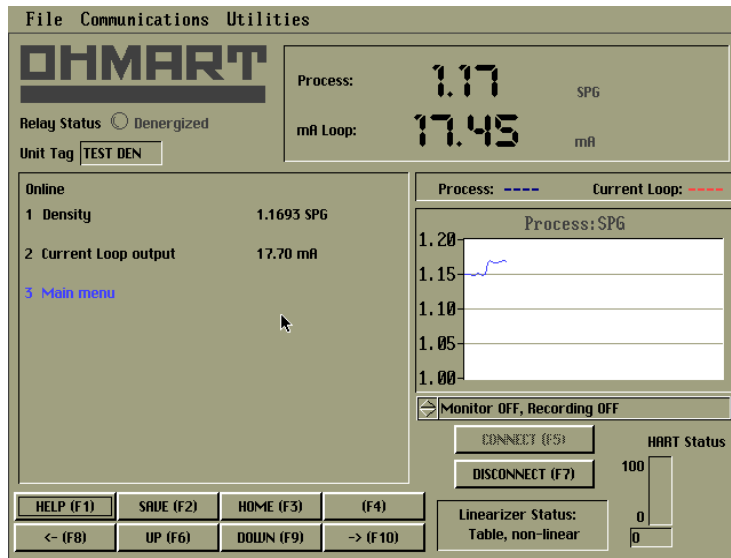


Figure 7: Ohmart View software

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 DSTH 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.

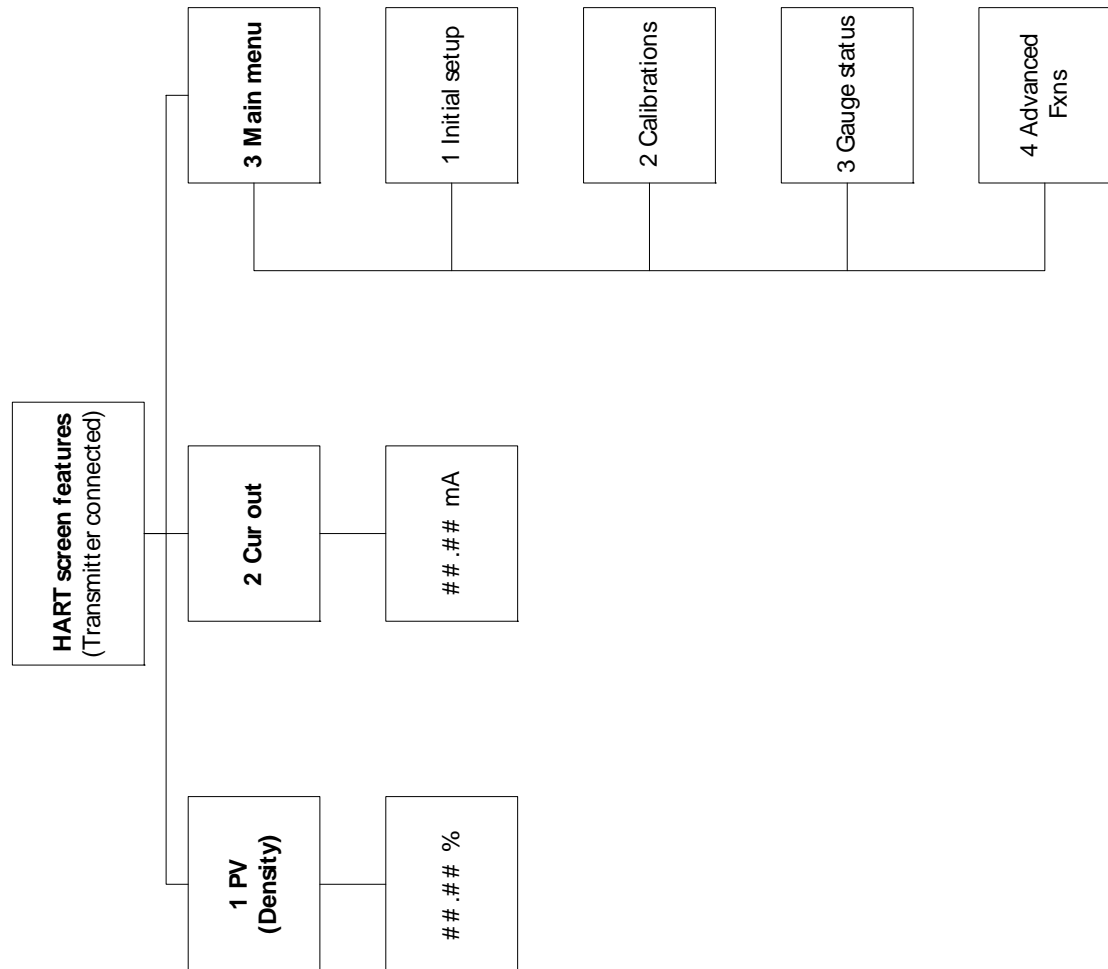


Figure 8: Online menu

For a detailed list of HART screens and sub-menus, see “Appendix V” 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

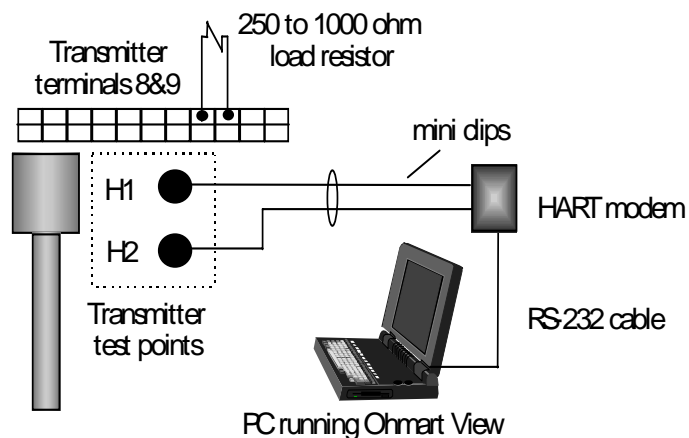


Figure 9: Bench test setup

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. Refer to Procedure 42 for instructions to set the time and date.

Many users choose to calibrate the current loop output on the bench before mounting the detector on the process. Refer to Procedure 1 for complete instructions on calibration of the current loop output.

Location considerations

When the DSTH was ordered, the source was sized 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 density 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. Refer to the *“Radiation Safety for U.S. General and Specific Licensees, Canadian, and International Users”* manual and *“Reference Addendum”* CD that came with the source holder and the appropriate current regulations for details.

Vertical pipe with upward flow

Mount the measuring assembly on a vertical pipe with upward flow of the process material. This position provides the best possible self-cleaning action, with a minimum possibility of gas or heavy solids collecting in the measuring section. You can mount the gauge on a horizontal pipe but a vertical flow is preferable. Keep the velocity above five feet per second to avoid build-up on the pipe walls and to keep the heavier solids in suspension. This is particularly true in sludge applications.

Pump considerations

Mounting the DSTH near a pump can be good or bad depending on the application. Check with Ohmart application engineers for a recommendation on your application.

No line hammering

The design of the DSTH requires operation in low-vibration conditions. Install it in a location with no line hammering or excessive vibration. Quickly changing flow conditions may cause line hammering. If necessary, you can physically mount the DSTH apart from the vessel or pipe, but notify Ohmart at the time of the order to ensure proper source size and shielding.

Stable temperature

Mount the DSTH on a portion of the line where the temperature of the process material is relatively stable. Process temperature change results in a density change that may affect the gauge indication. The amount of the effect depends upon the following:

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

Temperature compensation is available, but requires an Ohmart temperature probe in the process as an input to the DSTH.

No air entrainment

Mount the DSTH on a portion of the line where there is no possibility of air or gas entrainment and where the pipe is always full of process material.

Air or gas entrainment in the process, or a partially full pipe, results in an erroneous gauge indication because the density of the air measures along with the density of the process material.

Standardization considerations

The DSTH requires periodic standardization. Use process, absorber plates, or other easily repeatable reference fluid, such as water, for this standardization. You must be able to empty or fill the pipe with water if you plan to standardize with absorber plates or water. Often, you can purge the measuring section of a pipe by rerouting the process material through a bypass section.

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 the DSTH measurement includes the density of the liquid in the insulation.

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

You can mount the density gauge on the pipe by positioning the detector housing and source holder brackets with the bolts that Ohmart provides. If the pipe has insulation, the DSTH and source holder should have external support to prevent crushing of the insulation.



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

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.

Installation

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 Table 5: Terminal names and descriptions.

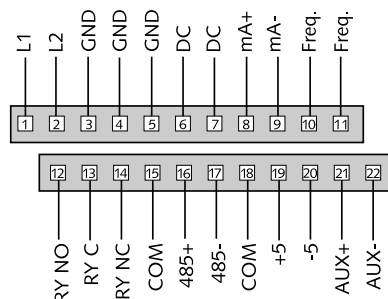


Figure 10: Interconnect

Table 5: 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 auxiliary input circuit board
19	+5	auxiliary input power—used only with auxiliary input circuit board
20	-5	auxiliary input power—used only with auxiliary 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 8VA maximum power consumption. Do not share AC power with transient producing loads.

The DC power source voltage input is 10–30VDC (less than 100mV, 1–1000Hz ripple) at 8VA maximum power consumption. The DC power cable can be part of a single cable 4-wire hookup, or it can be separate from the output signal cable. See the “Output Current Loop” section.

Note: The DSTH can accept either AC or DC input power, but not both at the same time.

Use wire between #14 –#22AWG (1.63 to 0.643mm) for power wiring.

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 DSTH. A minimum requirement is a 250 Ω load-resistance on the current loop. The hand-held terminal is Rosemount model 275 or equivalent (Ohmart number 236907).

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

Process alarm override switch

If the output relay is set as a process alarm relay (high or low-density 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 density 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 tasks to the source holder:

- 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 Ohmart certified drawings.
- Allow 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 DSTH 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 DSTH due to incorrect wiring not checked by the Ohmart Field Service Engineer.

- 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. A density change of at least 0.1SpG is a common requirement.
- When possible, have the material that you use for periodic re-standardization of the gauge available. Frequently this is water.

Installation

- ☑ If you cannot meet any of these process conditions, you can still calibrate the gauge, however, it is not as accurate
- ☑ 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

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

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

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 loop 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 density 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**.

Use the **View settings** function, from the **Initial setup** menu to quickly check the span settings.

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.

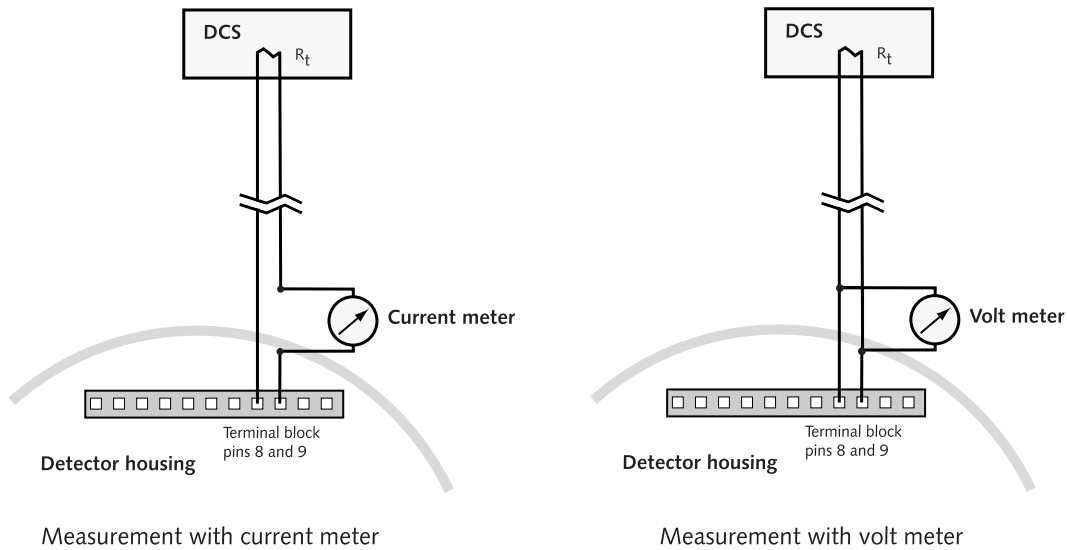


Figure 11: Measuring the current loop output

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 250–1,000 Ω 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

Current loop calibration

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.

Initial process calibration

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

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

You do not need to repeat the initial 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.

Preparing for initial calibration

Figure 12 illustrates the steps to prepare for and perform the recommended two-point calibration.

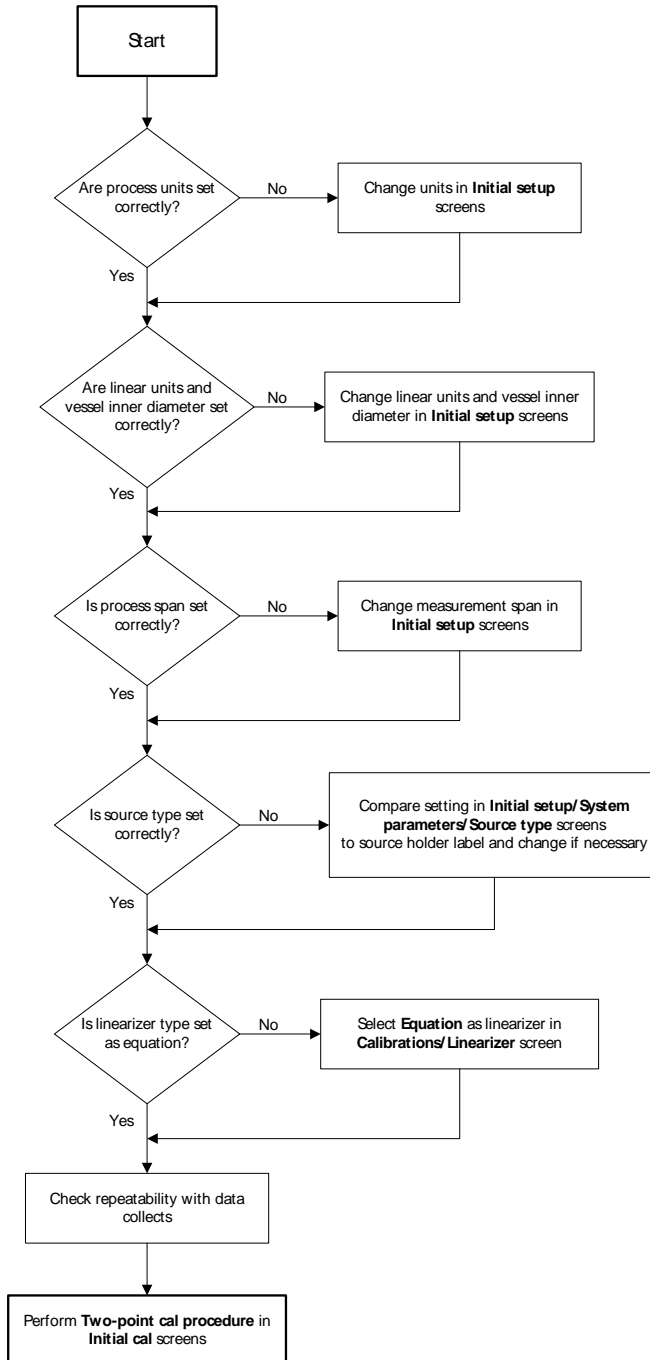


Figure 12: Density two-point calibration flow chart

Table 6: Flowchart steps and manual heading

Step in flow chart	Manual heading	Page
Check process engineering units	Units	72
Check linear units and vessel inner diameter	System parameters, linear units, and vessel inner diameter	80
Check process span	Span settings and process span	78
Check linearizer type	Choosing the linearizer type	25
Check the repeatability of measurement	Checking the gauge repeatability	26
Performing two-point calibration	Recommended two-point process calibration	29

Choosing the linearizer type

The DSTH calibration curve is non-linear, due to the measurement method of radiation transmission. A linearizer determines the shape of the curve between the endpoints. Linearization is critical for pipes that are larger than 12 inches.

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

- Non-linear table
- Linear table
- Equation

Note: Use the equation linearizer method to perform the one-point calibration method.

For density applications, the equation is the default, and we recommend it in most circumstances. Ohmart recommends using the equation linearizer method first. If results are not satisfactory, contact Ohmart Field Service at 513-272-0131.

The vast majority of applications do not require any method other than equation. Refer to "Appendix IV" of this manual for further explanation of the different methods.

Equation

The linearizer equation calculates a density reading for a given count reading at the detector. To make the correct calculation, it relies on the following information:

- Vessel's inner diameter system parameter (see page 81)
- Span settings parameter (see page 78)
- Data used in the initial calibration

Using the equation linearizer also enables a one or two-point initial calibration procedure.

Table, non-linear

Refer to Appendix IV for more information.

Table, linear

Refer to Appendix IV for more information.

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 current linearizer displays on the second line
6. From the **Select linearizer** screen, select either:
 - **Table, non-linear**
 - **Table, linear**
 - **Equation**
7. Press F4 to enter.

Note that Ohmart recommends **Equation** for most applications.

Checking the gauge repeatability

Check the DSTH 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 sample 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 75.

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 if it is necessary to discontinue data collection
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 to check repeatability.

One-point process calibration

The recommended initial calibration of a DSTH is a two-point calibration. The one-point calibration measures one process sample. The sample must be within the span set in the **Initial setup, Process parameters, Spans** screens.

The one-point calibration method is available only when you choose equation as the linearizer type.

Performing a one-point calibration requires measurement with the DSTH of a process sample and entry of the actual density.

Note: When performing calibration or any other procedure that affects the output of the gauge, be sure to disable the gauge from your DCS.

Note: The accuracy of the calibration depends on the accuracy of the sample. Obtain an accurate reading, from a lab, of the sample read by the DSTH.

Before starting the one-point calibration data collection:

- ☑ Check the parameters as described in the manual section, "Preparing for Initial Calibration" beginning on page 24
- ☑ Power up gauge one hour before start of calibration
- ☑ Fill vessel or pipe with process
- ☑ Prepare to draw a sample while the gauge is collecting data

Performing a one-point calibration

Procedure 4: Calibrating on one point

1. From the **Main menu**, select **Calibrations**
2. From the **Calibrations** menu, select **Initial cal**
3. From the **Initial cal** menu, choose **Select cal type**
4. From the **Select cal type** menu, select **One point cal**
5. At the prompt, Set Process to Desired Value. Take data?, select **Yes** to start data collection. The on-screen counter displays the time left. If necessary, press F3 to stop data collection
6. After data collection, the screen prompts you to input the actual value. The actual value is the value, in engineering units, from the lab
7. Take the sample drawn during the data collect to the lab to determine the actual density
8. If you are able to keep the HART device connected to the DSTH while you obtain the lab value, keep the **Input actual value** screen up. Do NOT press F3 to abort. Skip the next step in this procedure
9. If you must disconnect the HART device while you obtain the lab value, press F3 to abort now. The software saves the counts value from the DSTH data collect, but does not calculate a calibration until you return to the Input actual value screen and enter the actual value
10. When you reconnect, return to the **Input actual value** screen by progressing through the **Initial cal**, **Select cal type**, **One point cal** menus. The prompt, Set Process to Desired Value. Take Data? displays. Select **No** to prevent a new data collect. The **Input actual value** screen displays indicating the counts from the one-point cal data collect
11. At the prompt, Input Actual Value, enter the actual density from the lab in engineering units
 - At the prompt, Edit Counts?, you can manually edit either the counts or the lab actual value, if necessary, by selecting **Yes**
12. If using a hand-held Communicator, press F2 to send the calibration setting to the DSTH.

After performing the one-point calibration procedure, the calibration is complete. If after using the gauge for some time you think the calibration is incorrect, you may wish to use the optional two-point calibration procedure.

Recommended two-point calibration

In most installations, it is desirable to attain the high and low-process conditions for a two-point calibration instead of performing a one-point calibration.

The two-point calibration method is useful in conjunction with any linearizer method.

The two-point calibration method involves three main steps:

1. Setting the low density
2. Setting the high density
3. Calculating the calibration

Step 1: Set low density

Setting the low density for calibration requires the following:

- Measurement with the DSTH of the low process sample
- Entry of the actual density.

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 density, but only after you correctly enter the process span in the **Initial setup** screen.

Note: You must perform data collection for the low and high density within ten days of each other for a good calibration. The low and high values must be more than 10% 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:

- Check the parameters as described in the manual section, "Preparing for Initial Calibration" beginning on page 24
- Power up gauge one hour before start of calibration
- Fill vessel or pipe with low process
- Prepare to draw a sample while the gauge is collecting data

Setting the cal low density

Procedure 5: 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 density**
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 data collection, the screen prompts you to input the actual value
 - Actual value is the value, in engineering units, from the lab
 - At this step, you can skip to the Cal high-density procedure to perform the data collect for the high-density sample. Then come back to step 6 to enter the actual values
 - Take the sample drawn during the data collect to the lab to determine the actual density
7. At the prompt, Input Actual Value, enter the actual density, from the lab, in engineering units
8. If using a hand-held communicator, press F2 to send the calibration setting to the DSTH.

Step 2: Set high density

Setting the high density for calibration requires the following:

- Measurement with the DSTH of the high process sample
- Entry of the actual density

This sets the gain of the calibration curve. Perform this procedure either before or after setting the low density, but only after you correctly enter the process span in the **Initial setup** screen.

Note: You must perform data collection for the low and high density within ten days of each other for a good calibration. The low and high values must be more than 10% 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
- Prepare to draw a sample while the gauge collects data

Setting the cal high density

Procedure 6: Setting the cal high 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 high densi**
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. The actual value is the value, from the lab, in engineering units

Note

Has data collect for the low-density sample been performed yet? If not, do so now. Then return to step 2 to enter actual values. See the “Cal Low-Density” procedure.

7. Take the sample drawn during the data collect to the lab to determine the actual density
8. The prompt, Input Actual Value, displays. Enter the actual density, from the lab, in engineering units
9. If using a hand-held communicator, press F2 to send the calibration setting to the DSTH.

Step 3: Calculate calibration

The DSTH can make the calibration calculation after collection of the high and low-density calibration data.

Note: If you choose to use the non-linear table linearizer and collect data on process for a linearizer, you must perform those steps first. See the sections, “Collecting Linearizer Table Look Up Data” and “Calculating a Linearizer Curve” in Appendix IV.

Calculating the calibration result

Procedure 7: 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 collect actual or new data can 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 initial calibration may be necessary

Under most circumstances, you do not need to repeat the initial 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 with the DSTH
- Moving the DSTH to another location (in U.S. only persons with a specific license can relocate the gauge)
- Changes to pipe size, schedule, or any other change in process piping
- Excessive build up or erosion of pipe 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 sample.

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

Automatic standardization reminder

If you enable the standardization due alarm, the DSTH alarms when a 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

Choosing a standardization method

You can perform a standardization using any of the following:

- Process
- Water (or other repeatable fluid)
- Absorber plates

During the standardization procedure, the system displays one of the following:

- Default value for the standardization material
- Prompt to enter the actual value of the standardization material

See “Appendix I: Initial Factory Setup” for details on how to set up the software for either prompt.

The choice of the standardization method depends on several factors. This section includes an explanation of the advantages and disadvantages for each method.

Standardization on water

Standardization on water may be the best choice if water is readily obtainable. For example, if the process is water based or if the process is slurry with water as the carrier.

Advantages: If the source of water is of consistent purity (for example, city vs. pond), standardization on water is highly accurate. Water is an especially good choice if the density of the process is around 1.0 SpG, because standardization on water would be within the process span. This ensures high accuracy at that point on the calibration curve.

Disadvantages: You must be able to empty and fill the process pipe with a consistent source of water.

Procedure 8: Standardization on water

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 **Process Std config**
5. From the **Process Std config** menu, select **Process Stdz Type**
6. On the **Process Stdz Type** screen, choose **Use Default value**
7. Enter the value. Now the value of the water always appears as the actual value of the sample during the standardization procedure. Press F4 to enter
8. Press F2 to send.

Standardization on process

Calibration

Measure process in the pipe with the DSTH, and enter its lab-measured density into the software to perform the Standardization on process.

Advantages: Standardization on process is the easiest method. It ensures the DSTH reads what the lab reads at that density.

Disadvantages: It is not the most accurate or repeatable method. In addition, it relies on the laboratory for results.

Procedure 9: Standardization on process

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 **Process Std config**
5. From the **Process Std config** menu, select **Process Stdz Type**
6. On the **Process Stdz Type** screen, choose the **Use Lab Sample value** option
7. Enter the value of the sample and press F4 to enter
8. Press F2 to send.

Standardization on absorber plates

The features of the absorber plates are:

- Plates are usually made of lead
- Plates insert into slots in front of the DSTH detector for the standardization procedure.
- You can purchase absorber plates from Ohmart
- The use of absorber plates requires a mounting kit from Ohmart. This kit is usually specified at the time of the order, however, it can retrofit to existing equipment
- You must always use the same plates to ensure a consistent absorption of radiation. This is a substitute for the radiation absorption of the material in the pipe
- The use of absorber plates requires emptying the pipe of process and access to the measuring assembly

Note: You cannot use absorber plates for the initial calibration. You must determine the equivalent value of the absorber plates after the initial calibration of the DSTH with the gauge mounted on the pipe.

Advantages: Absorber plates provide the greatest long-term repeatability and precision, in comparison to the other standardization methods.

Disadvantages: Emptying the process from the pipe or vessel is not always possible. You must have physical access to the measuring assembly and must use the same plates repeatedly.

Procedure 10: Standardization on absorber plates

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 **Process Std config**
5. From the **Process Std config** menu, select **Process Stdz Type**
6. On the **Process Stdz Type** screen, choose **Use Default value**
7. Enter the value of the absorber and press F4. Then, the value of the absorber plates always appears as the actual value of the sample during the standardization procedure
8. Press F2 to send.

Performing a standardization

Before performing a standardization:

- Have the standardization material of known density ready to measure. See “Choosing a Standardization Method” for guidelines on the appropriate choice
- Prepare to draw a sample while the gauge is collecting data

Standardizing the gauge

Procedure 11: 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 pipe to continue the standardization procedure. The timer counts down while it collects 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 standardization material. The prompt asks, Edit Counts? Select **No** to continue or **Yes** to input the average counts

Calibration

5. Press F2 to send.

Chapter 4: Advanced functions

Functions that are not required for normal operation of the transmitter are grouped 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 users seek 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 density measurement from a radiation reading. In the **Process chain** screen a user can view intermediate values of the calculation to verify proper functionality of the software. Press the hot spot key (>>>) on the communicator to display the **Primary channel** screen.

Primary channel

The display values for the **Primary channel** screen are:

Temp

Displays the internal probe's measurement of the sensor temperature.

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 Density and Cal High Density

$C_L - C_H$ = counts range

% of span

The percent process span indicates the measurement value as a percent of the measurement span. The maximum and minimum density 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.

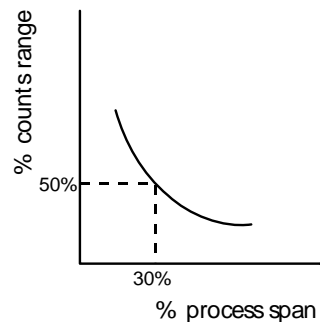


Figure 13: Percent counts range vs. percent process span

Raw Dnsity

Displays the raw density that is the calculated density in SpG (specific gravity units), unfiltered by time constant or rectangular window filter.

Uncomp Den

Displays the uncompensated density that is the density of the process before any process compensation. An example of this is the value of the process density before temperature or mass-flow compensation.

PV

Displays the process value that is the density 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 Density. Determination of the Cal low density occurs during the initial calibration procedure.

Counts high

Displays the temperature and sensor uniformity gain compensated counts from the sensor at the Cal High Density. Determination of the Cal High Density occurs during the initial calibration procedure.

Max Density

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

Min Density

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

Temp comp gain

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

Uniformity gain

Displays the current value of the uniformity gain. Use this to force all DSTH sensors to output the same counts at a given radiation field.

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

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

Auxiliary channel

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

Aux raw counts

Displays the frequency-input counts from optional auxiliary input.

Filt 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 values displayed are:

Temp min/max

Displays the internal temperature of the scintillator sensor. This does not apply to ion chamber detectors.

Sensor min/max

Displays raw uncompensated counts from the detector.

Aux in min/max

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 12: 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

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.

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.

If a new CPU board has been installed

Procedure 13: 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
5. Press F2 to save.

If a new sensor assembly has been installed

Procedure 14: 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
5. Press F2 to save.

Proper response to “New hardware found” message if new hardware HAS NOT been installed and a CPU EEPROM Corrupt message, or Sensor EEPROM Corrupt message displays

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.



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 15: 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?, displays. Select **Yes** to allow restoration from backups on the EEPROMs or select **No** to cancel
5. Press F2 to save.

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. Enable the test modes 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? appears, select **Yes** to ignore the Status Error.

Start milliamp output test mode

Procedure 16: 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 17: 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 using 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 18: 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. When prompted, 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 19: 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 can 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 20: 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
8. 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 21: 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.

To start Relay test mode

Procedure 22: 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 **Energize relay** or **De-energize relay**
5. The transmitter continues functioning in Relay test mode until it times out after one hour, or until you choose **Exit relay test**.

To exit Relay test mode

Procedure 23: 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 allows the user to manually force the sensor temperature probe output to a specified value. This is useful for verifying the scintillator sensor temperature compensation.

Start temperature test mode

Procedure 24: 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. When prompted, enter the value of the new temperature you wish to force
6. 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 25: 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 is installed on the DSTH
- Hardware version number
- Equipment serial numbers
- Temperature coefficients.

Sensor voltage

Displays the sensor voltage.

Poll address

This function 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

Displays the firmware version number.

Hardware version

Displays the hardware version number.

CPU Serial Number

Displays the CPU serial number.

Sensor Serial Number

Displays the sensor serial number.

View temperature coefficients

The temperature coefficients are used in an algorithm that compensates for variations in measurement output with changes in temperature. The Ohmart factory determines the coefficients through rigorous testing. You cannot change these values through normal operation.

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

Procedure 26: 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 gage type

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

Procedure 27: 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 **Density**
4. If using a HART hand-held communication device, press F2 to send.

Select gage 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.

Procedure 28: Select gage location

1. From the **Main menu**, select **Advanced Fxns**

Advanced functions

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 DSTH system can alert users to potential problems by:

- Posting messages on the HART screens
- Energizing the output relay
- Distinctly changing the current loop output

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 DSTH 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

Allows the relay output to trip when the process value 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 7: 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: See “Appendix I: Initial Factory Setup” for details on setting up the alarm functions.

Gauge status

Use the **Gauge Status** screens under the **Main** menu to check the present 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 53 for a summary of all of the diagnostic alarm conditions and recommended user 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 present status. View the historical occurrences 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 29: 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 selecting **Continue**
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. 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 DSTH, any conditions in alarm display on the screen.

Summary of diagnostic alarm conditions

Table 8: Summary table of diagnostic alarm conditions

Diagnostic check on Gauge status screen	Normal /Error conditions	HART message	Alarm acknowledgment / Recommended action
RAM status	Pass / Fail	RAM corrupt	RAM memory corruption has occurred and resolved internally. Repeated triggering of this alarm indicates a possible hardware problem—consult Ohmart Field Service.
Sensor EEPROM status	Pass / Fail	Sensor EEPROM corrupt	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 42.
Real time clock test	Pass / Fail	Real time clock fail	The clock has failed which may result in miscalculation of timed events. (If there has not been any power to the DSTH 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	Pass / Fail	Sensor temp probe fail	The sensor temperature probe may not be functioning, which results in erroneous measurements. Verify by checking the sensor temperature in the Primary channel screen from the Advanced Fxns, Process chain menus. If the temperature reads -0.5 C constantly, the probe is broken and you may need to replace the

Diagnostic check on Gauge status screen	Normal /Error conditions	HART message	Alarm acknowledgment / Recommended action
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 in the Process Stdz screen from the Calibrations menu.
Source wipe due?	No / Yes	Source wipe due	A source wipe is due. Alarm acknowledges by logging a shutter check in the Source function screen, from the Initial setup, System parameters menus. See page 63 for details.
CPU EEPROM status	Pass / Fail	CPU EEPROM corrupt	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. If alarm occurs again, it indicates a hardware problem. Perform the procedure, "Repairing corrupted EEPROM" on page 42.
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	Source holder shutter check is due. Acknowledge the alarm by logging a shutter check in the Source function screen from the Initial setup, System parameters menus. See page 63 for details.
New hardware found?	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 41 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 density and Min density in the gauge span settings.
Sensor voltage status	Pass / Fail	Sensor high voltage fail	High voltage on the PMT is outside 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 threshold (set by Ohmart), 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 59 for a diagram of the electrical connections on the connector

Process alarm

The process alarm alerts users when the process value (density) 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 DSTH 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 DSTH 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 DSTH 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 14 illustrates the current loop output. You can set the parameters of the output. Refer to “Appendix I: Initial Factory Setup”.

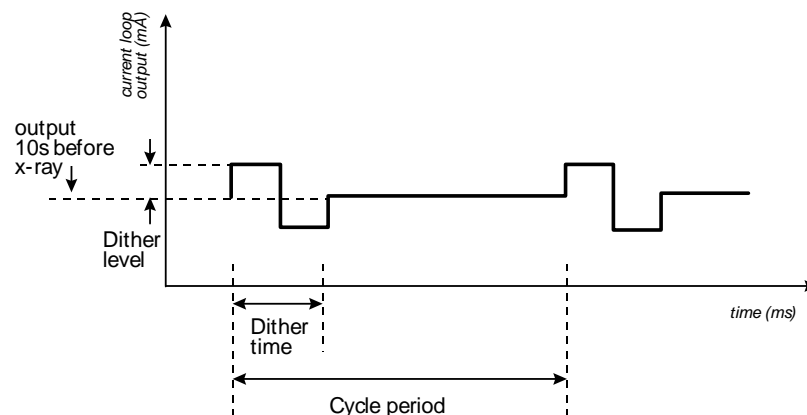


Figure 14: X-ray interference alarm output

History information

Diagnostics and Repair

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

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

Test points

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

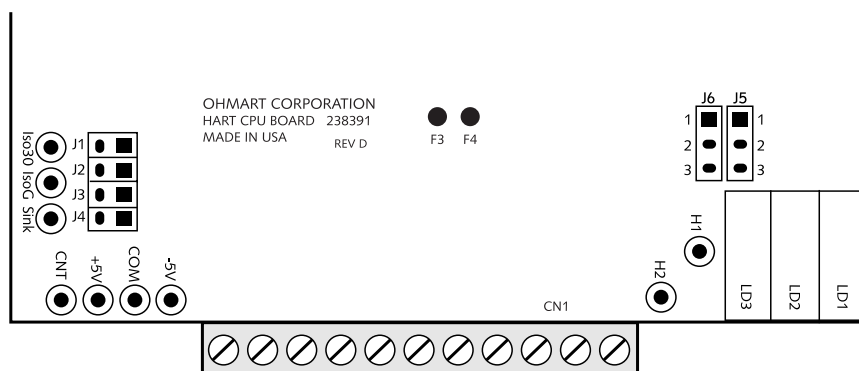


Figure 15: Test points and jumpers

Table 9: 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 DSTH 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 10: Jumper settings

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

LED indicators

Check the basic functioning of the DSTH 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 58 for a summary of the LED indications.

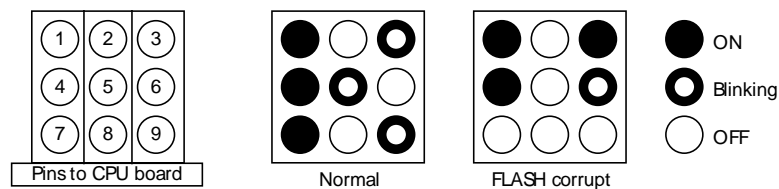


Figure 16: LED indicators

FLASH corrupt LED pattern

The FLASH chip stores the device description (DD) 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.

Diagnostics and Repair

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 11: 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 1 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 and 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 (2580nC/kg/hr) field is usually required for a measurement. Check for closed source shutter, buildup, insulation.

Troubleshooting

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

- HART communication problems
- DSTH transmitter not responding

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 diagram to track the power distribution on the DSTH system.

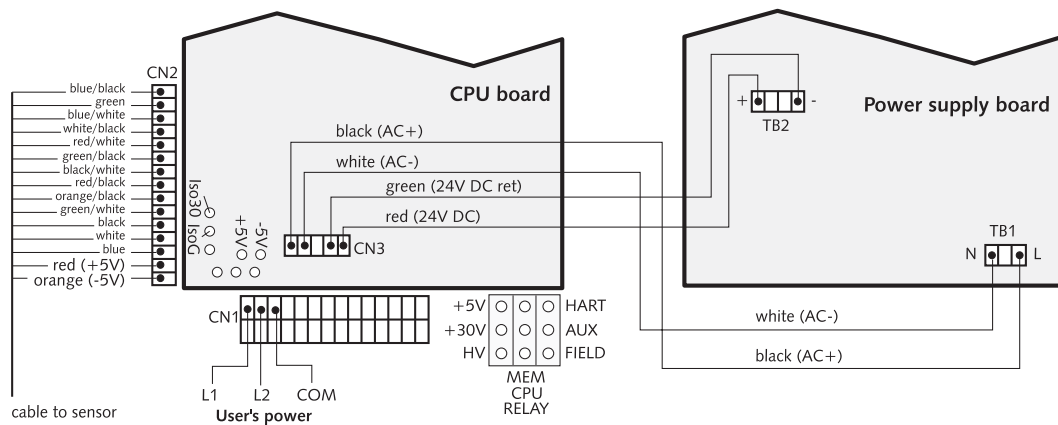


Figure 17: Power intraconnect diagram

Communication problem flowchart

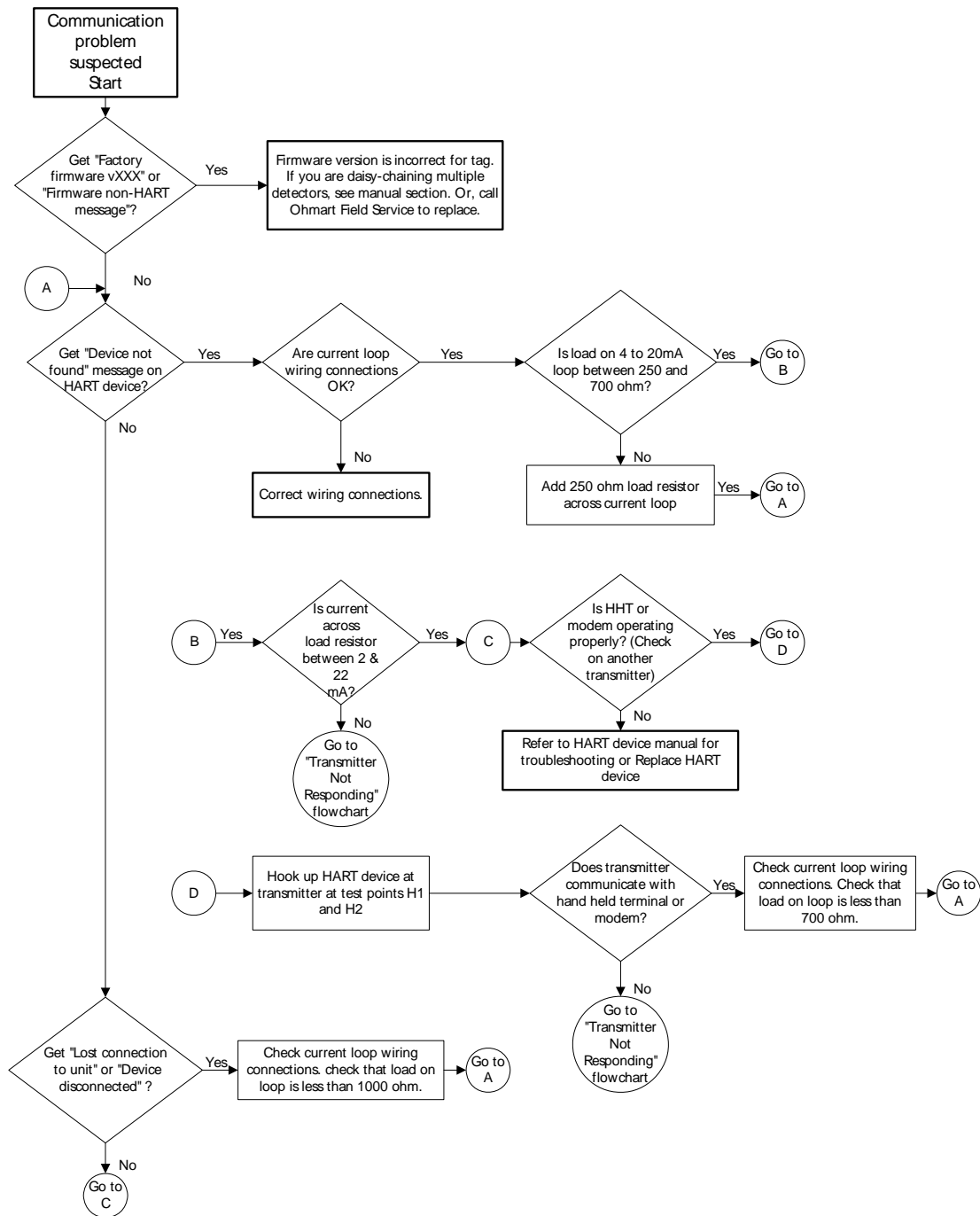


Figure 18: HART Communication problem suspected flowchart

Transmitter not responding flowchart

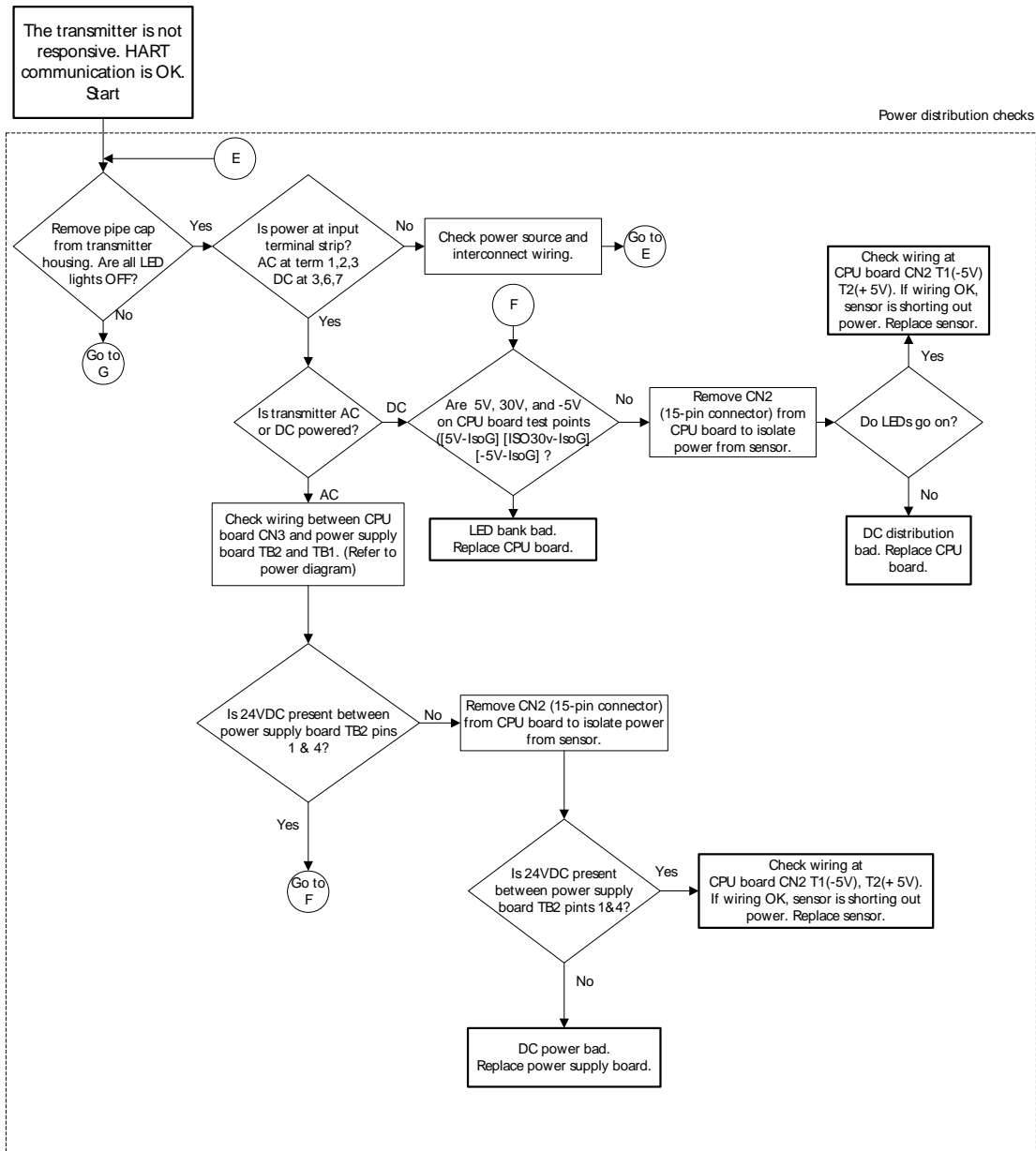


Figure 19: Transmitter not responding flowchart, part 1

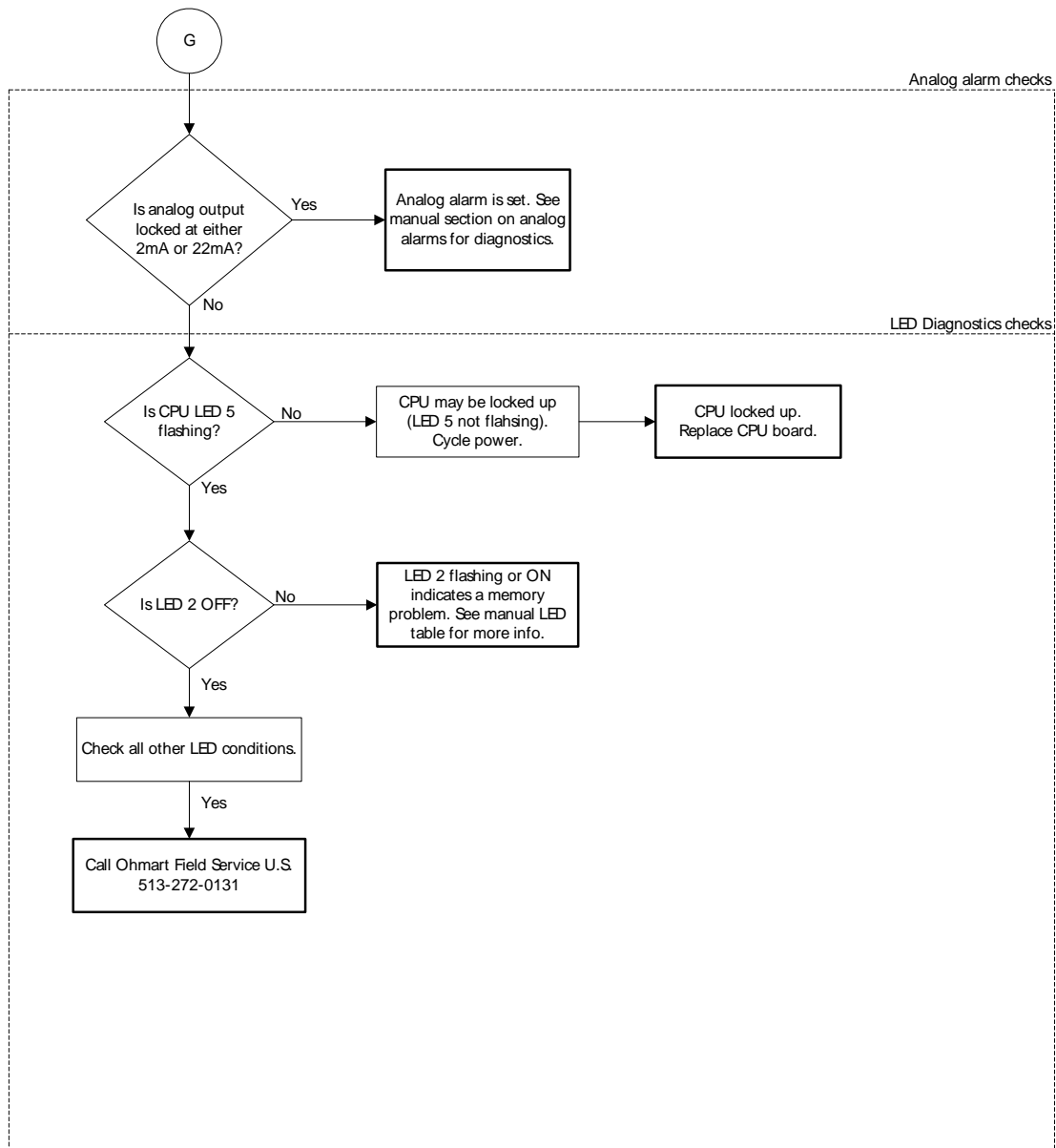


Figure 20: Transmitter not responding flowchart, part 2

Maintenance and repair

Periodic maintenance schedule

Since the DSTH contains no moving parts, it requires very little periodic maintenance. We suggest the following schedule to prevent problems and to comply with radiation regulations:

Table 12: 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 DSTH 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 DSTH to acknowledge the alarm and to reset the timer.

Perform the following procedure after a source wipe or a shutter check (see the Radiation safety instructions shipped with the source holder):

Recording a source wipe or shutter check

Procedure 30: 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
6. Press F2 to save.

Check when the next source wipe or shutter check is due

Procedure 31: 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.

Table 13: Spare part numbers

Description	Ohmart part number
AC power supply board	237382
DSTH CPU board	238747
DSTH complete tested assembly (AC input systems)	237004
DSTH complete tested assembly (DC input systems)	237412
HART Hand-held Terminal, or HART Modem kit	236907 237857

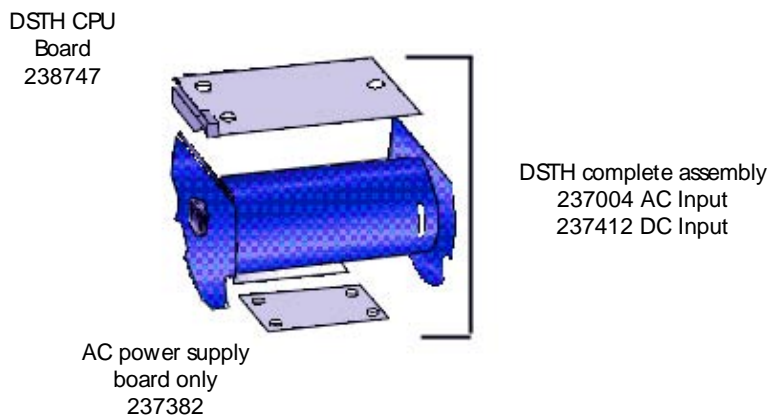


Figure 21: Spare parts identification

Field repair procedures

Very few parts are field repairable, but you can replace entire assemblies or boards. The following parts are replaceable:

- CPU board
- AC power supply board for AC powered systems
- Sensor assembly

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 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.

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.

Replace the CPU board

Procedure 32: Replacing the CPU board

1. At the DCS, remove DSTH from automatic control loop
2. If possible shut off power to the DSTH 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. 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 DSTH uses AC-power, remove the two pluggable terminal blocks on the power supply 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. The CPU board is held on to the sensor assembly with three screws and 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!

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.

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. The HART device should indicate an error message, New Hardware Found
15. 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 DSTH.

Note: The double backup of the EEPROMs enables calibration, setup, and history information to transfer from the existing sensor EEPROM to the new CPU board EEPROM. A new two-point calibration is not necessary. However, Ohmart recommends that you standardize the gauge since the sensor was removed from the housing and may be returned in a slightly different orientation.

Replacing the sensor assembly

Replacing the sensor assembly may be required. Before replacing the sensor, check the troubleshooting flowcharts or call Ohmart Field Service to be sure a replacement is necessary.

The CPU board EEPROM contains a backup of the sensor EEPROM. After physically replacing the sensor assembly, you must perform a memory backup to update the sensor EEPROM with the information in the CPU board EEPROM. Perform the memory backup in the **New hardware found** screen from the **Advanced Fxns** menu. Instructions are available in the following procedure.

Replace the sensor assembly

Procedure 33: Replacing the sensor assembly

1. At the DCS, remove DSTH from automatic control loop
2. If possible shut off power to the DSTH 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. 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 DSTH is AC-powered, remove the two pluggable terminal blocks on the power supply 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. The CPU board is held on to the sensor assembly with three screws and 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!

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.

11. Remove the AC power supply from the sensor assembly. The power supply is mounted on an aluminum sheet, fastened with one screw and a standoff near the back, and two bolts connecting the sheet, plastic housing, and steel mounting bracket
12. Mount the old CPU board and AC power supply to the new sensor assembly housing
13. Reconnect all pluggable terminal blocks, in the reverse order they were removed
14. Plug in the interconnect terminal CN1 last
15. Apply power
16. Check the LED bank. LED 5 should blink, indicating the CPU is functioning. LED 7 should be on, indicating that the sensor voltage is within specifications
17. 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
18. The HART device should indicate an error message, New Hardware Found
19. Using the HART device, perform the following steps:
 - From the **Main menu**, select **Advanced Fxns**
 - From the **Advanced Fxns** menu, select **New hardware**
 - From the **New hardware** menu, select **New sensor**
 - At the prompt, select **Yes** to verify the installation of the new sensor
20. The software automatically performs the appropriate backups with the new sensor and the existing CPU board
21. Place the detector assembly back into the pipe housing

- Secure the mounting bracket to the inside of the housing with the screw
 - Replace the pipe cap
22. Return the source holder shutter to the **ON** position to establish a radiation field and resume normal operation of the DSTH.

Note: A new two-point calibration is not necessary. However, Ohmart recommends that you standardize the gauge since the sensor was removed from the housing and may be returned in a slightly different orientation.

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, be ready with the following information:

- ☑ 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 34: 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

The following engineering units are available for density measurement:

- Density—weight/volume
- Flow rate measurement—volume/unit time
- Mass flow measurement—weight /unit time
- Special custom units

These units are:

Density

- SpG—specific gravity
- g/cm³—grams per cubic centimeter
- kg/m³—kilograms per cubic meter
- degAPI—degrees API
- lb/ft³—pounds per cubic foot
- g/ml—grams per milliliter
- dBaum L—degrees Baume light (less than water)
- dBaum H—degrees Baume heavy (greater than water)
- degTwad—degrees Twaddle
- %—percent
- lb/gal—pounds per gallon
- kg/l—kilograms per liter
- g/l—grams per liter
- lb/Cuin—pounds per cubic inch

- S ton/cu yd—short ton per cubic yard
- % solid—percent solid
- % sol—percent solution

Flow rate

- L/sec—liters per second
- m³/hr—cubic meters per hour
- m³/min—cubic meters per minute
- gal/hr—gallons per hour
- gal/min—gallons per minute
- gal/sec—gallons per second
- ft³/hr—cubic feet per hour
- ft³/min—cubic feet per minute
- ft³/sec—cubic feet per second

Mass flow

- m³/hr—cubic meters per hour
- m³/min—cubic meters per minute
- g/sec—gallons per second
- Kg/sec—kilograms per second
- Kg/hr—kilograms per hour
- Kg/min— kilograms per minute
- ton/hr—ton per hour
- lb/min—pounds per minute
- lb/sec—pounds per second
- Spcl—special (use in conjunction with Custom units that follow)

Note: For important information regarding the following units, refer to “Appendix III: Special Units Indication”:

- Degrees API
- Degrees Baume (light) or degrees Baume (heavy)
- Degrees Twaddle
- Percent solid
- Percent solution

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/spg (or x custom units / g/cm³).

Setting the process units for density applications

Procedure 35: 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 **Density units**
5. From the **Density units** screen, scroll through the list and choose the correct density 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 36: 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 SPG**
6. Enter the conversion factor in custom units per specific gravity
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 **Density units**
10. In the **Density 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 sample measurement. Use this interval time to collect data for initial calibration, linearizer curve, and standardization.

Warn % cal span

Warning percentage span calibration is the difference between the two initial calibration points (cal low density and cal high density) as a percent of density 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 change 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 density as the sample value.

Default std

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

Stdz interval

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

Setting the calibration parameters

Procedure 37: 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 75 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 to filter the noise in the signal. An increased time for averaging allows 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 DSTH offers a choice of signal filters, RC exponential or rectangular window. The DSTH 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.

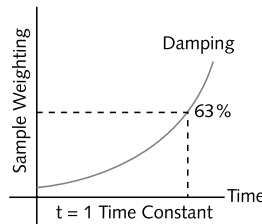


Figure 22: RC exponential filtering

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.

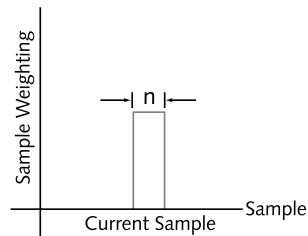


Figure 23: Rectangular window filtering

Damping

Damping's function depends on what type of filter is chosen.

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 DSTH 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 38: 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 is shown 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 76 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 76 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 density (Min and Max Density) measurement with the gauge. The DSTH 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 density values for the process span are essential to proper calibration of the system. You must enter the Min and Max density 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 densities change.

Modify the span setting if the DSTH 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 39: 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 span is the lowest and highest density 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 density and Max density), but must be within the boundaries set for the process span.

The screens prompt entry of a 4 mA Density and a 20 mA Density.

The current loop output can be set to be either forward or reverse acting by choosing the appropriate values of 4 mA Density and 20 mA Density. A forward acting output is proportional to the density and a reverse acting output is inversely proportional to the density. See the table that follows for an example of settings for process values of 0.5 and 1.0 SpG:

Table 14: Example of settings for process values

Forward acting (proportional)		Reverse acting (inversely proportional)	
4 mA Density	20 mA Density	4 mA Density	20 mA Density
0.5 SpG	1.0 SpG	1.0 SpG	0.5 SpG

Procedure 40: 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 Density**

6. In the **4mA Density** screen, enter the minimum value for the measurement span
7. From the **Current loop span** menu, select **20mA Density**
8. In the **20mA Density** screen, enter the maximum value for the measurement span
9. Press F2 to send the setting to the transmitter.

View PV unit

Field device variable unit —Engineering unit to display with the digital value representation, minimum span, upper range value, lower range value, lower sensor limit, and upper sensor limit.

Procedure 41: Viewing the PV unit

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** screen, select **PV Unit**
6. Press F4 to exit.

System parameters

The system parameters define settings for the internal operation of the DSTH 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 42: 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.

Linear units

Use the Linear units feature to view or enter the units (e.g., inches) used in the vessel inner diameter parameter (below). The system uses this number in the equation linearizer to calculate the density for a given count input.

Procedure 43: Setting the linear units

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **System parameters**
3. From the **System parameters** menu, select **Linear units**
4. From the **Linear units** menu, select one of the following:
 - **in**
 - **ft**
 - **cm**
 - **mm**
 - **m**
5. 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.

Vessel Inner Diam

Appendix I: Initial factory setup

Use the vessel inner diameter feature to view or enter the measurement for the inner diameter of the process flow pipe. The system uses this number in the equation linearizer to calculate the density for a given count input.

Procedure 44: Setting vessel diameter measurement

1. From the **Main menu**, select **Initial setup**
2. From the **Initial setup** menu, select **System parameters**
3. From the **System parameters** menu, select **Vessel Inner Diam**
4. In the **Vessel Inner Diam** screen, enter the new value
5. Press F4 to save the new value for the vessel inner diameter
6. 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. You can check the isotope type against the source holder label.

Procedure 45: 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 save
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 feature 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 the instrument. The Ohmart factory enters this parameter prior to shipment if the information is available at the time of the order. Otherwise, you can enter it on this screen.

Setting the tag identifier

Procedure 46: 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 save
6. Press F2 to send the updated parameters to the transmitter.

System information

Message

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

Procedure 47: 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 save
7. If using a hand-held HART Communicator, press F2 to send the updated parameters to the transmitter.

Descriptor

The Descriptor is a shorter message field to record information or messages.

Procedure 48: 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 DSTH 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 DSTH. In addition, if the DSTH relay is set as a diagnostic alarm, the condition trips the relay on.

In the setup, there is a list of every possible diagnostic alarm condition that can flag 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 53 for more details.

Table 15: Diagnostic alarm conditions

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

Setting the diagnostic alarm conditions

Procedure 49: 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 **Diagnostic alarm**
5. If using a hand-held HART Communicator, from the **Diagnostic alarm** menu, select **Diagnostic Gp1** (Diagnostic Group 1). If using Ohmart View, proceed to the next step
6. From the **Diagnostic 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 **Diagnostic alarm** screen
7. If using a hand-held HART Communicator, from the **Diagnostic alarm** menu, select **Diagnostic Gp2** (Diagnostic Group 2)
8. From the select **Diagnostic 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 50: 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 **Sel relay function**
4. From the **Sel relay function** menu, select **Diagnostic** 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 variable.

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

Table 16: Analog alarm conditions

Alarm out 22 mA	Alarm out 2 mA
-----------------	----------------

Setting the analog alarm output

Procedure 51: 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 measurement below a set point energizes the relay; for a high limit, a process measurement 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 17: Process relay set alarm conditions

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

Setting up the process alarm

Procedure 52: 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 **Sel relay function**
4. From **Sel 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
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 the gauge detects external radiographic sources. Vessel weld inspections often use portable radiographic sources. Detection of x-rays by the gauge cause 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.

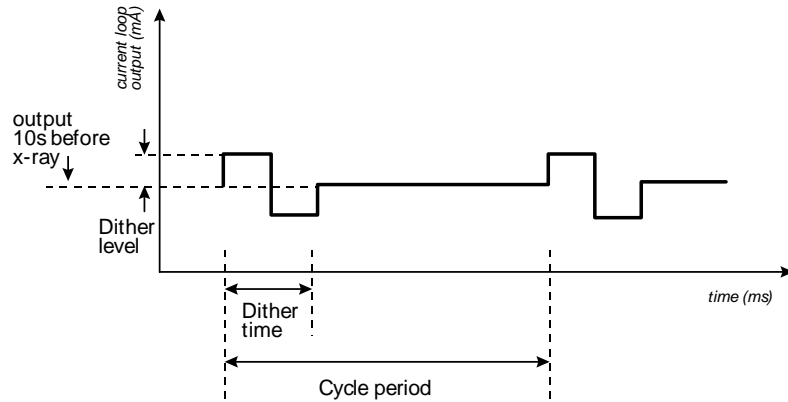


Figure 24: X-ray interference alarm output

Note: Only Ohmart Field service can adjust the time-out period of 60 minutes and the reversion to 10 seconds before the x-ray detection.

In the **Initial setup** screens, you can adjust the parameters shown in the figure. 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

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

Table 18: X-ray alarm conditions

Threshold	Dither level
Dither time	Cycle period

Setting up the x-ray alarm parameters

Procedure 53: 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 54: 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 **Sel relay function**
4. From the **Sel 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 DSTH to receive a frequency signal. With special software, the frequency signal incorporates into the final output.

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

- Temp compensation
- NORM compensation
- Summation mode

- Mass flow compensation

Note: Refer to “Appendix II: Special applications”, for complete application information regarding the use of auxiliary compensation.

Input parameters

Input filter

Input filter is the auxiliary input signal with application of the time constant.

Setting the input filter

Procedure 55: 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.

Multiple DSTH gauge input

Multiple gauges

The DSTH can receive raw sensor output from another slave DSTH that the HART current loop cannot use. The master DSTH receives the input and uses the incoming signal to modify its output. For example, you may use this feature to make the master DSTH read the difference or sum of two density gauges. This feature is available after you choose the **Summation** feature from the **Compensation** menu.

If you choose to use this feature, first contact Ohmart Field Service at 513-272-0131 for advice.

Custom

Custom auxiliary input settings are possible with custom software. Contact Ohmart for information on custom orders.

Appendix II: Special applications

This chapter provides application specific information for special installations. If your application is not in this section, you may have application specific information on the certified drawings. If you have other application questions, contact Ohmart Field Service in the U.S. or Canada at 513-272-0131. Clients outside of the U.S. and Canada should contact their local representative.

Process temperature—compensated density

You can adjust the density indication to reflect the density of the process at a reference temperature. The DSTH requires input from a temperature probe to measure the process temperature. The temperature probe provides an analog signal to the DSTH. The output of the DSTH is the 4–20mA signal with calibration and temperature compensation for control and HART communication.

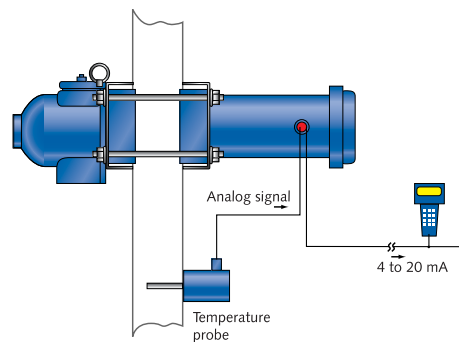


Figure 25: Temperature compensated density system

Installation requirements

Interconnect for RTD temperature probe

Use of an RTD temperature probe requires an Ohmart analog input circuit board (p/n 239409). The analog input circuit board mounts to the face of the sensor assembly, just below the interconnect terminals on the CPU board.

Use the 4-pin connector, J1, to wire in the RTD:

Table 19: RTD temperature probe pin and connections

J1 pin	RTD connection
1	–Signal return
2	+Signal in
3	+RTD source
4	–RTD return

The analog input circuit board interfaces with the CPU board through the 11-pin connector, pins 18–22, as shown below.

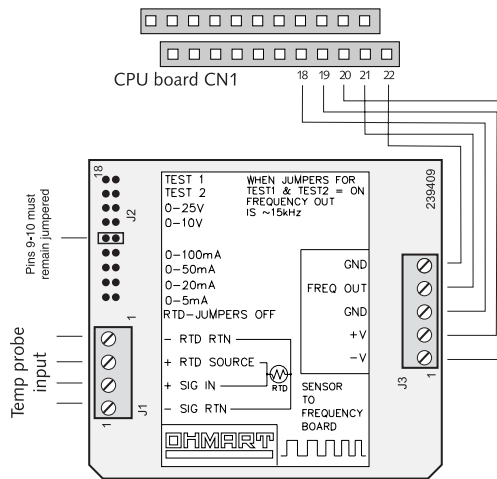


Figure 26: RTD input interfaces with circuit board

Interconnect for analog temperature probe

An analog (current or voltage) temperature probe input uses an Ohmart analog input board.

Use the 4-pin connector, J1, to wire in the RTD:

Table 20: Analog temperature probe pin and connections

J1 pin	RTD connection
1	– Signal return
2	+ Signal in
3	Not used
4	Not used

Set the jumpers on J2 for the proper input range, keeping one jumper on pins 9–10, and use the other for the input.

Analog input circuit board calibration

We recommend calibrating the analog input circuit board, although it is not a requirement.

See “Calibrating the Analog Input” on page 104.

Algorithm for temperature compensation

The temperature compensation algorithm adjusts the final density output based on the temperature characteristics of both the RTD temperature probe and the process material.

The algorithm equations require constants that you must enter in the **Initial setup** screens.

Table 21: Temperature compensation parameters and descriptions

Parameter	Description	Symbol
Temperature Units	Display units for the temperature (°C or °F)	
Reference Temperature	Temperature that the density reading adjusts to.	
Process Temperature Coefficients	Polynomial coefficients to linearize the process; dependent on the process material and how it changes with temperature. Your process-testing lab should determine these coefficients.	$P_0 - P_3$
Device (RTD) Temperature Coefficients	Polynomial coefficients to linearize the temperature measurement device. The default coefficients are for a Platinum 100 RTD. Do not alter these coefficients unless you have a different temperature device. For adjustments to the temperature input, use the Temperature Probe Offset, below.	$D_0 - D_2$
Temperature Probe Offset	Offset term that can add to the temperature sensor reading to get the correct temperature.	T_{offset}

Use the following equations to determine the actual temperature of the process (t):

- Counts from the RTD or other temperature probe (counts)
- Device temperature coefficients (D)
- Temperature probe offset

$$t = T_{\text{offset}} + [D_0 + (D_1)(\text{counts}) + (D_2)(\text{counts})^2]$$

Calculate the expected density at the temperature (t) with the polynomial and the coefficients (P) from your process laboratory:

$$d_t = P_0 + (P_1)(t) + (P_2)(t^2) + (P_3)(t^3)$$

Calculate a density offset by subtracting the density at temperature (t) with the density at the reference temperature (calculated in the same manner):

$$d_{\text{offset}} = d_{t=\text{tref}} - d_t$$

Finally, calculate the temperature compensated density by adding the offset density to the gauge's density measurement:

$$d = d_{\text{measured}} + d_{\text{offset}}$$

Initial settings and calibration requirements

To use the DSTH with temperature compensation, it must have specific settings in the **Initial setup** screens.

Setting up temperature compensation

Procedure 56: Setting up temperature 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**
4. The **Compensation** screen displays the current type of auxiliary input
5. From the **Compensation** menu, select **Type**
6. From the **Type** menu, select **Temperature** and press F4 to enter. You return to the **Compensation** menu
7. From the **Compensation** menu, select **Temp**
8. From the **Temp** screen, adjust the settings as required. See the “Temperature Compensation Parameters” section for a description of the parameters
9. If using a hand-held HART communicator, press F2 to send the settings to the transmitter.

Temperature compensation parameters

See the previous section, “Algorithm for Temperature Compensation” to see how to use these parameters.

Temp Units

Choose the units for the temperature (°C or °F).

Ref Temp

The reference temperature is the temperature to which the density reading adjusts.

Process Temp Coeff

The process temperature coefficients are polynomial coefficients to linearize the process. They are dependent on the process material and how it changes with temperature. Your process-testing lab should determine these coefficients.

P_0 (Coeff0) is the offset term and P_1 (Coeff1) is the linear term. For a linear response, only P_0 and P_1 are needed; P_2 and P_3 must be set to zero.

Device Temp Coeff

Appendix II: Special applications

The device temperature coefficients are polynomial coefficients to linearize the temperature measurement device. The default coefficients are for a Platinum 100 RTD. Do not alter these coefficients unless you have a different temperature device. For adjustments to the temperature input with a Platinum 100 RTD, use the Temperature Probe Offset that follows.

The default values for the Platinum 100 RTD are:

Coeff	Temperature Units °C	Coeff	Temperature Units °F
D₀	D0=-243.50029	D₀	-135.2779
D₁	D1=0.01909	D₁	0.010606
D₂	D2=7.9066 ×10 ⁻⁸	D₂	4.3892×10 ⁻⁸

For a linear temperature device, the coefficient D₂ (Coeff2) must be set to zero. D₀ is the offset term and D₁ is the linear term. (See “Working with a Linear Temperature Device” on page 97)

Offset

The temperature probe offset term can add to the temperature sensor reading to get the correct temperature.

To determine if you need to adjust the Temperature Probe Offset, check the process chain menu (see page 37 for process chain information). The process chain lists the process temperature. If the temperature is not correct, adjust the Temperature Coefficient Offset value to get the correct reading.

Process Temp

The process temperature is the temperature of the process material.

Analog in Cal

The Analog in Cal feature has the following menu components:

- AI Low Cal Cnts—Average counts from analog input low density calibration
- Aux Low Input Cal—Use this function to calibrate the Analog Input board for the low input signal of the auxiliary span
- AI High Cal Cnts—Average counts from analog input high density calibration
- Aux High Input Cal—Use this function to calibrate the Analog Input board for the high input signal of the auxiliary span

For further information concerning the Analog in Cal feature, see the procedure on calibrating the analog input circuit board in the “Mass Flow” section of this Appendix.

Platinum 100 RTD temperature to frequency

For reference, Table 22 gives the conversion of temperature in degrees C to the frequency output of the Platinum 100 RTD.

Table 22: Platinum 100 RTD temperature to frequency output

Temp (degC)	Frequency	Temp (degC)	Frequency	Temp (degC)	Frequency
-100	7313.11	110	17268.20	310	26166.26
-90	7803.40	120	17726.94	320	26595.87
-80	8292.48	130	18183.25	330	27024.27
-70	8777.91	140	18638.35	340	27452.67
-60	9263.35	150	19093.45	350	27878.64
-50	9746.36	160	19544.90	360	28302.18
-40	10226.94	170	19996.36	370	28725.73
-30	10706.31	180	20446.60	380	29148.06
-20	11184.47	190	20894.42	390	29567.96
-10	11661.41	200	21342.23	400	29986.65
0	12135.92	210	21787.62		
10	12609.22	220	22229.37		
20	13081.31	230	22674.76		
30	13552.18	240	23115.29		
40	14021.84	250	23555.83		
50	14490.29	260	23993.93		
60	14968.45	270	24430.83		
70	15422.33	280	24866.50		
80	15885.92	290	25300.97		
90	16348.30	300	25734.22		
100	16809.47				

Working with a linear temperature device

If you have a temperature device that is not an RTD, but provides a linear voltage output as a function of temperature, you can use the temperature compensation feature by performing the setups that follow.

Setting up temperature compensation with a linear device

Procedure 57: Setting up temperature compensation with a linear device

1. Calculate the value of the device temperature coefficient D1 by using the following equation:

$$D1 = (\text{Temperature span}) / (\text{Analog Input High Calibration value} - \text{Analog Input Low Calibration value})$$
2. Calculate the value of the device temperature coefficient D0 by using the following equation:

$$D0 = (\text{Max Temperature}) - (\text{coefficient D1} \times \text{Analog Input High Calibration value})$$
3. Set the device temperature coefficient D3 to 0.

Appendix II: Special applications

For example, suppose you have a 0 to 10V temperature measurement device with a temperature span of 20 to 200°C. The configuration of the analog input circuit board is for an input range of 0 to 10V.

Set the analog input signal to 10V and perform an Analog Input High Calibration to find out the highest output frequency of the Analog Input Circuit Board. For this example, assume this value is set at 29,760Hz.

Set the analog input signal to zero volts and perform an Analog Input Low Calibration. For this example, assume 100Hz.

Device Coefficient $D1 = (200 - 20) / (29760 - 100) = 0.006069$

Device Coefficient $D0 = 200 - (.006069 \times 29760) = 19.39$

Mass flow measurement

Mass flow measurement, with a flow meter input into the DSTH, provides a mass/time indication.

When using the mass flow measurement, the PV (process value indication) of the gauge shows the actual density or percent solid measurement. The 4–20 mA output, however, indicates the calculated mass flow value.

When setting up the gauge spans, the PV span is the normal material density span or percent solids span, but the current loop span is the actual span of the mass flow measurement.

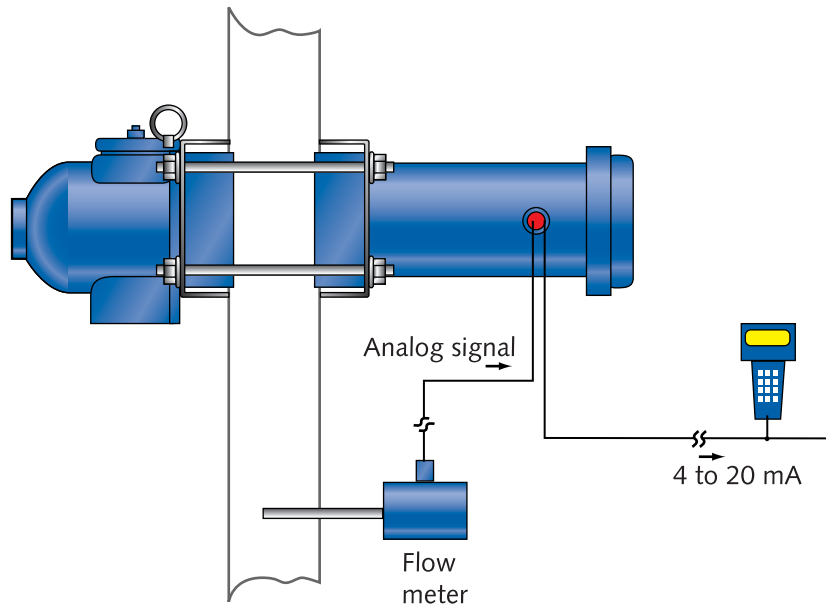


Figure 27: Flow meter

Installation requirements

Interconnect for flow meter to DSTH

Use of a flow meter input requires an Ohmart analog input circuit board (p/n 239409). The analog input circuit board mounts to the face of the sensor assembly, just below the interconnect terminals on the CPU board.

Use the 4-pin connector, J1, to wire in the flow meter: See Table 23 for jumper settings for a flow meter connection.

Table 23: Jumper settings for flow meter connection

J1 pin	Flow meter connection
1	– Signal return
2	+ Signal in
3	Not used
4	Not used

The analog input circuit board interfaces with the CPU board through the 11-pin connector, pins 18–22, as shown in Table 24.

Jumper settings for analog input board

A jumper is required to select the type of analog input from the flow meter. See Table 24 for jumper settings for an analog input board.

Table 24: Jumper settings for analog input board

J2 pin	Signal type from flow meter
1–2	0–5mA
3–4	0–20mA
5–6	0–50mA
7–8	0–100mA
9–10	Not used
11–12	0–10V
13–14	0–25V
15–16	Test 2 (not used for operation)
17–18	Test 1 (not used for operation)

If you notice errors in the measurement that relates to the input, you may need to calibrate the analog input board. See “Calibrating the Analog Input” on page 104.

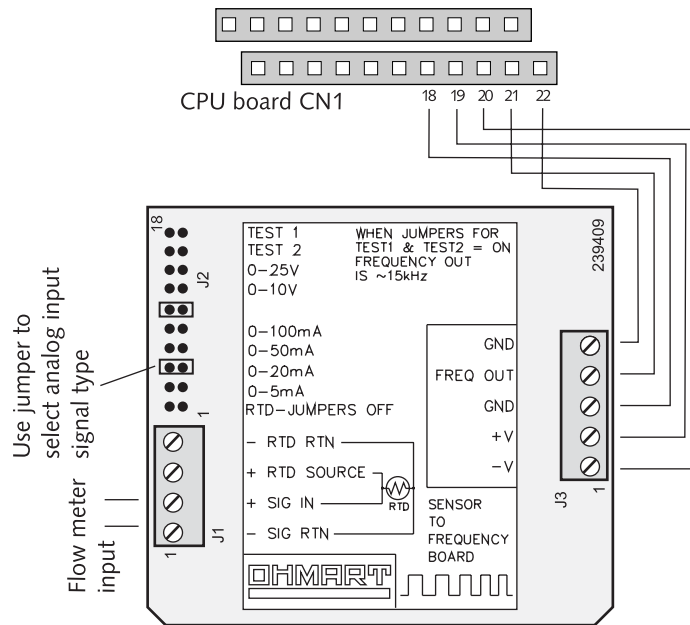


Figure 28: Flow meter interface with analog input circuit board

Algorithm for mass flow

The mass flow algorithm allows the final indication of the DSTH to be a mass/time indication, instead of a density indication.

Calculation of the mass flow is from the weight per volume (w/v) that the DSTH density gauge measures and the volume per unit time (v/t) of the process flowing through the pipe that the flow meter measures.

$$\text{Mass flow} = (w/v) (v/t)$$

Refer to Procedure 58 to set up mass flow.

Setting up mass flow

Note: Before setting up mass flow, set up the gauge for the density or percent solids measurement first. Be sure to enter the correct process span. If using percent solids, enter the correct product and carrier densities.

Procedure 58: Setting up mass flow

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 the proper density units
5. Move back to the **Process parameters** menu and select **Spans**
6. From the **Spans** menu, select **Process span**
7. Enter the span for the density of the process material
8. If the measurement is %Solids, setup the proper product and carrier densities (refer to the “Percent Solid” or “Percent Solution Indication” section of the manual, page 108).
9. Move back to the **Initial setup** menu and select **Auxiliary input**
10. From **Auxiliary input** menu, select **Compensation**
11. Select the **Type** menu, select **Mass Flow**
12. Move back to the **Compensation** menu, select **Mass Flow**
13. Press F4 to enter
14. From the **Mass Flow** menu, select **Flow Meter Unit**
15. In the **Flow Meter Unit** screen, select the proper units of the flow meter. Press F4 to enter
16. From the **Mass Flow** menu, select **Min Flow Value** and then the **Max Flow Value** menus and enter the span for the flow meter
17. From the **Mass Flow** menu, select the **Min Mass Flow** and **Max Mass Flow** to view the mass flow range. This is the allowable setting for the current loop span

Procedure 58: Setting up mass flow (continued)

18. Press the LEFT ARROW until you are back at the **Initial setup** menu
19. From the **Initial setup** menu, select **Process parameters**
20. From the **Process parameters** menu, select **Spans**
21. From the **Spans** menu, select **Current loop span**
22. From the **Current loop span** menu, select **4 mA Density** and then **20 mA Density** to enter the mass flow span. Press F4 to enter and F2 to send to the hand-held communicator
23. Calibrate the gauge following the procedure specified in the “Initial Process Calibration” section of the manual (page 21)
24. Either press the HOT KEY on the hand-held HART communicator to move directly to the **Process chain** menu or press the LEFT ARROW to go back to the **Main menu**
25. From the **Main menu**, select **Advanced Fxns**
26. From the **Advanced Fxns** menu, select **Process chain**
27. From the **Process chain** menu, select **Flow Rate**
28. Verify the correct flow meter reading from the **Flow Rate** menu. Press F4 to exit
29. From the **Process chain** menu, select **Mass Flow**
30. Verify the correct mass flow output from the **Mass flow** menu. The current loop output corresponds to this mass flow output value. Press F4 to exit.

Table 25: Flow rate unit to mass flow unit

User Selected Flow Rate Units	Mass Flow Units
Liter/sec	kg/sec
m3/sec	kg/sec
m3/min	kg/min
m3/hr	kg/hr
Gal/sec, ft3/sec	lb/sec
Gal/min, ft3/min	lb/min
Gal/hr, ft3/hr	Ton/hr

Mass flow parameters

Refer to the previous section, “Algorithm for mass flow.” to see how to use these parameters:

Flow meter units

Units of the flow rate; choose from:

Table 26: Flow unit options

liter/sec	m ³ /hr	gal/hr	ft ³ /hr
m ³ /sec	gal/sec	ft ³ /sec	
m ³ /min	gal/min	ft ³ /min	

Min Flow Value

The minimum expected flow rate.

Max Flow Value

The maximum expected flow rate.

Min Mass Flow

The minimum allowable mass flow value as the gauge calculates. This is a read-only value.

Max Mass Flow

The maximum allowable mass flow value as the gauge calculates. This is a read-only value.

Mass Flow Gain

The gain term that is multiplied by the calculated mass flow value to compensate for any linearity problems.

Mass Flow Units

The units of the 4–20mA output as selected by the software:

Table 27: Mass flow unit output options

kg/sec	kg/min	
lb/sec	lb/min	ton tn/hr

These units are selected based on the time scale of the flow units and if the flow units are metric or English.

Calibrating the analog input

Some measurements make use of an auxiliary analog input. For example, the mass flow measurement and temperature compensation input. The analog input enters through an analog input circuit board. Ohmart recommends calibrating the analog input circuit board.

The analog input circuit board converts the input signal, either a voltage or a current, to a frequency output for the CPU board. The frequency range of the output can vary up to 30kHz for the maximum input level of the selected range. The output frequency of the analog input circuit board does vary from board to board, and therefore you must calibrate it for the working input range. The following steps calibrate the analog input circuit board:

Calibrating the analog input circuit board

Procedure 59: Calibrating the analog input circuit board

1. Set the input signal to the analog input circuit board to its lowest level
2. From the **Main menu**, select **Initial setup**
3. From the **Initial setup** menu, select **Auxiliary input**
4. From the **Auxiliary input** menu, select **Compensation**
5. From the **Compensation** menu, select **Mass Flow** or **Temp**
6. From the **Mass Flow** or **Temp** menu, select **Analog in Cal**
7. From the **Analog in Cal** menu, select **Aux Low Input Cal**
 - At the prompt, select **Yes** to take data
 - This forces the CPU board to perform a data collect on the auxiliary input and store the counts for the low-level analog input signal
 - Select **Yes** to accept the counts and press F4 to enter
8. From the **Analog in Cal** menu, select **Aux High Input Cal**
 - At the prompt, select **Yes** to take data
 - This forces the CPU board to perform a data collect on the auxiliary input and store the counts for the high-level analog input signal
 - Select **Yes** to accept the counts and press F4 to enter.
9. Press F2 to save.

The output of the Analog Input Circuit Board is dependent on the input signal. The table below shows typical output frequencies based on the applied input signal:

Table 28: Output frequencies based on applied input signal

Input Signal	Selected Range	Frequency Output
4mA	0–20mA	6,000Hz
20mA	0–20mA	30,000Hz
5V	0–10V	15,000Hz
2.5V	0–25V	2,880Hz

Material present/absent detector or point level detector with quick relay response

You can use the DSTH as a switch to indicate the presence or absence of material and trigger the relay. Applications of this include the following:

- Detecting a slab of steel at the furnace discharge
- Counting product on a conveyor
- Area safety monitor
- Point level switch on a tank

Note: The quick response relay feature is only used in special point level applications that require a very fast relay output instead of HART output. This feature requires special firmware for the gauge. If using this firmware, HART communication disables when the unit is measuring.

The minimum response time for a standard DSTH output is one second. Some applications require a quicker response time. Response times as low as 250ms are possible to achieve by disabling the HART communication during normal operation of the gauge and by using a special version of the DSTH firmware. HART communication can be re-enabled as necessary for calibration, standardization, or other functions.

Note: Use the CPU board jumper J1 (located near the test points) to toggle between setup and run mode. You can use HART communication in setup mode, but the relay does not respond. In run mode, the relay responds with its quickest response time, but HART communication is not possible.

Special firmware for quick response relay

To use the quick response relay requires special firmware. The DSTH can operate as a point level or presence/absence detector with the standard DSTH firmware, but the relay response time is the standard response time controlled by the filtered time constant.

To check the firmware version

Use a HART device to view the firmware version by performing the following procedure:

Procedure 60: Check firmware version

1. From the **Main menu**, select **Advanced Fxns**
2. From the **Advanced Fxns** menu, select **Other advanced**
3. From the **Other advanced** menu, select **Firmware ver**
4. The firmware version should indicate 200.00 or higher

Initial settings and calibration requirements

To use the DSTH as a presence/absence indicator with a quick response relay, it must have proper calibration and specific settings in the **Initial setup** screens. Refer to these sections of this manual for more details:

Table 29: Initial setting locations

Setting	Manual heading	Page
Verify the firmware is version 200.00 or higher	Checking the equipment version and serial numbers	48
Change the gauge type to LEVEL	Select gauge type	49
Engineering units set as %	Units	72
Configure the relay function as Process, and set the relay setpoint as the % to trigger the relay	Process alarm setup	87
Calibrate on low density (0%) with no material present, and high density (100%) with material present (see note below for hints)	Set low density Set high density	27 30

Note: In many cases, you are unable to fill or empty the process vessel for proper calibration. Use the following hints in these situations:

- High level alarm calibration—with the vessel empty, open the source holder shutter to simulate low level (**Set Cal low density** in software). Close the source holder shutter to simulate high level (**Set Cal high densi** in software).
- Low level alarm calibration—with the vessel full, calibrate Set cal high density as usual. For the low-level condition, estimate the counts and enter them manually in the **Cal result** function.

Jumper requirements for quick response relay

You can make the hardware changes to enable the quick response relay after meeting the following conditions:

- Setup of the DSTH
- Calibration of the DSTH
- DSTH is ready for normal operation

Setting the CPU jumpers for a quick response relay

Procedure 61: Setting the CPU jumpers for a quick response relay

1. Remove the DSTH housing cap to access the transmitter electronics
2. Remove the interconnect terminal block from the CPU board connector (CN1)
3. Remove the jumper J1 to switch from setup mode to the quick response relay run mode
4. Reapply power. The gauge reads the jumper setting only on power-up to determine its operating mode.

Internal heater kit for applications below $-50\text{ }^{\circ}\text{C}$

A heater kit option is available for the DSTH for applications that require a $-50\text{ }^{\circ}\text{C}$ ($-58\text{ }^{\circ}\text{F}$) temperature rating. With the heater option, the internal temperature of the unit rises approximately $30\text{ }^{\circ}\text{C}$ ($86\text{ }^{\circ}\text{F}$) degrees.

The features of the heater are as follows:

- The heater kit does not affect the functionality of the DSTH in any way. There is no requirement for special firmware
- The factory installs the internal heater kit if you order it with the DSTH
- 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 30: Heater kit part numbers

Heater kit power	Ohmart Part Number
115 VAC	239831
220 VAC	239834

Changes to specifications

The power rating changes from the specifications on page 4 of this manual when you install the heater kit on the DSTH.

With the installation of the heater, the maximum power consumption increases to 30 watts. The unit is either $115\text{VAC}\pm 10\%$ or $220\text{VAC}\pm 10\%$, instead of the standard $90\text{--}270\text{ VAC}$ range.

Appendix III: Special units indication

Percent solid or percent solution indication

The DSTH can be set up to indicate percent solid or percent solution. The setup requires the choice of units %solid or %solution in the **Process units** screen, from the **Initial setup**, **Process parameters** menus for this feature. View the following two definitions to see which one applies to your process.

- Slurries, in which the solid product does not dissolve in the carrier liquid, generally use percent solid.
- Solutions, in which the solid product dissolves in the carrier liquid, or when two solutions mix to make a third, generally use percent solution.

The DSTH directly measures only the total mass in the volume between the detector and source holder. This is equivalent to a direct measurement of density (mass/volume), since the volume remains constant. Effective density (D_{eff}) is the directly measure quantity in a percent solid or percent solution application.

When the DSTH indicates percent solid or percent solution, it is indicating a derived quantity. The density in SpG (specific gravity) of both the carrier (C_{spg}) and the solid product (P_{spg}) must be constant and known. The basis for the percent solid or percent solution internal calculation is the following:

- Effective density
- Carrier density
- Product density

Note: When the DSTH is set up as a percent solid or percent solution gauge, the current loop (4–20mA) varies linearly with the percent solids or percent solution. It does not vary linearly with the effective density.

The calculation of percent solid and percent solution uses the following variables:

- C_{SpG} = density of carrier liquid in specific gravity
- P_{SpG} = density of solid product in specific gravity (if product is a liquid/liquid solution this is the specific gravity of the second liquid)
- D_{eff} = effective density of slurry or solution, as measured by the DSTH The DSTH calculates the percent solid for slurries with the following equation:

$$\% \text{ solid} = \frac{(D_{\text{eff}} - C_{\text{SpG}})}{(P_{\text{SpG}} - C_{\text{SpG}})} \times P_{\text{spg}} \times 100$$

If you know the percent solid indication of the gauge and want to determine the effective density, it calculates with the following equation that is the effective density solution to the above equation:

$$100 P_{\text{SpG}} C_{\text{SpG}}$$

$$[(100-\% \text{solid } P_{\text{SpG}})] + [(\% \text{solid } C_{\text{SpG}})]$$

The DSTH calculates the percent solution with the following equation:

$$\% \text{ solution} = \frac{(D_{\text{eff}} - C_{\text{SpG}})}{(P_{\text{SpG}} - C_{\text{SpG}})} \times 100$$

The percent solution solved for effective density is:

$$D_{\text{eff}} = \frac{\% \text{ solution} \times (P_{\text{SpG}} - C_{\text{SpG}})}{100} + C_{\text{SpG}}$$

Initial settings and calibration requirements

To use the DSTH as a percent solid or percent solution indicator, it must have specific settings in the **Initial setup** screens and proper calibration. Refer to these sections of this manual for more details:

Table 31: Initial settings and calibration—percent solid or solution

Setting	Manual heading	Page
Set units as % solid or % solution	Units	72
Set process span (Min density, Max density), with the appropriate values in %solids or %solution units	Span settings, process span	78
Calibrate on low density with only carrier liquid for slurry or solid/liquid solutions, or on only one solution for liquid/liquid solutions	Set low density	27
Calibrate on slurry at high end of range to be measured, or final product solution at high end of range to be measured	Set high density	30
Set current loop span (4mA density, 20mA density) with the appropriate values in %solid or %solution units	Span settings, current loop span	78

Degrees API indication

The DSTH can be set up to indicate degrees API by choosing degAPI in the **Process units** screen, from the **Initial setup**, **Process parameters** menus. Petroleum industries use the unit degrees API.

The DSTH directly measures only the total mass in the volume between the detector and source holder. This is equivalent to a direct measurement of density (mass/volume), since the volume remains constant.

When the DSTH indicates degrees API, it is indicating a derived quantity.

Note: When the DSTH is set up as a degrees API gauge, the current loop (4–20mA) varies linearly API. It does not vary linearly with specific gravity.

The DSTH calculates degrees API with the following equation:

$$\text{API} = \frac{(141.5)}{\text{SpG}} - 131.5$$

Appendix III: Special units indication

When the DSTH is indicating API, the following equation calculates the specific gravity:

$$\text{SpG} = \frac{141.5}{(131.5 + ^\circ\text{API})}$$

Initial settings and calibration requirements

To use the DSTH as a degrees API indicator, it must have specific settings in the **Initial setup** screens and proper calibration. Refer to these sections of this manual for more details:

Table 32: Reference table for Initial Setup and calibration—degrees API

Setting	Manual heading	Page
Set units as degrees API	Units	72
Set process span (Min density, Max density), with the appropriate values in degrees API units	Span settings, process span	78
Calibrate on low density	Set low density	27
Calibrate on high density	Set high density	30
Set current loop span (4mA density, 20mA density) with the appropriate values in degrees API units	Span settings, current loop span	78

Degrees Twaddle indication

The DSTH can be set up to indicate degrees Twaddle by choosing degTwad in the **Process units** screen, from the **Initial setup**, **Process parameters** menus. Degrees Twaddle is a specific gravity scale for liquids between 1.0 SpG and 2.0 SpG that divides the specific gravity scale in that range into 200 equal parts. Each degree Twaddle equals a difference in specific gravity of 0.005. For example, 40° Twaddle is equivalent to 1.200 SpG.

Note: If the product is outside the range defined for degrees Twaddle (0° –200° Twaddle, or 1.000–2.000 SpG) the output of the DSTH locks on the last valid reading, either 0° Twaddle or 200° Twaddle.

The DSTH directly measures only the total mass in the volume between the detector and source holder. This is equivalent to a direct measurement of density (mass/volume), since the volume remains constant.

When the DSTH indicates degrees Twaddle, it is indicating a derived quantity.

The DSTH calculates the Degrees Twaddle with the following equation, valid only when $1.000 \text{ SpG} \leq D_{\text{eff}} \leq 2.000 \text{ SpG}$:

$$\text{degTwad} = \frac{(\text{SpG} - 1.000)}{0.005}$$

When the DSTH is indicating degrees Twaddle, the following equation calculates the specific gravity:

$$\text{SpG} = (\text{degTwad} \times 0.005) + 1.000$$

$$\text{SpG} = \frac{145}{1000}$$

$$(145.0 - ^\circ\text{Be}_{(\text{heavy})})$$

Initial settings and calibration requirements

To use the DSTH as a degrees Twaddle indicator, it must have specific settings in the **Initial setup** screens and proper calibration. Refer to these sections of this manual for more details:

Table 33: Reference table for Initial Setup and calibration requirements—degrees Twaddle

Setting	Manual heading	Page
Set units as degrees Twaddle	Units	72
Set process span (Min density, Max density), with the appropriate values in degrees Twaddle units	Span settings, process span	78
Calibrate on low density	Set low density	27
Calibrate on high density	Set high density	30
Set current loop span (4mA density, 20mA density) with the appropriate values in degrees Twaddle units	Span settings, current loop span	78

Degrees Baume indication

The DSTH can be set up to indicate degrees Baume by choosing Be(lt) (Baume light) or Be(hv) (Baume heavy) in the **Process units** screen, from the **Initial setup, Process parameters** menus. Use Baume light for liquids or solutions less than 1.0 SpG. Use Baume heavy for liquids or solutions greater than 1.0 SpG.

The DSTH directly measures only the total mass in the volume between the detector and source holder. This is equivalent to a direct measurement of density (mass/volume), since the volume remains constant.

When the DSTH indicates degrees Baume, it is indicating a derived quantity.

Note: When the DSTH is set up as a degrees Baume gauge, the current loop (4–20 mA) varies linearly with the Baume. It does not vary linearly with specific gravity.

The DSTG calculates degrees Baume with the following equations:

$$^\circ\text{Be}_{(\text{light})} = \frac{140}{\text{SpG}} - 130$$

$$^\circ\text{Be}_{(\text{heavy})} = 145 - \frac{145}{\text{SpG}}$$

When the DSTH is indicating Baume, the following equation calculates the specific gravity:

$$\text{SpG} = \frac{140}{(130 + ^\circ\text{Be}_{(\text{light})})}$$

$$\text{SpG} = \frac{145}{(1450 - ^\circ\text{Be}_{(\text{heavy})})}$$

Initial settings and calibration requirements

Appendix III: Special units indication

To use the DSTH as a degrees Baume indicator, it must have specific settings in the **Initial setup** screens and have proper calibration. Refer to these sections of this manual for more details:

Table 34: Reference table for Initial Setup and calibration requirements—degrees Baume

Setting	Manual heading	Page
Set units as degrees Baume light or Baume heavy	Units	72
Set process span (Min density, Max density), with the appropriate values in degrees Baume light or Baume heavy units	Span settings, process span	78
Calibrate on low density	Set low density	27
Calibrate on high density	Set high density	30
Set current loop span (4mA density, 20mA density) with the appropriate values in degrees Baume units	Span settings, current loop span	78

NOTES

Appendix IV: Using a linearizer table

Most density applications use an equation that calculates internally. This calculation linearizes the radiation transmission signal with respect to changing density. There is an option in the DSTH that enables the use of a look-up table to enter any linearizer.

Note: Ohmart recommends using the equation method first. In most applications, it gives the best results. If for some reason the calibration is not satisfactory, you can try the linearizer table.

Two linearizer tables are available:

1. Non-linear table
2. Linear table

Non-linear table

The non-linear table is more accurate than the linear table. This is because 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:

- Actual process samples
- Linearizer data from an earlier model Ohmart density gauge

Table, linear

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. This is because the straight-line linearizer calculates from the high and low-density initial calibration points.

Calibration using a non-linear table linearizer

The following flow chart outlines the non-linear table linearizer calibration procedure.

Note: You must use the two-point initial calibration when using a linearizer table.

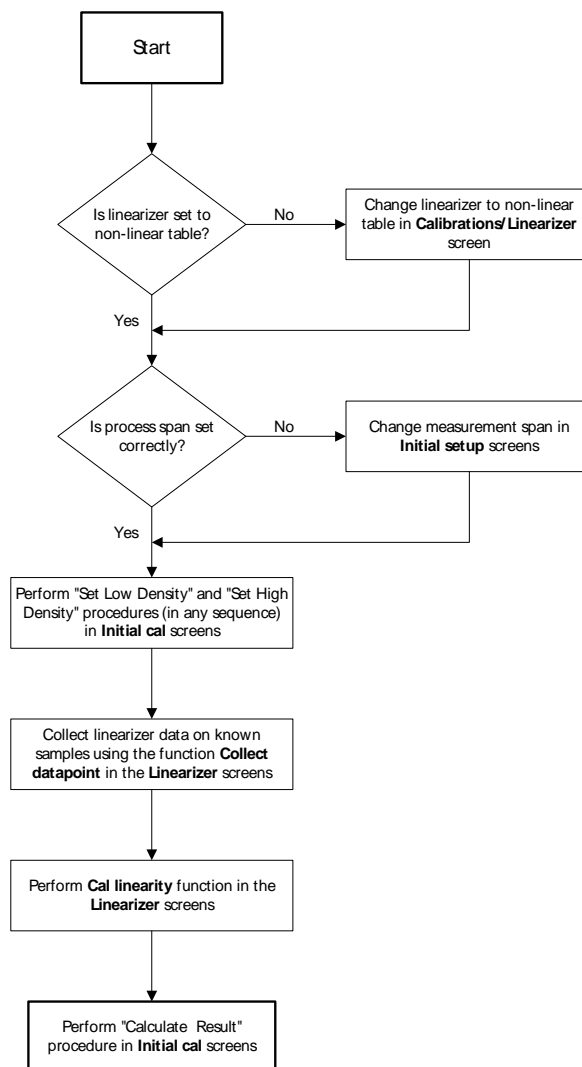


Figure 29: Calibration with non-linear table linearizer flow chart

Note: The procedures for performing the two-point initial calibration are found in the "Calibration" chapter beginning on page 29.

Collecting linearizer look up table data

In density applications, the recommended linearizer is the equation. The equation calculates the shape of the curve between the low and high calibration endpoints. However, you can collect data points between the high and the low calibration points so that the DSTH calculates a curve based on your samples.

Before collecting the linearizer table data:

- Have the samples of known density ready to measure
- Have actual density (or percent solids) value for these samples from the lab ready to enter

Procedure 62: 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 coll**
5. From **Linear data coll** menu, select **Collect datapoint**
6. At the prompt, enter the actual known lab value of process
7. Accept or reject the results when they display
8. Repeat procedure for all available samples
9. Press F2 to send.

Calculating the linearizer curve

Calculate the linearizer after you perform the following steps:

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

Procedure 63: 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 coll**
5. From the **Linear data coll** menu, select **Calc linearity**
6. At the prompt, select **Yes** to proceed with the linearity calculation. The linearizer table calculates based on the samples you collect
7. Press F2 to save.

Calibration using a linear table linearizer

The following flow chart outlines the calibration procedure for using a linear table linearizer.

Note: You must use the two-point initial calibration when using a linearizer table.

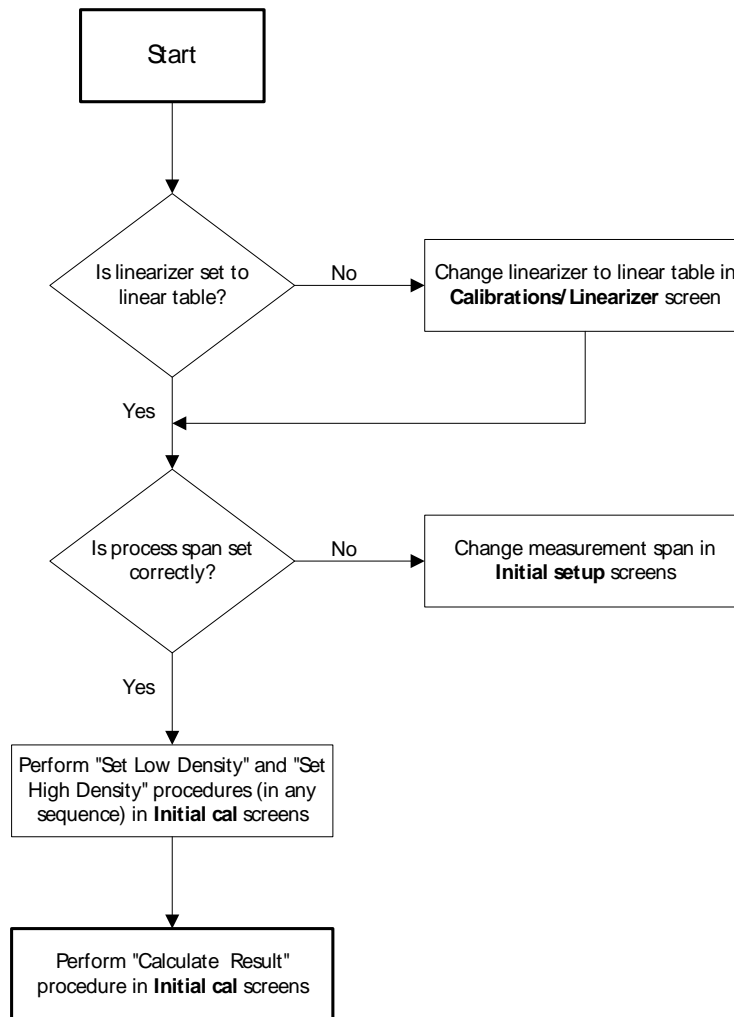


Figure 30: Calibration with a linear table linearizer flow chart

Appendix V: HART Menus and screens

The figures in this section 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.

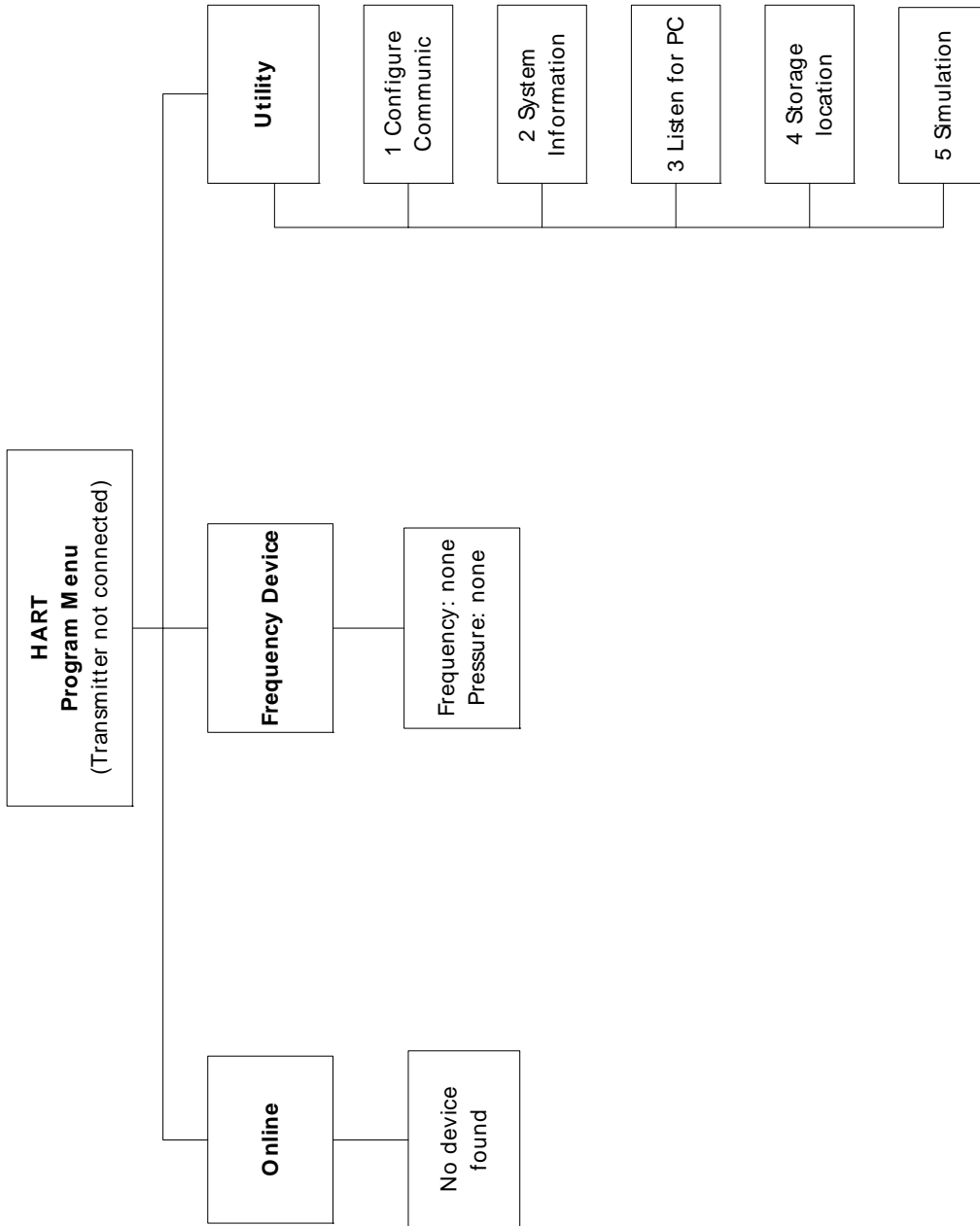


Figure 31: HART screen—Transmitter not connected

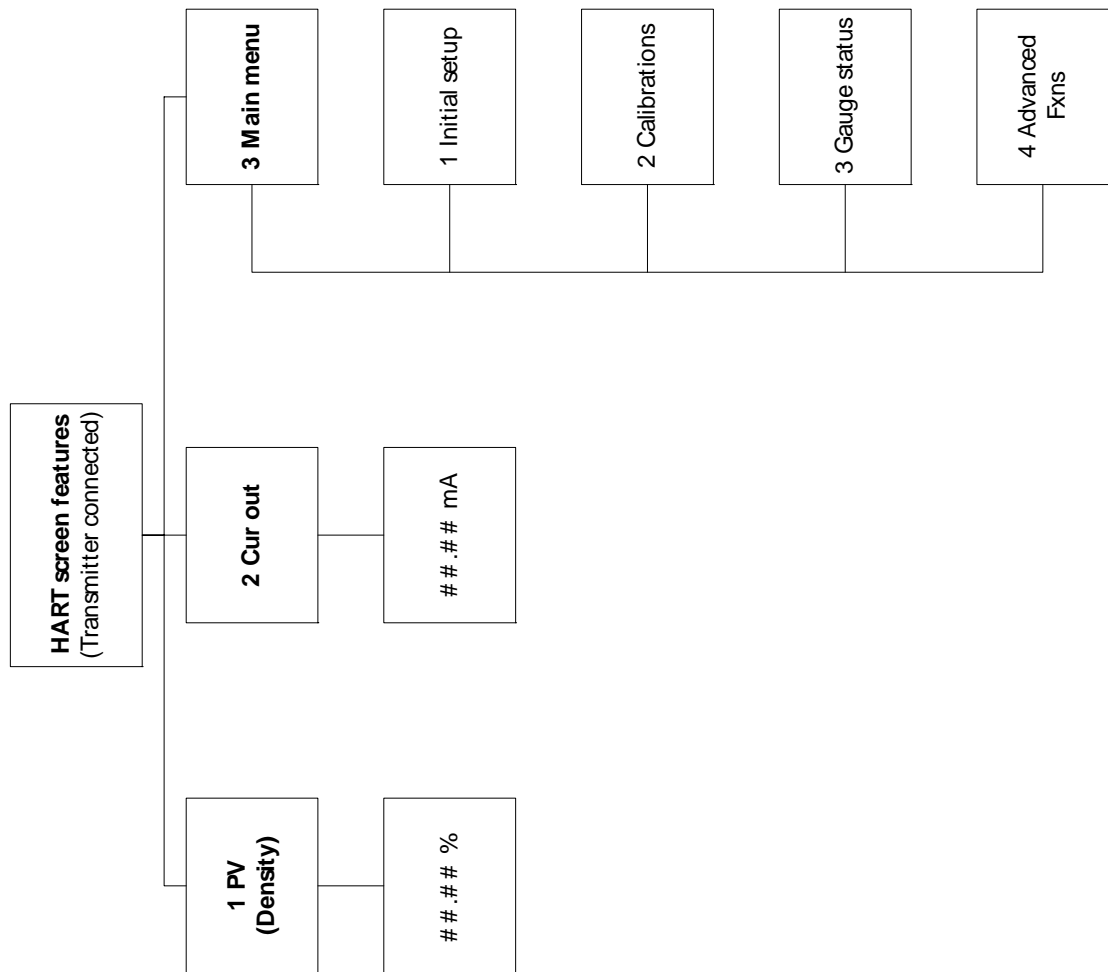


Figure 32: HART screen—Online

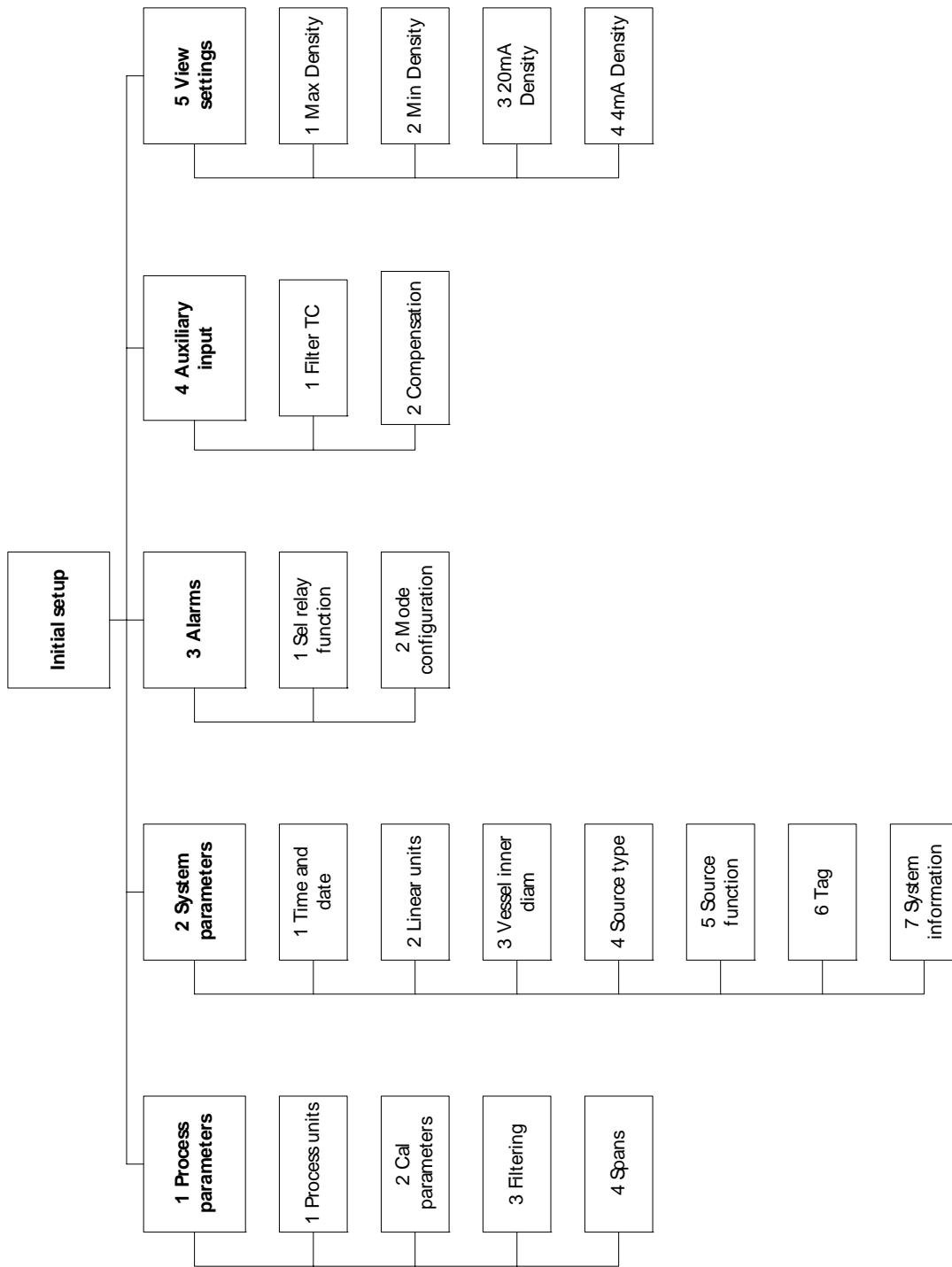


Figure 33: Initial setup

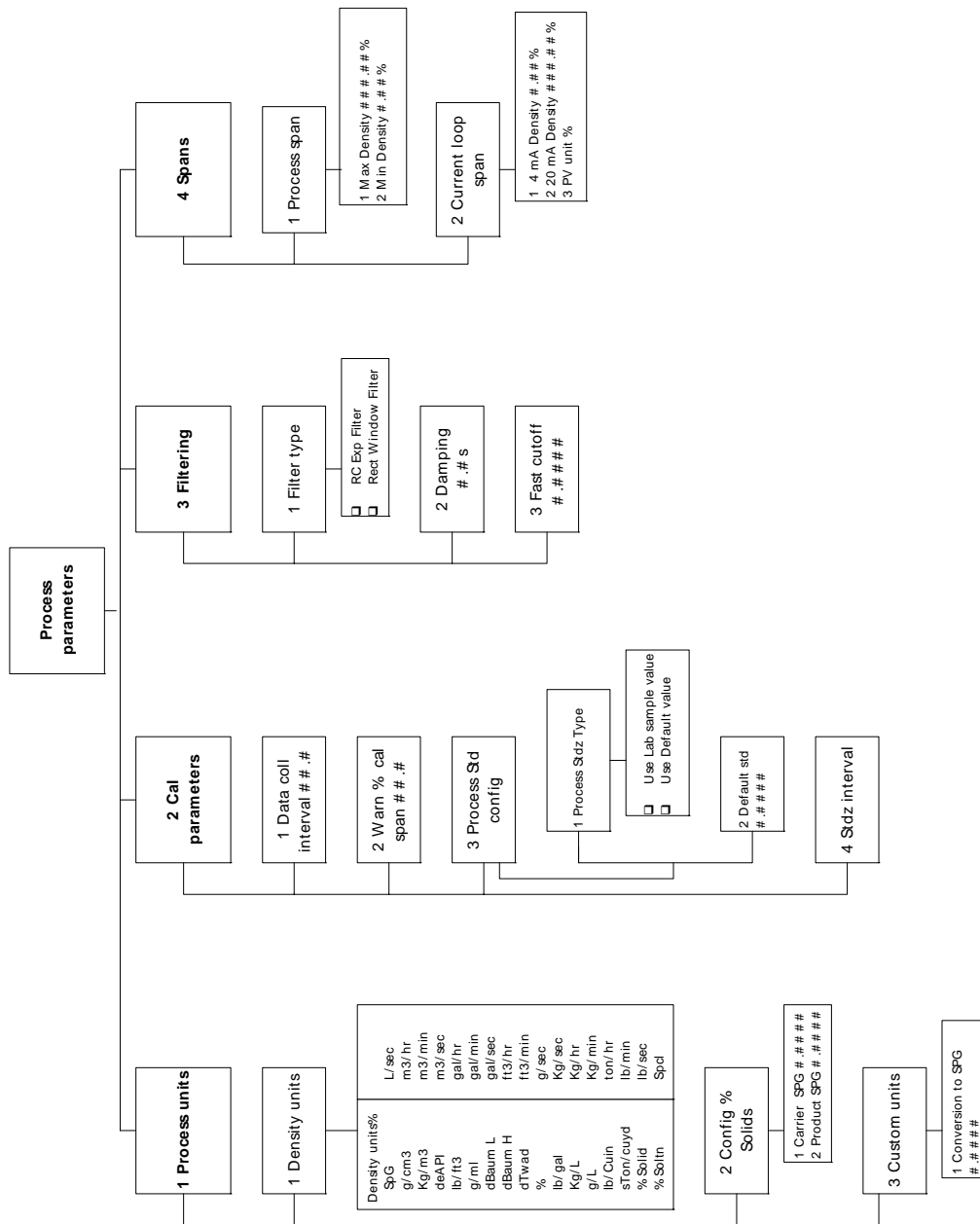


Figure 34: Initial setup—process parameters

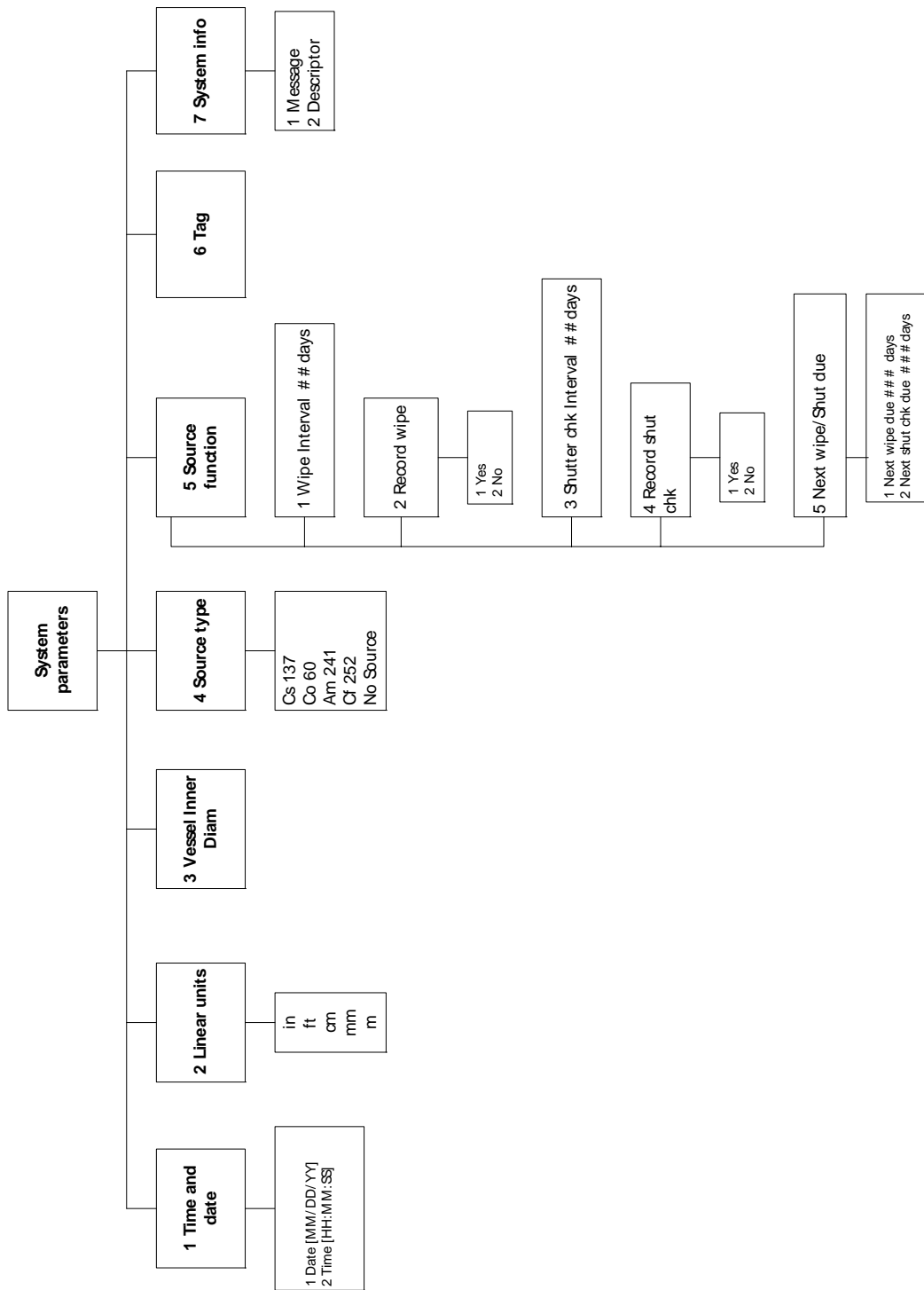


Figure 35: Initial setup—System parameters

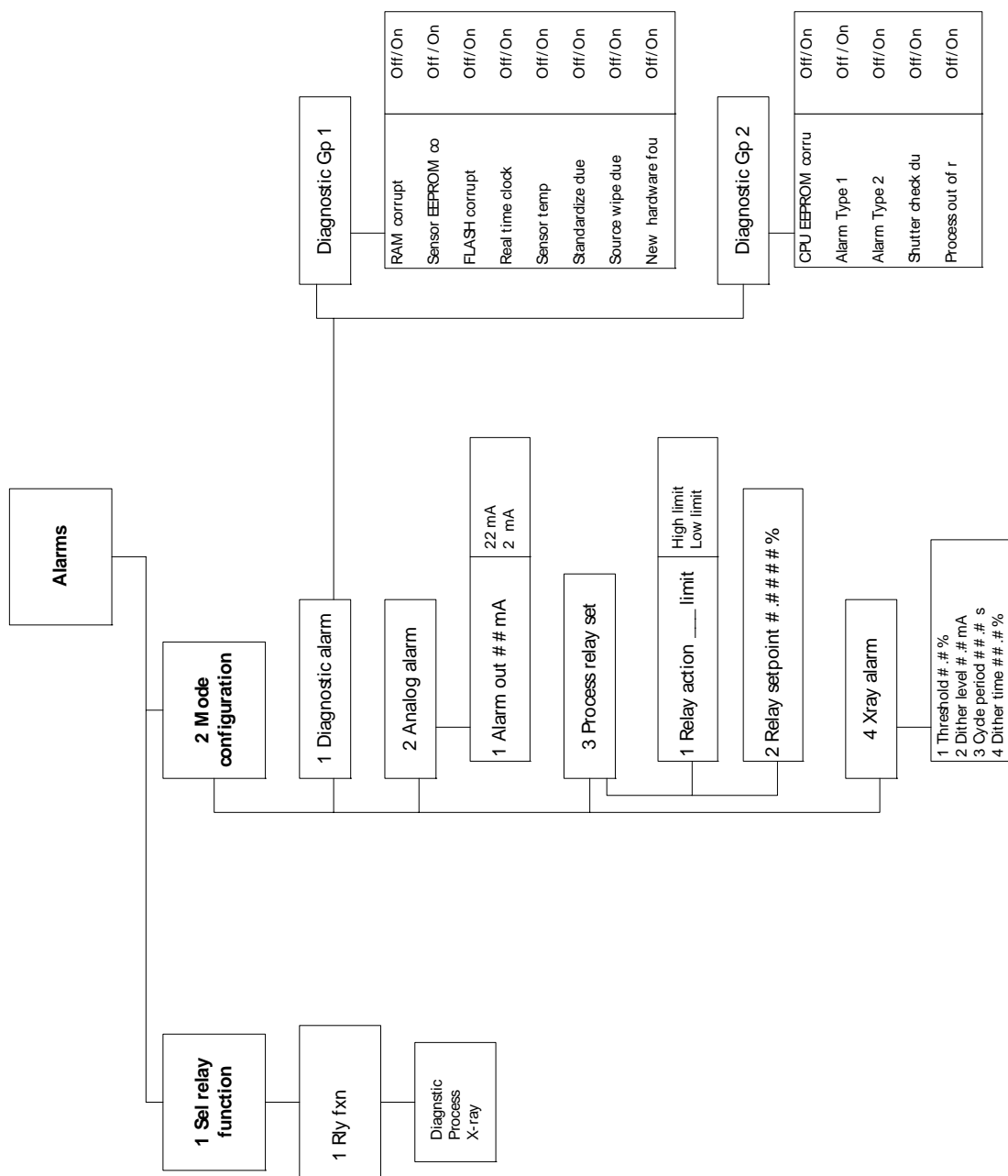


Figure 36: Initial setup—Alarms

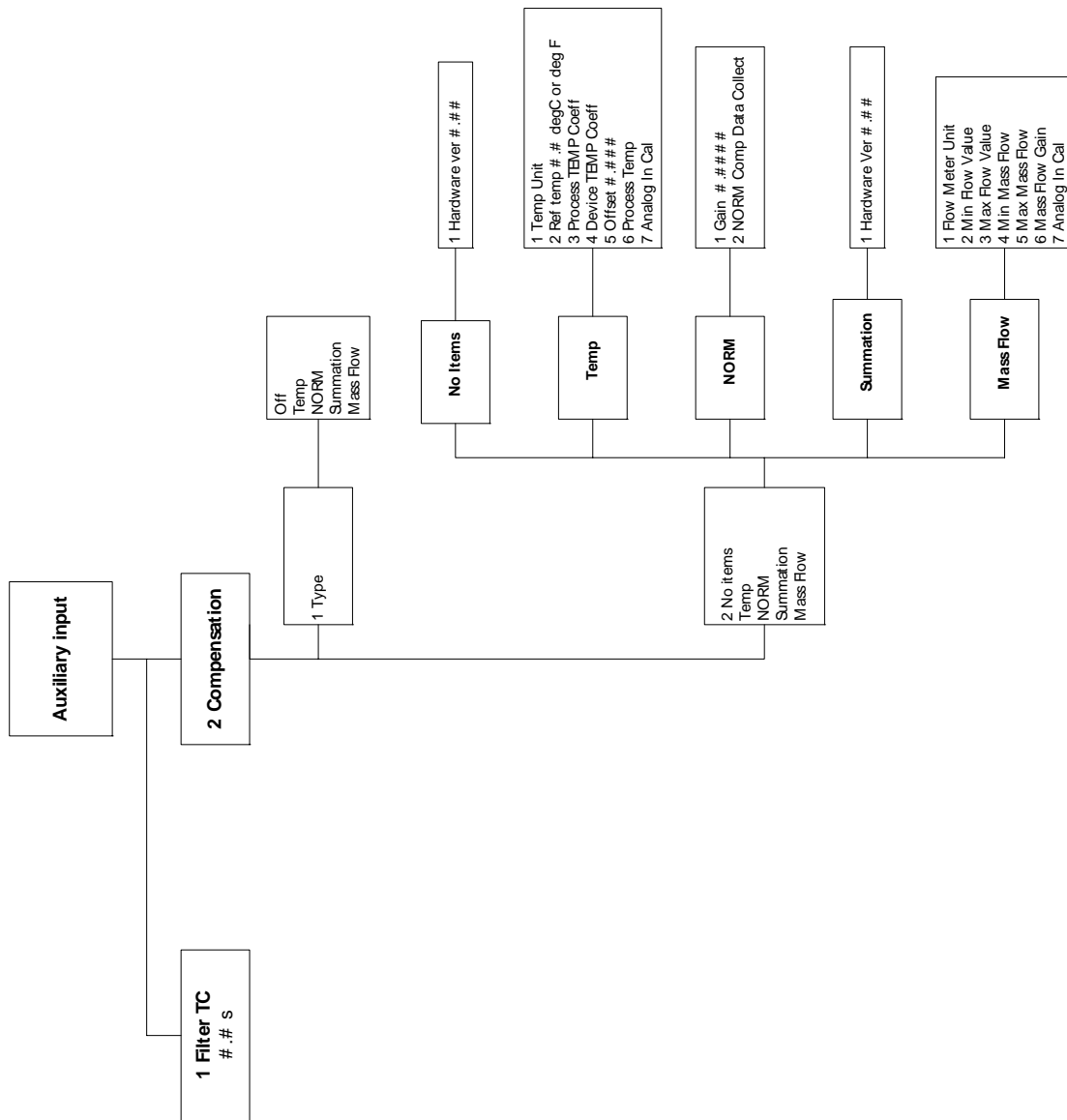


Figure 37: Initial setup—Auxiliary input

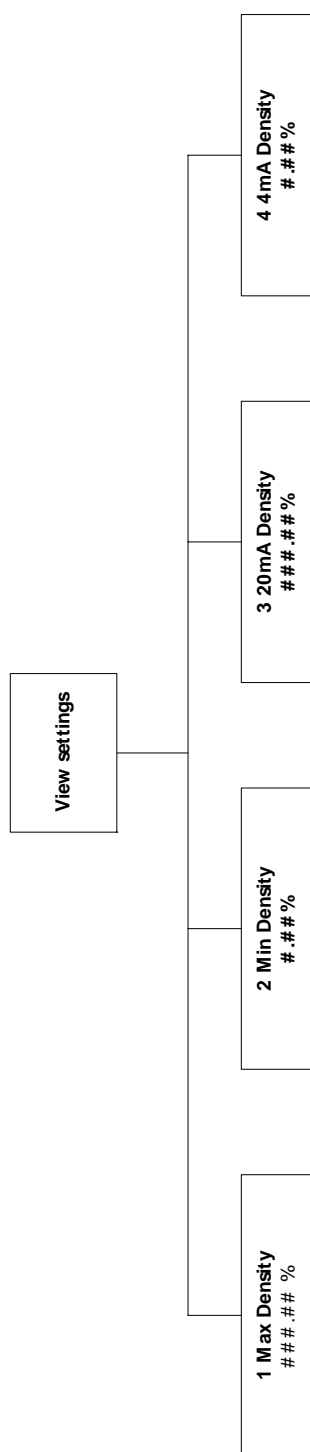


Figure 38: Initial setup—View settings

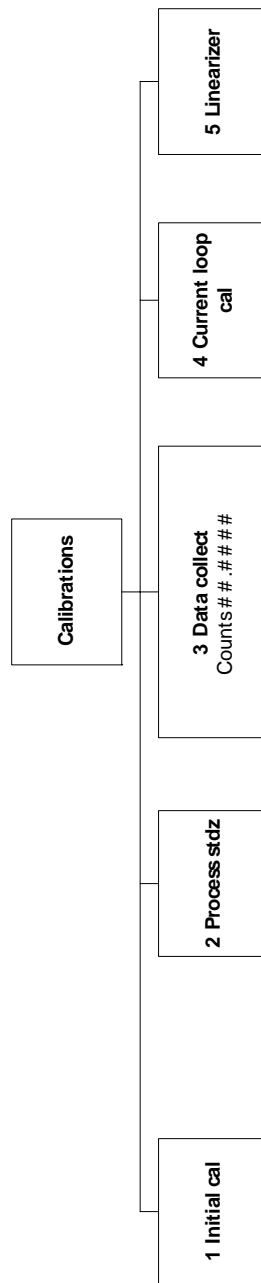


Figure 39: Calibrations

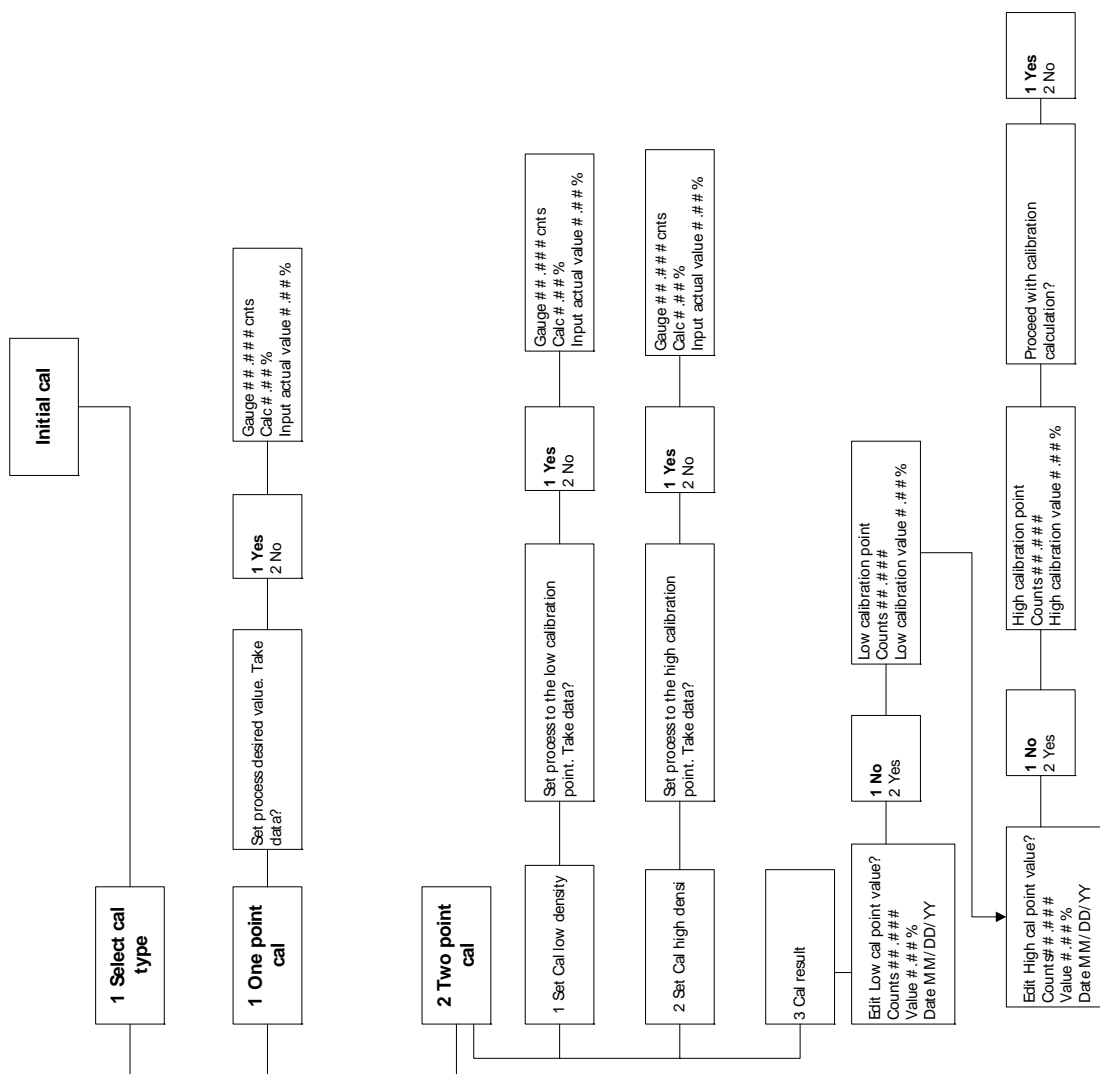


Figure 40: Calibrations—Initial cal

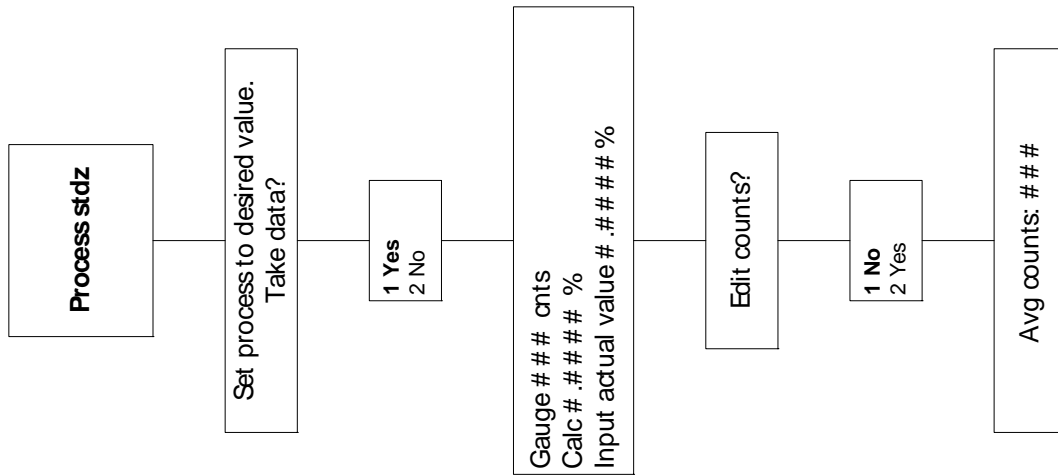


Figure 41: Calibrations—Process standardize

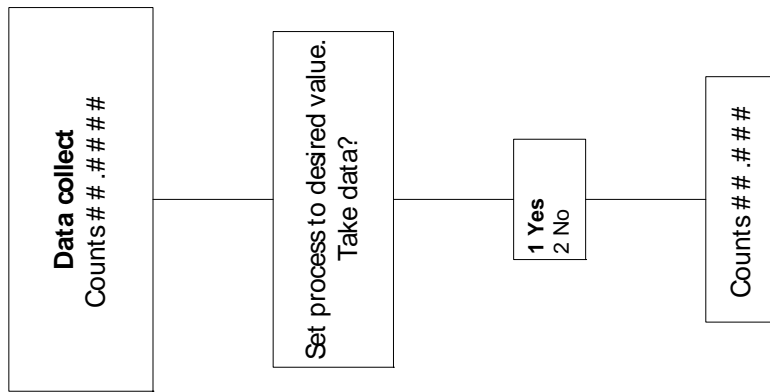


Figure 42: Calibrations—Data collect

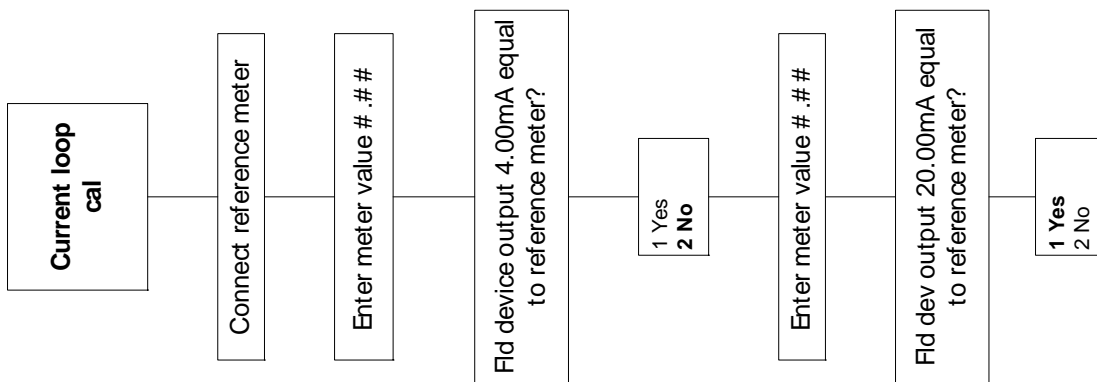


Figure 43: Calibrations—Current loop calibration

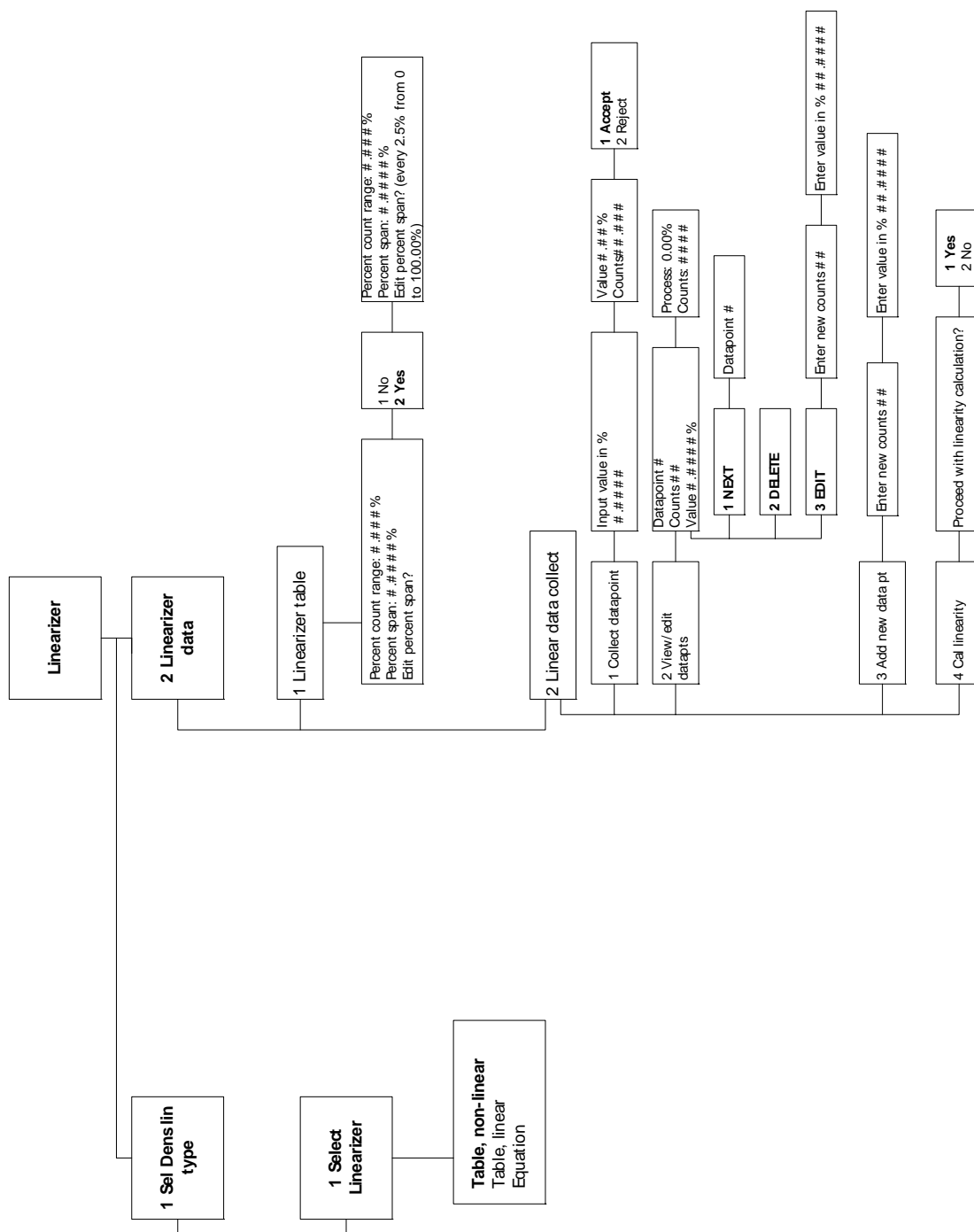


Figure 44: Calibrations—Linearizer

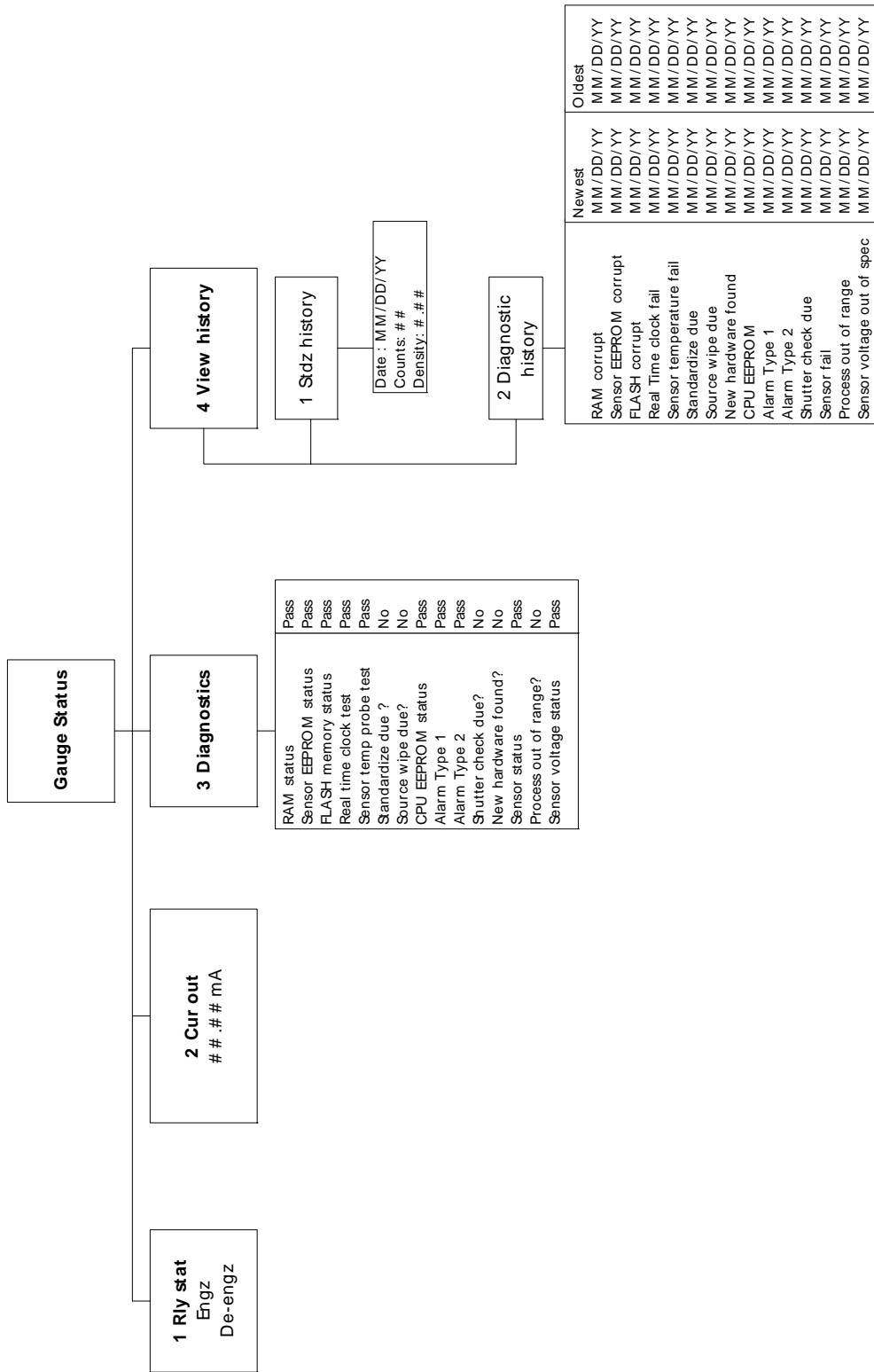


Figure 45: Gauge Status

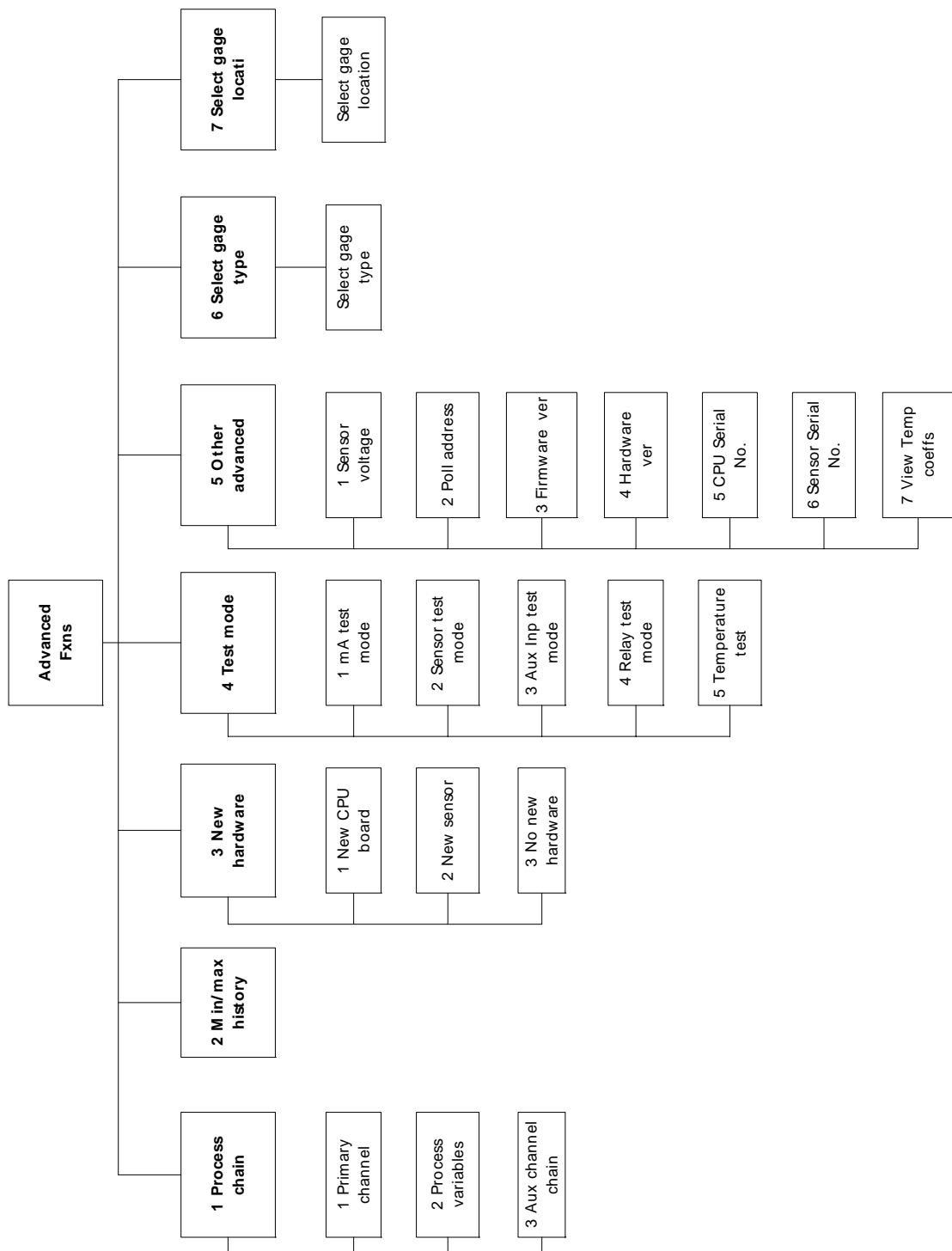


Figure 46: Advanced functions

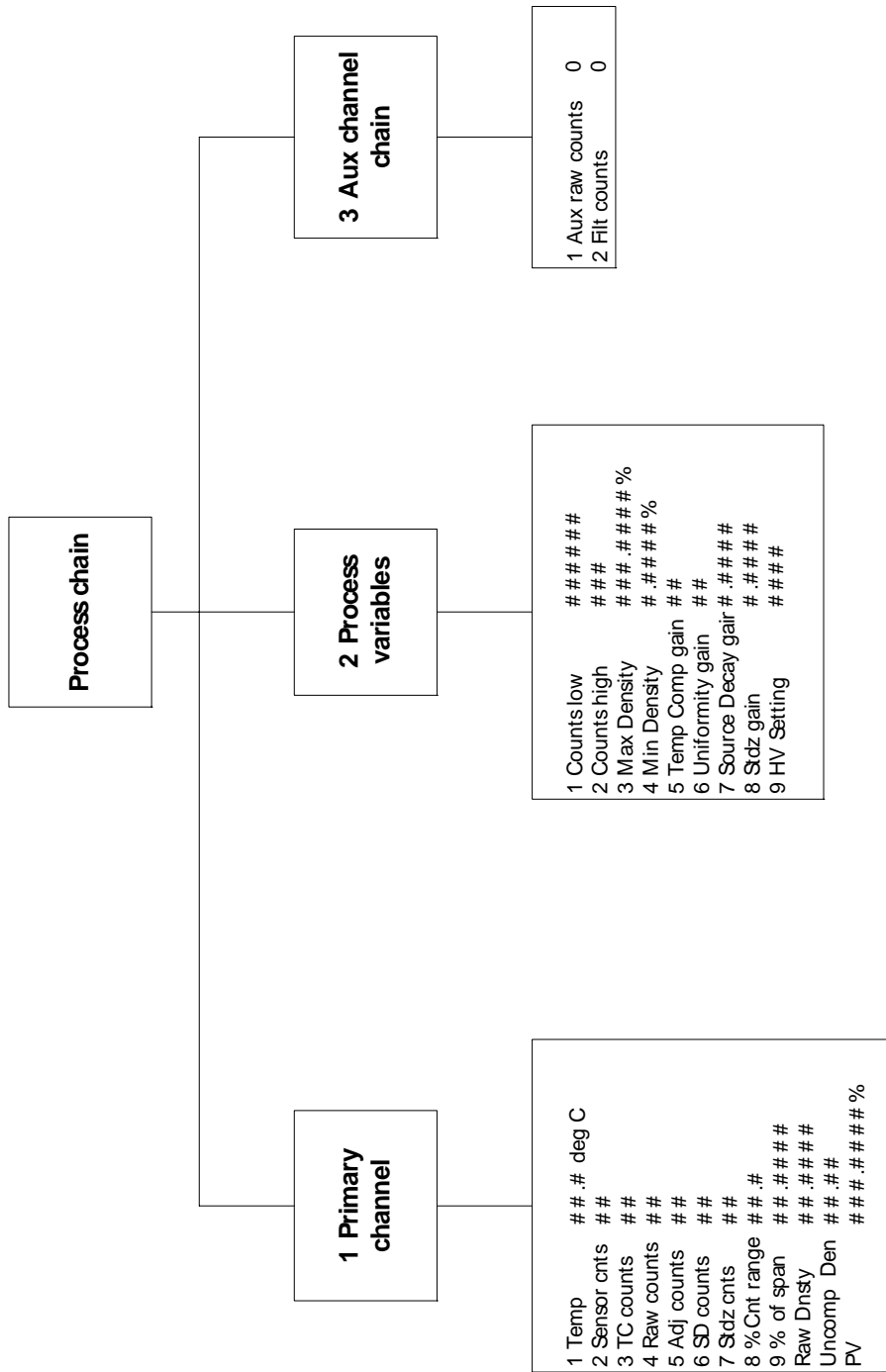


Figure 47: Advanced functions—Process chain

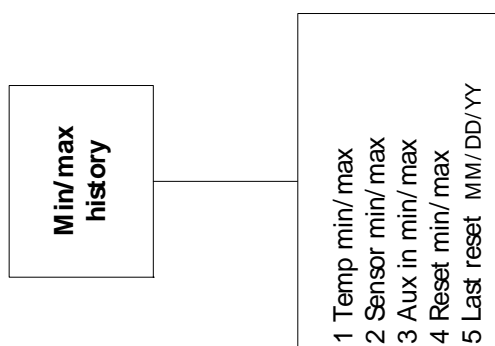


Figure 48: Advanced functions—Minimum/maximum history

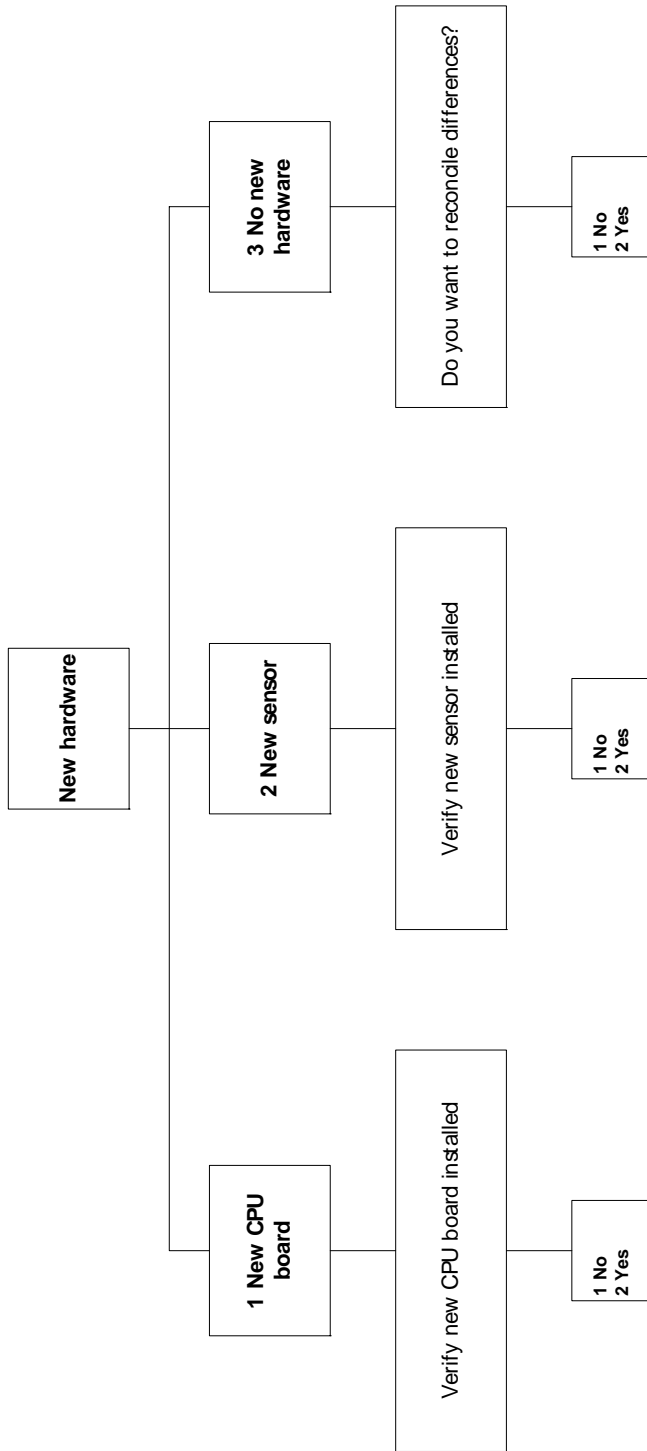


Figure 49: Advanced functions—New hardware

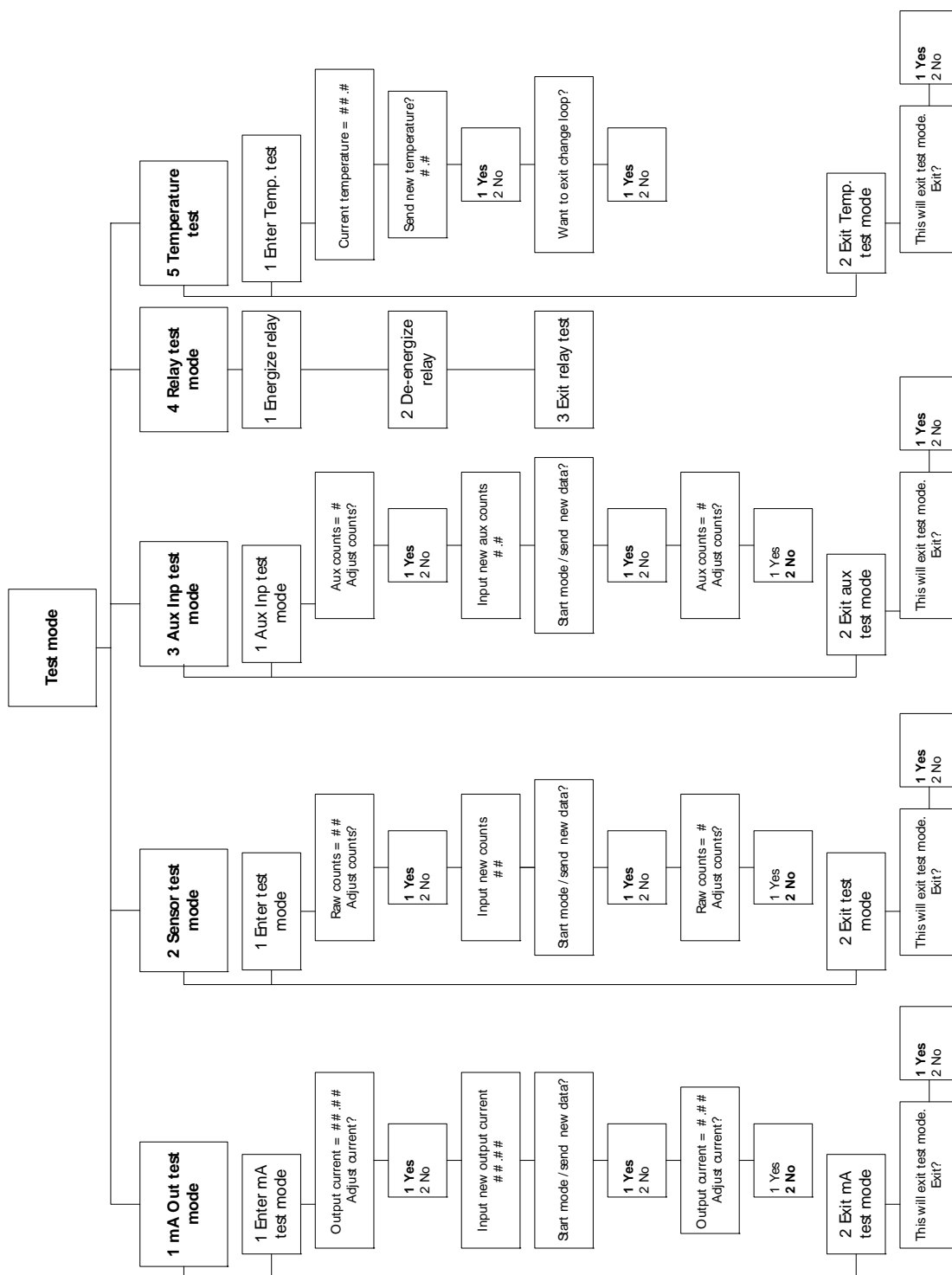


Figure 50: Advanced functions—Test mode

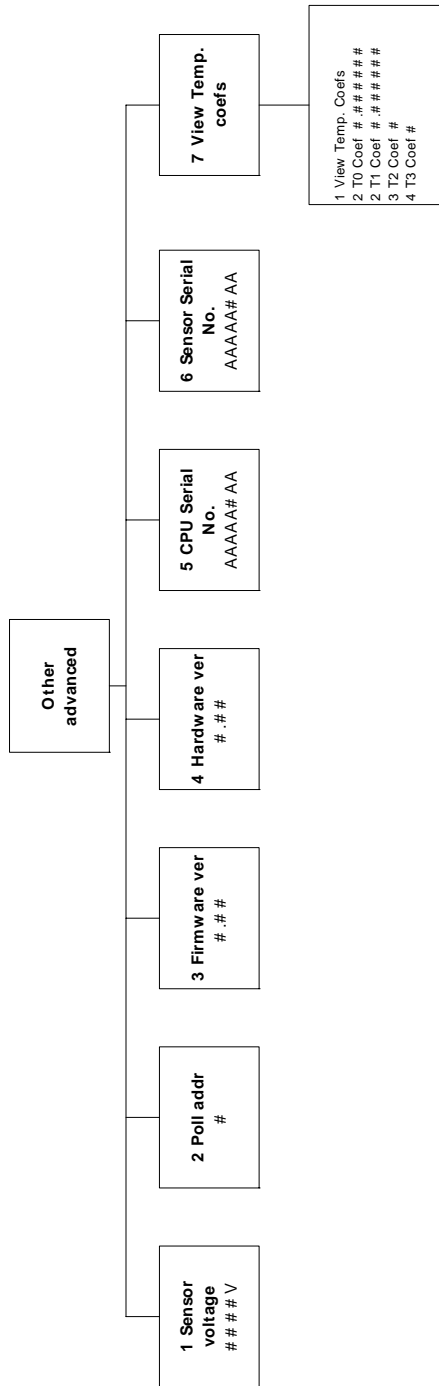


Figure 51: Advanced functions—Other advanced

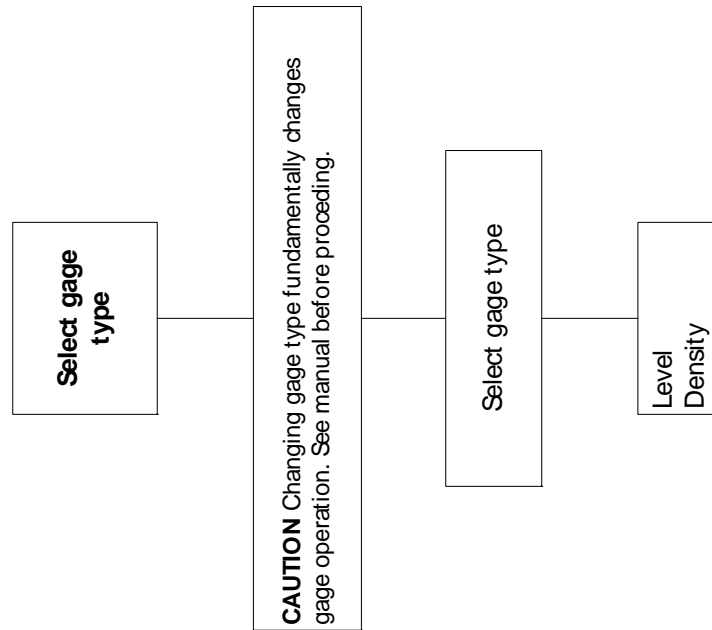


Figure 52: Advanced functions—Select gage type

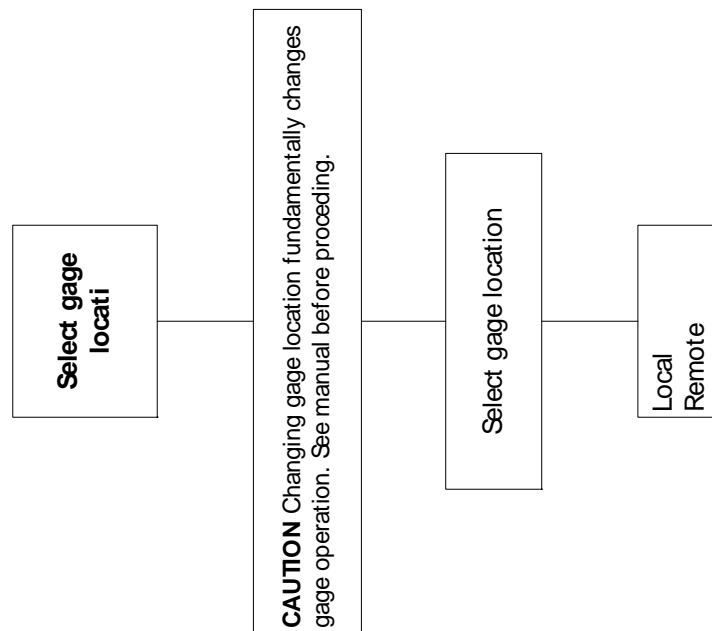


Figure 53: Advanced functions—Select gage location

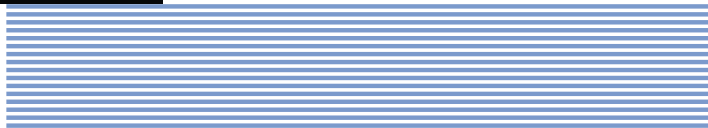
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