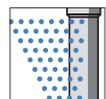


Technical Reference Manual DSGH[®]

Radiation-Based Detector with GEN2000[®]
Electronics for Density Measurement



Document ID:
31399



Revision history

Table 1: Revision History

Version	Description	Date
1.0	Initial release. Formerly 241528.	051201
1.1	Corrected website address for VEGA Corrected copyright and registered marks	061211
1.2	Electronics revision	090306
1.3	Added certification information and IECex lable	090814
1.4	Changed company name, logo, and website	110301
1.5	Removed one point calibration	111121
1.6	Updated certification information	140516

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WARNING

Use this equipment only in the manner that this manual describes. If the equipment is not used per 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

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

Your comments

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

Manual: DSGH Detector with GEN2000 Electronics 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:

VEGA Americas, Inc.
Director of Engineering
4241 Allendorf Drive
Cincinnati, OH 45209-1599

Chapter 1: Introduction

Nuclear materials notice

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

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

VEGA 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 VEGA 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 the “*Radiation Safety Manual References 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 VEGA 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 VEGA" 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. (This is not necessary if you have a SHGL source holder)



Note: Most source holder models accept a lock. Call VEGA 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 (not required for a SHGL source holder). 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 10 °C and 35 °C (50 °F and 95 °F) and less than 50% relative humidity. Keep the equipment dry until installation.

Certifications

This gauge is designed for certification compliance from the following agencies:

- ATEX Standard
- CCOE (India)
- CEPEL/INMETRO (Brazil)
- CSA
- FM Standard
- IECex
- JIS (Japan)
- KTL (Korea)
- NEPSI (China)

Safety Information for EX Areas

Please note the EX-specific safety information for installation and operation in EX areas.

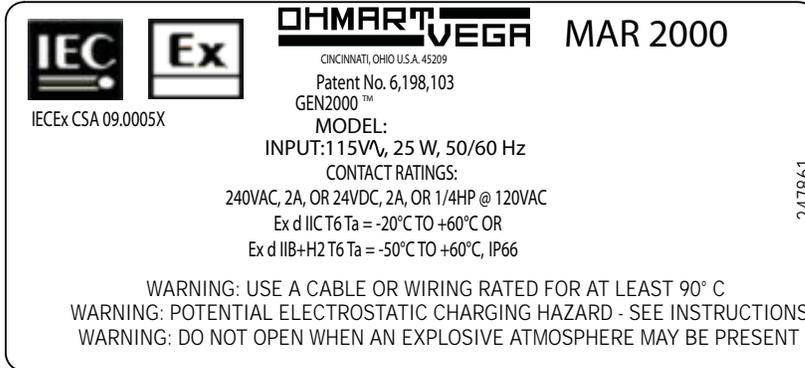


Figure 1: IECEx Label

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 & 1.3MeV gamma radiation emitter, 5.3 year half life
Power Requirements*	AC	100–230VAC±10% (90–250VAC) at 50 /60 Hz, at 15VA maximum power consumption (25VA max with heater) CE compliance requires 100 to 230VAC ±10%
	DC	20–60VDC (less than 100mV, 1/1,000 Hz ripple) at 15VA CE compliance requires 24VDC
	Wiring	1.63–0.643mm (#14–22AWG)
Signal Cable	Maximum length	1,000m (3,280ft)
	HART signal	1.02–0.643mm (#18–22 AWG) two conductor shielded
GEN2000® Electronics Housing	4-wire hookup with DC	1.02–0.643mm (#18–22 AWG) four conductor shielded
	Certification to CSA and UL standards	<ul style="list-style-type: none"> •Designed to meet National Electric Code (U.S. & Canada) •Class I, Group A, B, C & D, Div 1 & 2 •Class II, Groups E, F & G, Div 1 & 2
	CENELEC certification	EExd IIC T5 (pending)
	Enclosure rating	NEMA 4X IP-66
	Ambient temperature	–20 °C ... 60 °C (–4 °F ... 140 °F), option for lower temperatures available
	Humidity	0–95%, non-condensing
	Vibration	Tested to IEC 68-2-6, IEC 68-2-27 and IEC 68-2-36
	Material	Cast aluminum ASTM A 357
	Paint	Polyester Powder Coating
Weight	Detector housing	5.44kg (12lb)
Current Loop Output	Rating	4 ... 20 mA, isolated, into 250–800ohm
	Power	Jumper selectable: source (active) or sink (passive) mode.
Relay Output	Software user-settable	Diagnostic alarm or process high/low alarm function
	Rating	6A at 240VAC, or 6A at 24VDC (SPDTForm C) 1/4 HP at 120VAC
HART® Communication	HART Protocol	BEL202 FSK standard current loop output
	PC interface	HART modem and VEGA communications software package
	Optional hand-held interface	HART Communicator Model 275 hand-held terminal with VEGA device descriptions loaded
Auxiliary Input Capability	Type	Frequency input (0 /100 kHz)
	Possible function	Optional NORM or vapor phase comp., multiple gauge linking, etc.
Electronics	On-board memory	FLASH and two EEPROMs
	Real-time clock	Maintains time, date, & source decay compensation. Y2K compatible
Diagnostics	LED indication	+6V, Memory Corruption, HART, CPU Active, Auxiliary, High Voltage, Relay & Field Strength

* Power specifications change if an internal heater kit is used. See page 102.

Typical applications

Density

The DSGH 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 DSGH can measure the percent of solids in a carrier, when you enter the known density value of both the carrier and the solids into the software.

Cut detection or interface detection

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

System overview

The DSGH detector uses VEGA's GEN2000 electronics. The GEN2000 is VEGA's newest compact electronics that support 4 ... 20 mA HART protocol, frequency, or field bus output. The DSGH system consists of three main components:

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

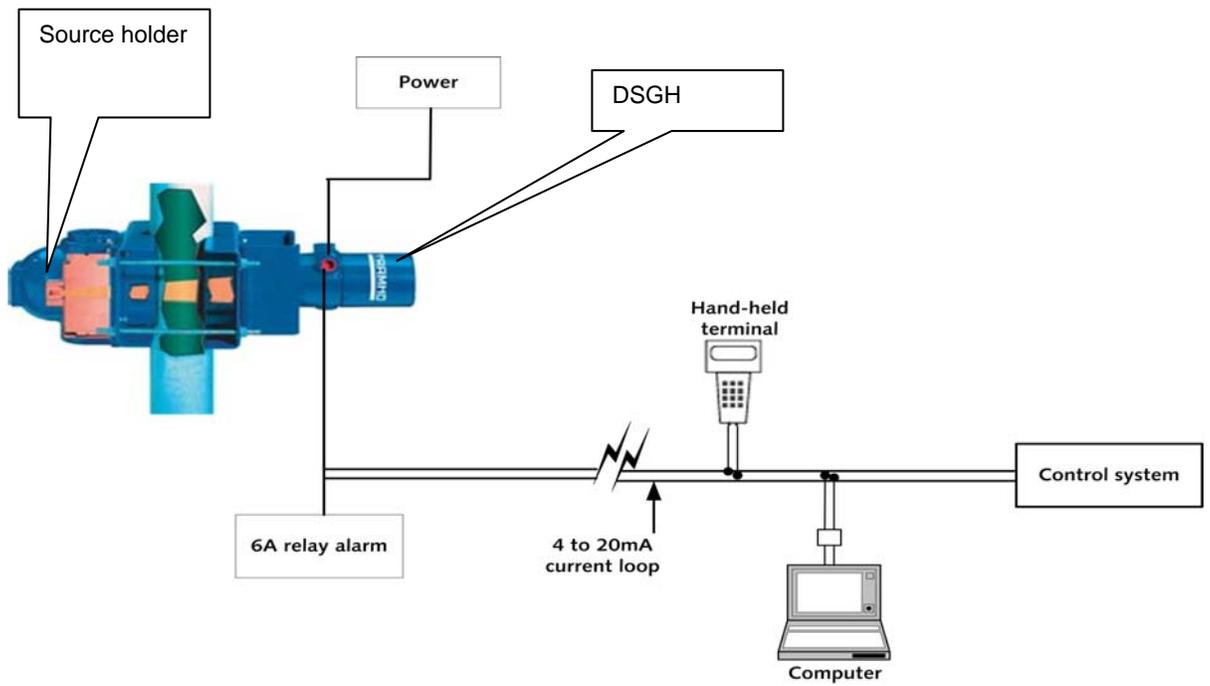


Figure 2: System overview

Introduction

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)

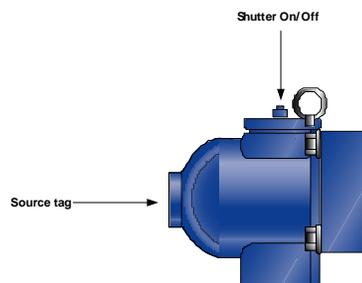


Figure 3: Typical source holder

DSGH 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

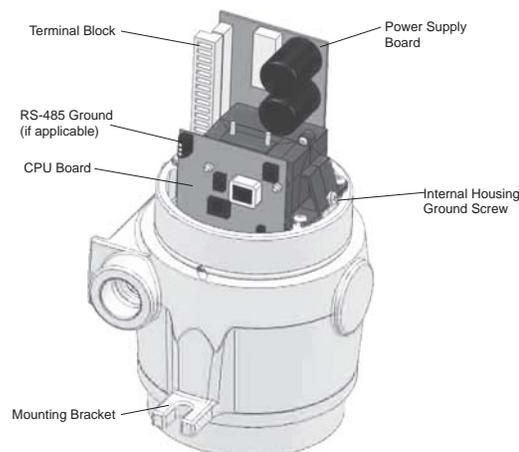


Figure 4: DSGH exploded view

Principle of operation

VEGA's DSGH 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 materials 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 DSGH associates the detector readings, known as counts, with the density of the material in engineering units. The output range of the DSGH is a 4 ... 20 mA current loop signal, in proportion to the density of the process. See "Appendix I, Table 16" for examples of process value settings.

Communicating with the gauge

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

Use either a HART Communicator or HART modem and VEGA View or Ohmview 2000 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 ... 20 mA current-loop line. After setup and calibration of the density gauge, there are no day-to-day requirements for external electronics.

Using a universal hand-held terminal

VEGA's DSGH 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 ... 20 mA current loop. To function, the minimum load resistance on the 4 ... 20 mA 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

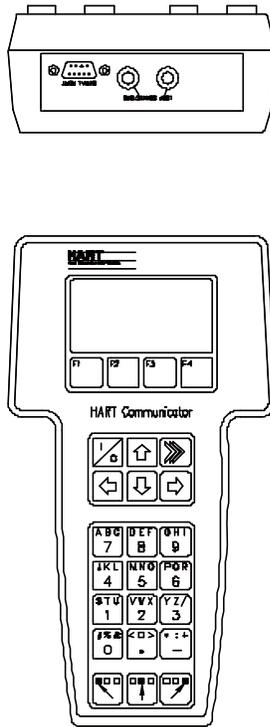


Figure 5: HART hand-held communicator

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

Use firmware 2000.00 or higher when you use the hand-held HART communicator to make temperature or mass flow compensation. See "Appendix II: Special Applications" for further information concerning compensation methods.

Using VEGA View software on a PC

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

- Modem
- Cables
- Software
- Manual

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

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

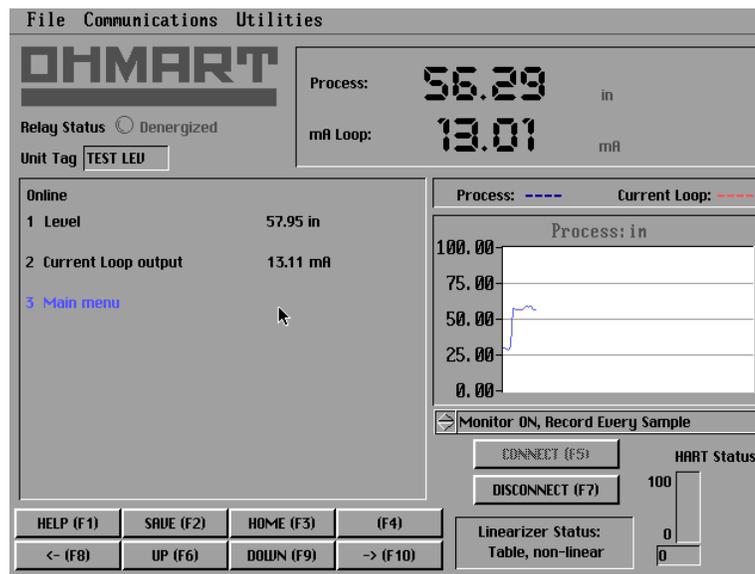


Figure 6: VEGA View software

Note: There are some minor differences in operation of the VEGA View software and the hand-held communicator. Most significantly, VEGA View software writes entries immediately to the density 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 *VEGA View User Manual* that accompanies the software diskette for complete instructions for using VEGA View software.

Using Ohmview 2000 Software on a PC

When you use an IBM-compatible personal computer with windows and a Pentium processor to communicate with the DSGH, or other VEGA HART transmitter field devices, you must have a HART modem and Ohmview 2000 software. The Ohmview 2000 software kit, part number 243008, includes the following:

- Modem
- Cables
- Software

Ohmview 2000, RS-485 Network, Ohmview 2000 Logger, and Ohmview 2000 Configuration software is a window's program that emulates the HART Communicator Model 275. In addition, Ohmview 2000 enables the following:

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

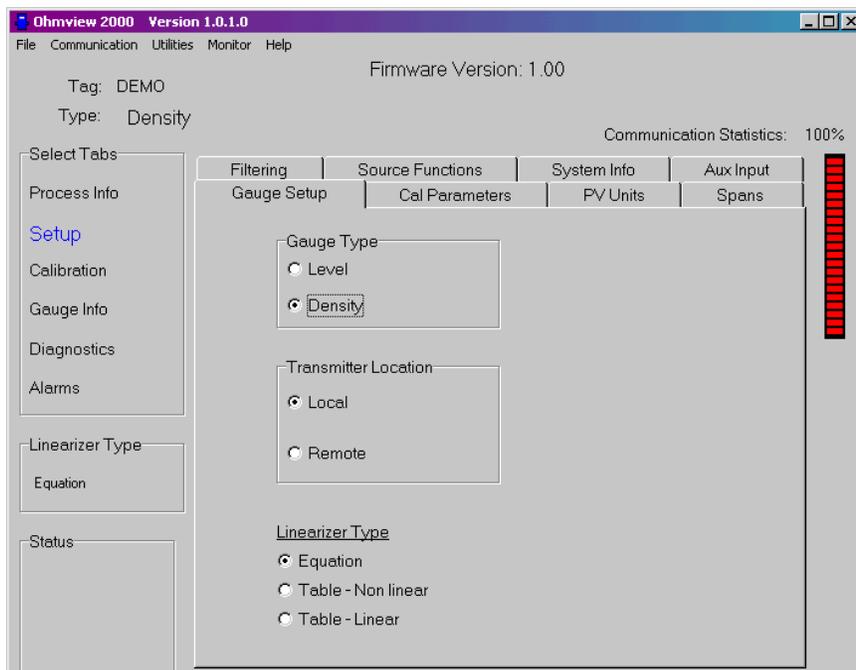


Figure 7: Ohmview 2000 software

Note: There are some minor differences in operation of the Ohmview 2000 software and the hand-held communicator. Most significantly, Ohmview 2000 software writes entries immediately to the 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 *Ohmview 2000 Electronic User Manual* that accompanies the software diskette for complete instructions for using Ohmview 2000 software.

The Ohmview 2000 software includes the main Ohmview 2000 software, HART Communication Server, Launcher program, RS-485 Network Configuration, Ohmview 2000 Logger, Ohmview 2000 File Configuration, and the Ohmview 2000 Electronic User Manual. When you insert the disk into your CD drive, the program automatically starts installing these programs onto your hard drive.

Note: The HART Communication Server must always be on when using Ohmview 2000's main program and Ohmview 2000 Logger.



Figure 8: Example of an Ohmview 2000 CD label

The HART screens menu structure

In both the hand-held HART Communicator and the VEGA View or Ohmview 2000 software, the user-interface for HART functions is in a menu structure. When the HART Communicator, VEGA View, or Ohmview 2000 starts up, the **Online** menu displays. For a detailed list of HART screen sub-menus, see “Appendix IV” of this manual.

Chapter 2: Installation

Testing on the bench

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

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

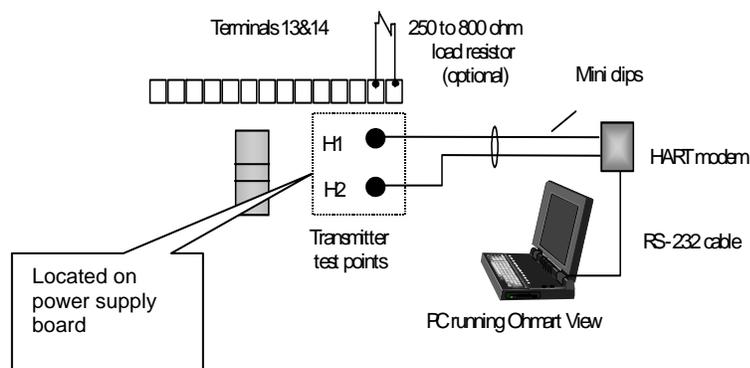


Figure 9: Bench test setup

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 39 for instructions on setting 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 DSGH was ordered, the source was sized for optimal performance. Notify VEGA 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 the *“Radiation Safety Manual References 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 DSGH near a pump can be good or bad depending on the application. Check with VEGA application engineers for a recommendation on your application.

No line hammering

The design of the DSGH 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 DSGH apart from the vessel or pipe, but notify VEGA at the time of the order to ensure proper source size and shielding.

Stable temperature

Mount the DSGH 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 VEGA temperature probe in the process as an input to the DSGH.

No air entrainment

Mount the DSGH 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, can result in an inaccurate gauge indication.

Standardization considerations

The DSGH 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 DSGH 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 VEGA provides. If the pipe has insulation, the DSGH 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 VEGA provides.

This does not apply if you have an SHGL (low activity) source holder.

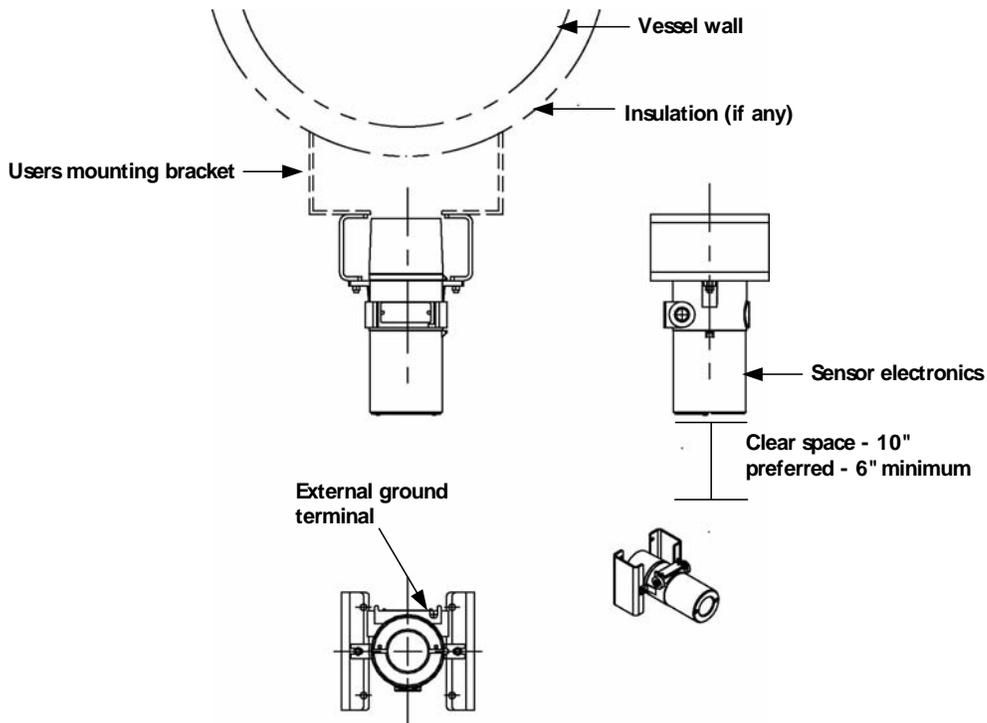


Figure 10: Mounting the detector

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.

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 power supply board. Access the power supply board by removing the explosion-proof housing cap.

Note: Not all connections are required for operation. See Table 4: Terminal names and descriptions.

VEGA provides an internal and external ground screw for connection of the power Earth ground wire. After removing the top cover, the location of the internal ground screw is at the front of the housing. The location of the external ground screw is next to the conduit entry.

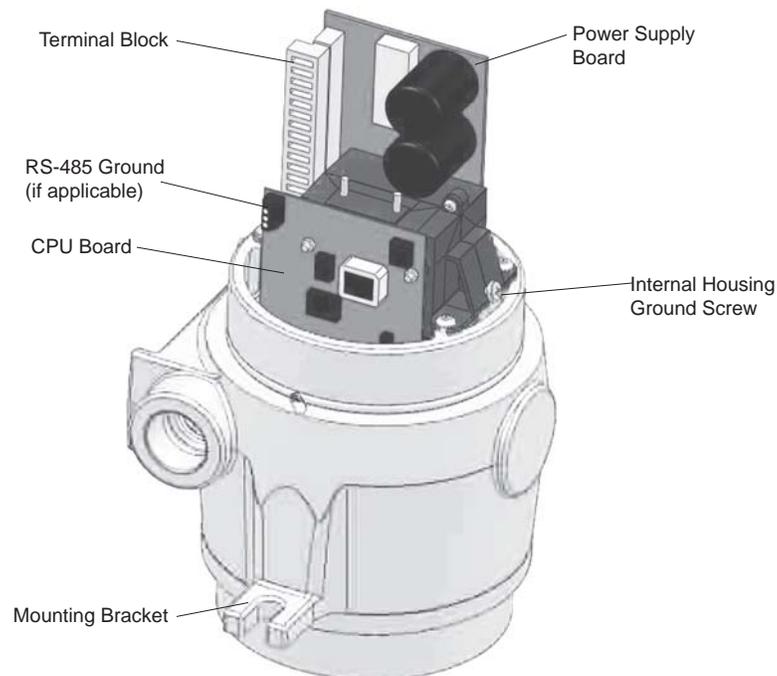


Figure 11: Internal and external ground screw

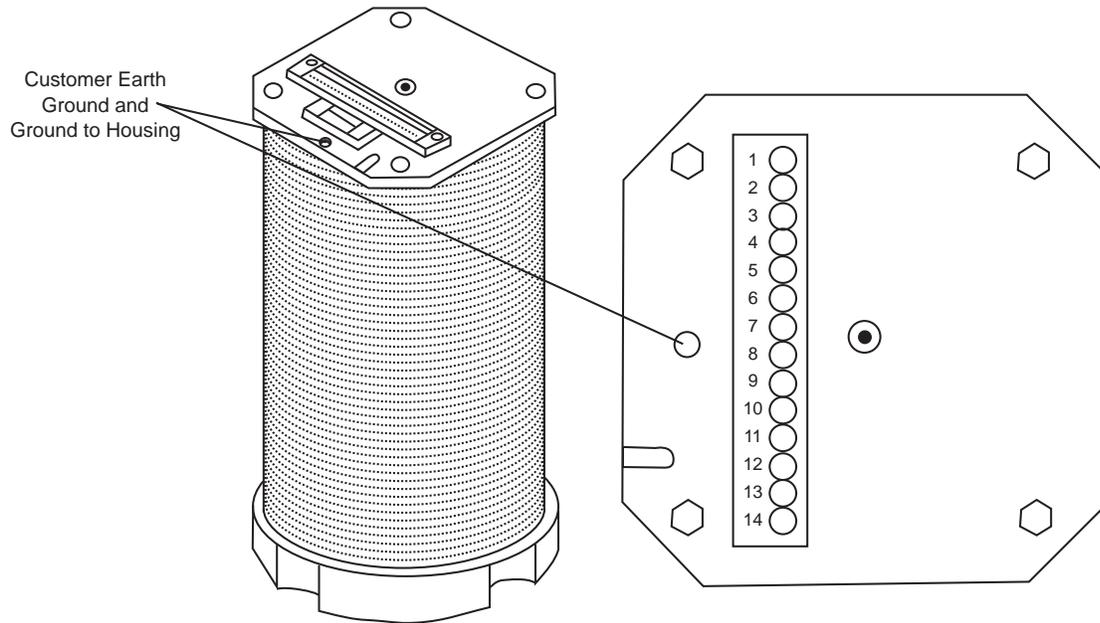


Figure 12: DSG Perforated View

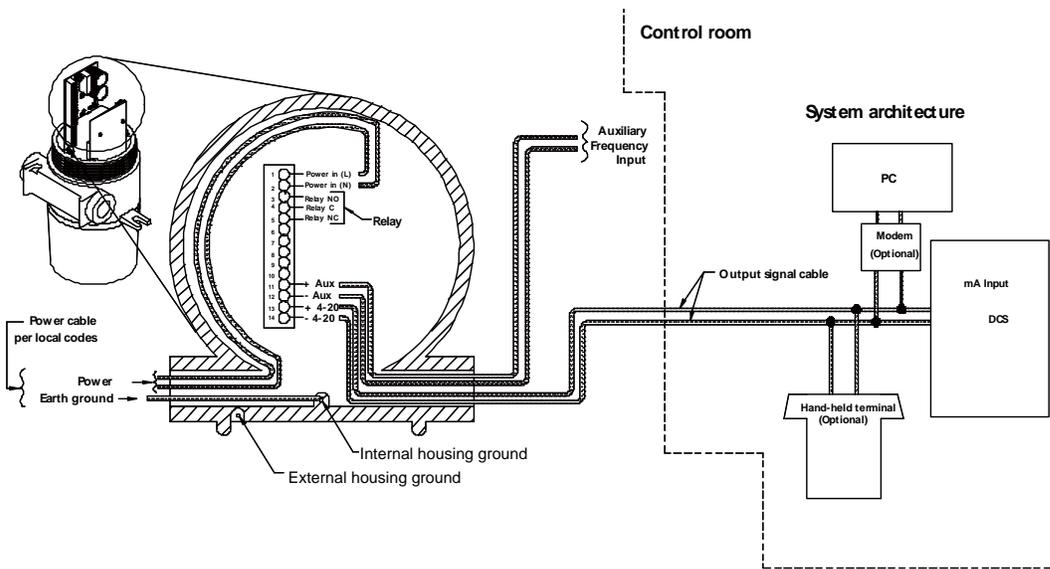


Figure 13: Typical interconnect

DSGH

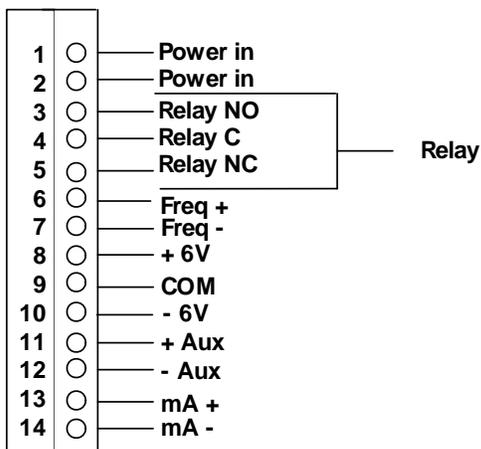


Figure 14: Terminal connections

Table 4: Terminal names and descriptions

Terminal	Name	Description
1	L1	AC or DC power input
2	L2	AC or DC power input
3	RY NO	Relay normally open
4	RY C	Relay common
5	RY NC	Relay normally closed
6	Freq+	Not used in HART® applications
7	Freq-	Not used in HART® applications
8	+6	Auxiliary input power
9	COM	Auxiliary input power common
10	-6	Auxiliary input power
11	Aux+	Auxiliary input frequency signal
12	Aux-	Auxiliary input frequency signal
13	mA+	Positive current loop output
14	mA-	Negative current loop output

Note: The power input terminals are not polarity sensitive.

Power



CAUTION!

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

The AC power source voltage input is 100–230VAC±10% (90–250VAC) at 50/60 Hz, at 15VA maximum power consumption. Do not share AC power with transient producing loads.

The DC power source voltage input is 20–60VDC (less than 100mV, 1/1,000 Hz ripple) at 15VA maximum power consumption. DC power cable can be part of a single cable 4-wire hookup, or can be separate from output signal cable. (See "Output current loop" section)

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 ... 20 mA into 250–800ohms (Ω).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 ... 20 mA output) cables that VEGA 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 or 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 ... 20 mA).

Communication

The HART hand-held terminal can connect anywhere across the 4 ... 20 mA wires to communicate with the DSGH. A minimum requirement is a 250 Ω load-resistance on the current loop. The hand-held terminal is Fisher-Rosemount HART Communicator Model 275 or equivalent (VEGA number 236907).

A HART modem can also connect across the 4 ... 20 mA wires to enable communication between the DSGH 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

VEGA 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: this does not apply if you are using a low activity source holder such as the SHGL.



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:

4. General
5. 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

Installation

- 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 VEGA 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 VEGA 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 VEGA 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 VEGA 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 DSGH is a regulated transient-free power source. UPS type power is the best
- ☑ If using DC power, verify that the ripple is less than 100millivolts

Note: The equipment warranty is void if there is damage to the DSGH due to incorrect wiring not checked by the VEGA 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.
- ☑ 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 VEGA Field Service if there is damage to the lock or it is missing. This does not apply if you are using a low activity source holder such as the SHGL.

Notes

Chapter 3: Calibration

Before using the DSGH 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

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

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

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

Current loop (analog output) calibration

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

To correlate the 4 ... 20 mA 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 4 mA and the 20 mA 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.

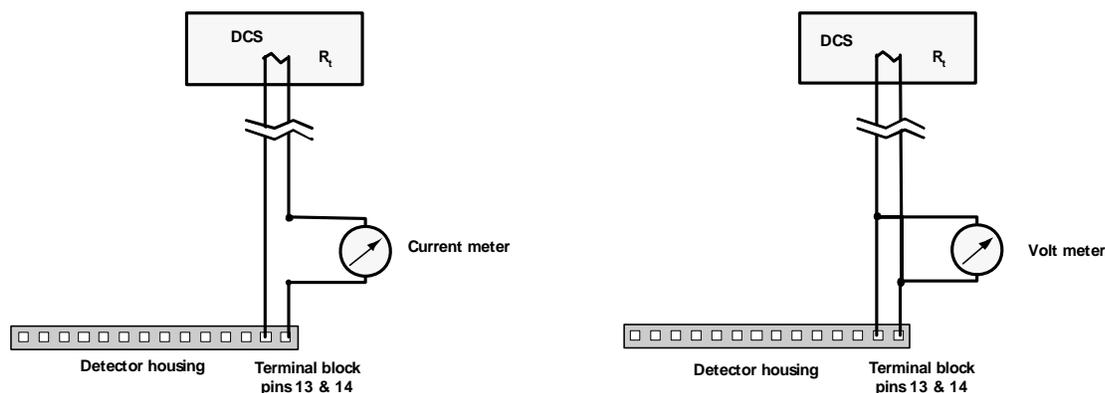


Figure 15: Measuring the current loop output

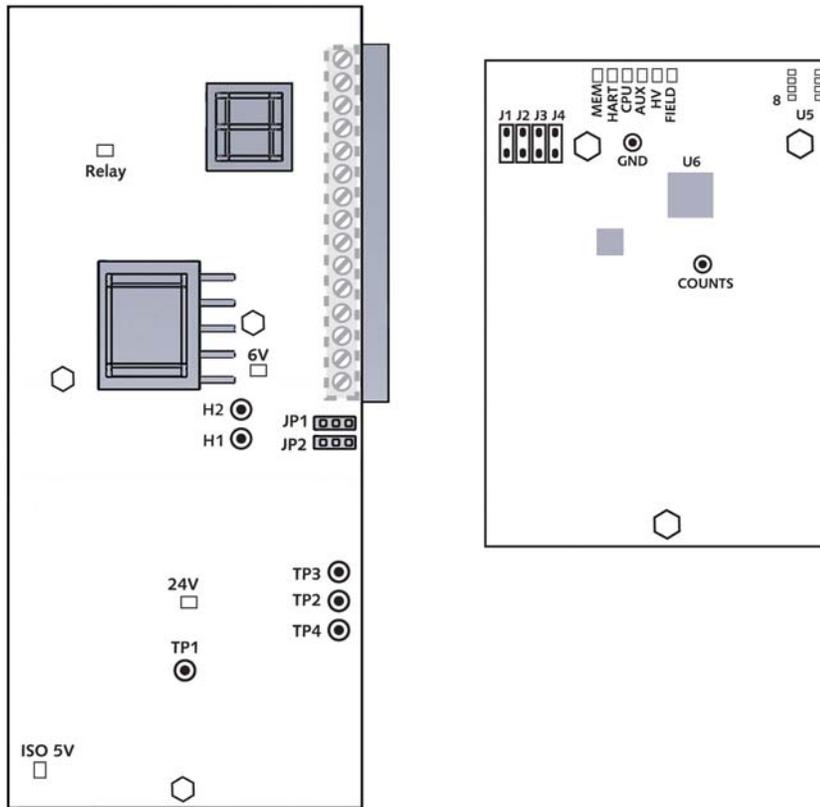


Figure 16: H1 and H2 test points

Before a current loop calibration:

- ☑ Connect an ammeter or the DCS to terminal connections 13 (mA +) and 14 (mA –) or the test points H1 and H2 on the power supply board, or anywhere along the current loop
- ☑ Make sure there is a 250Ω to 800Ω 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 13 and 14

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 after you connect the ammeter

The screen displays, Setting Field Device Output To 4 mA. The analog output circuit on the transmitter sets the current to approximately 4 mA
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 mA Equal to Reference Meter?
 - Choose **Yes** if the ammeter reads 4.00 mA
 - Choose **No** if the ammeter reads anything but 4.00 mA
6. Repeat until the meter reads 4.00 mA. The meter approaches the 4.00 mA successively
7. Repeat procedure for 20 mA 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.

Preparing for calibration

Figure 17 illustrates the steps to prepare for and perform the recommended two-point calibration.

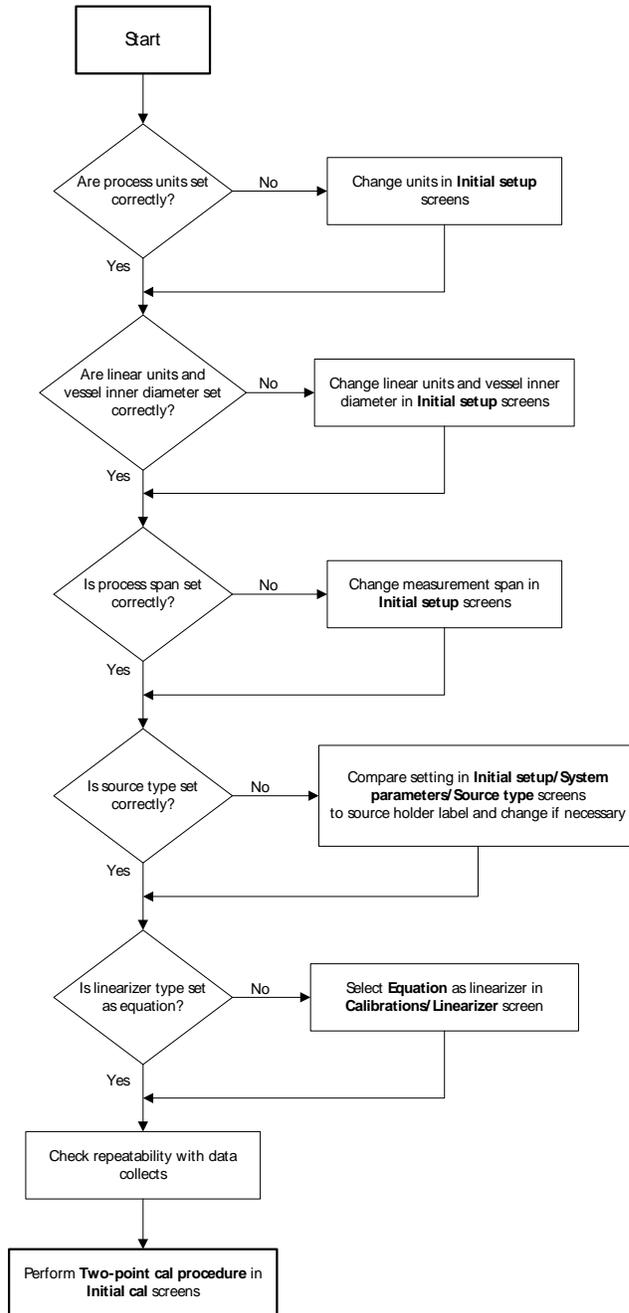


Figure 17: Density two-point calibration flow chart

Table 5: Flowchart steps and manual heading

Step in flow chart	Manual heading	Page
Check process engineering units	Units	82
Check linear units and vessel inner diameter	System parameters, linear units, and vessel inner diameter	90
Check process span	Span settings and process span	88
Check linearizer type	Choosing the linearizer type	43
Check the repeatability of measurement	Checking the gauge repeatability	44
Performing two-point calibration	Recommended two-point process calibration	45

Choosing the linearizer type

The DSGH 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 DSGH 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. VEGA recommends using the equation linearizer method first. If results are not satisfactory, contact VEGA 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 91)
- Span settings parameter (see page 88)
- Data used in the calibration
- Absorption co-efficient

Using the equation linearizer also enables a one or two-point 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 Main menu, select Calibrations|Linearizer| Select linearizer
2. On the **Select linearizer** screen, the current linearizer displays on the second line
3. From the **Select linearizer** screen, select either:
 - Table, non-linear
 - Table, linear
 - Equation
4. Press F4 to enter

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

Checking the gauge repeatability

Check the DSGH 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 84.

Performing a data collect

Procedure 3: Performing a data collect

1. From the Main menu, select Calibrations|Data collect
2. 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
3. After data collection, the screen displays the number of counts (cnts) output by the sensor. Make note of the counts value
4. Repeat as often as necessary to check repeatability.

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 DSGH of the low process sample
- Entry of the actual density.

This sets the low end (sometimes referred to 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 Calibration” beginning on page 42
- ☑ 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 4: To set the cal low density

1. From the Main menu, select Calibrations|Initial cal|Two point cal|Set Cal low density
2. 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
3. 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
4. At the prompt, Input Actual Value, enter the actual density, from the lab, in engineering units
5. If using a hand-held communicator, press F2 to send the calibration setting to the DSGH.

Step 2: Set high density

Setting the high density for calibration requires the following:

- Measurement with the DSGH 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 5: To set the cal high density

1. From the Main menu, select Calibrations|Initial cal|Two point cal|Set Cal high densi
2. 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
3. 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.
4. Take the sample drawn during the data collect to the lab to determine the actual density
5. The prompt, Input Actual Value, displays. Enter the actual density, from the lab, in engineering units
6. If using a hand-held communicator, press F2 to send the calibration setting to the DSGH.

Step 3: Calculate calibration

The DSGH 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.

Procedure 6: To calculate the calibration

1. From the Main menu, select Calibrations|Initial cal|Two point cal|Cal result
2. 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
3. The prompt, Proceed with Calibration Calculation?, displays. Select **Yes** to proceed with the calculation.
4. Press F2 to save.

When is a new calibration necessary?

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

- Measurement of a new process application (contact VEGA 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 DSGH
- Moving the DSGH to another location. Note: In the U.S. only persons with a specific license can relocate the gauge (excluding a low activity gauge such as the SHGL).
- 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 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 DSGH alarms when standardization is due. The standardize interval is programmed into the calibration parameters setup. Refer to “Appendix I: Initial Factory Setup”, for details on the following subjects:

- Output relay setup
- Standardization due alarm
- Standardization interval

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 1.0SpG, 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 7: Standardization on water

1. From the Main menu, select Initial setup| Process parameters|Cal parameters| Process Std config| Process Stdz Type
2. On the Process Stdz Type screen, choose Use Default value
3. 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
4. Press F2 to send.

Standardization on process

Measure process in the pipe with the DSGH, 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 DSGH reads what the lab reads at that density.

Calibration

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

Procedure 8: Standardization on process

1. From the Main menu, select Initial setup|Process parameters|Cal parameters|Process Std config| Process Stdz Type
2. On the Process Stdz Type screen, choose the Use Lab Sample value option
3. Enter the value of the sample and press F4 to enter
4. 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 DSGH detector for the standardization procedure.
- You can purchase absorber plates from VEGA
- The use of absorber plates requires a mounting kit from VEGA. 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 calibration. You must determine the equivalent value of the absorber plates after the calibration of the DSGH 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 9: To standardize on absorber plates

1. From the Main menu, select Initial setup|Process parameters|Cal parameters|Process Std config|Process Stdz Type
2. On the Process Stdz Type screen, choose Use Default value
3. 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

4. Press F2 to send.

Performing a standardization

Before performing 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 10: To perform a standardization

1. From the Main menu, select Calibrations| Process stdz
2. 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
3. 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
4. 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 VEGA personnel for advanced troubleshooting and repair. This chapter gives a basic explanation of these functions.

Note: VEGA 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 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.

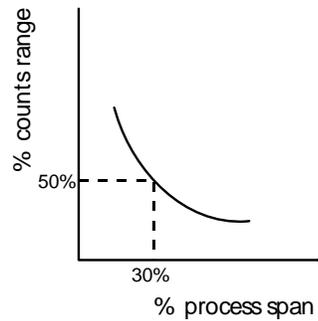


Figure 18: Percent counts range vs. percent process span

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 is made during the 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 is made during the 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 DSGH 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 11: Resetting the minimum and maximum history

1. From the Main menu, select Advanced Fxns|Min/max history
2. From the Min/max history screen, select Reset min/max
3. When prompted, select **Yes** to reset the min/max values. Or select **No** to cancel
4. 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, the EEPROM backups on the CPU 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 the CPU board and the sensor assembly 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 12: New Hardware Found message with new CPU board

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

3. Press F2 to save.



CAUTION!

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

To repair the corruption from the EEPROM backup

Procedure 13: Repairing corrupted EEPROM

1. From the Main menu, select Advanced Fxns|New hardware|No new hardware
2. 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
3. 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? displays, select **Yes** to ignore the Status Error.

Start milliamp output test mode

Procedure 14: To start the mA output test mode

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

Exit milliamp output test mode

Procedure 15: To exit the mA output test mode

1. From the Main menu, select Advanced Fxns|Test mode|mA Out test mode| Exit mA test mode
2. 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 16: To start the Sensor test mode

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

Exit sensor test mode

Procedure 17: To exit the Sensor test mode

1. From the Advanced Fxns menu, select Test mode|Sensor test mode|Exit test mode
2. 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 18: To start the Auxiliary test mode

1. From the Main menu, select Advanced Fxns|Test mode|Aux Inp test mode|Aux Inp test mode

2. At the prompt, select **Yes** to adjust counts
3. Input the Aux counts that you want to force
4. At the prompt, select **Yes** to start test mode and send new data
5. The transmitter continues functioning in auxiliary test mode until it times out after one hour, or until you choose **Exit Aux test mode**.

Exit auxiliary input test mode

Procedure 19: To exit the Auxiliary test mode

1. From the Advanced Fxns menu, select Test mode|Aux Inp test mode| Exit Aux test mode
2. 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 20: To start the Relay test mode

1. From the Main menu, select Advanced Fxns|Test mode|Relay test mode| Energize relay or De-energize relay
2. 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 21: To exit the Relay test mode

1. From the Advanced Fxns menu, select Test mode|Relay test mode|
2. 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 22: To start the 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 23: To exit the 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 DSGH
- 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 VEGA 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 24: To check the 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

Advanced Functions

Select gauge type

VEGA's nuclear density gauges use much of the hardware and software of the DSGH. If your DSGH indicates density 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 gauge.

Procedure 25: To select the gauge 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 gauge location

The local gauge refers to a gauge that has its sensor electronics and processing electronics all contained in the same housing. Set a gauge to remote if the sensor electronics and processing electronics are in separate housings and the process signal connects to the auxiliary input of the processing electronics.

Procedure 26: To select the gauge location

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

Notes

Chapter 5: Diagnostics and Repair

Software diagnostics

The DSGH 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:

- Diagnostic
- Analog
- Process
- X-ray

Diagnostic alarm

Provides information about the DSGH 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 6: 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:

Diagnostics screens in the **Gauge Status** menu

HART messages that appear when a HART device connects if the diagnostic condition is set to **On** in the **Initial setup** screens

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 69 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 27: Checking and acknowledging diagnostic alarms

1. From the Main menu, select Gauge status
2. From the **Gauge status** menu, select **Diagnostics**
3. The first diagnostic condition displays. Press F4 to view all the conditions
4. If a diagnostic condition is in alarm, you can either:
 - clear the alarm by choosing Acknowledge alarm
 - or ignore the alarm by 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 DSGH, any conditions in alarm display on the screen.

Summary of diagnostic alarm conditions

Table 7: 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 VEGA 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 58.
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 DSGH for more than 28 days, reset the time and date.) To resolve, try to reset the time and date. If the time and date do not reset, call VEGA 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 $-0.5\text{ }^{\circ}\text{C}$ constantly, the probe is broken and you may need to replace the sensor assembly. Call VEGA Field Service.
Standardize due?	No / Yes	Standardize due	A standardize procedure is due. Alarm is acknowledged automatically by the system when a process standardize procedure is completed 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 77 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. Perform the procedure, “Repairing corrupted EEPROM” on page 58.
Alarm type 1	Not used		Not used in standard software. Consult VEGA special software.
Alarm type 2	Not used		Not used in standard software. Consult VEGA 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 77 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 57 for more information.
Sensor status?	Pass / Fail	Sensor fail	Less than one count seen in the last 10 seconds. (Configurable by Field Service.) Indicates the sensor is malfunctioning.
Process out of range?	No / Yes	Process out of measurement range	The current process value is not within the limits set by the Max 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 VEGA), 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.

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 DSGH 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 DSGH 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 DSGH 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 density or until a time-out period of 60 minutes.

The standard x-ray alarm only triggers when the counts are greater than the cal low count value. These counts are found on the process variable menu. If the x-ray source is setup so that the counts increase but do not go above the cal low counts, the x-ray alarm does not trigger and the gauge reads the x-ray interference as a true process shift.

VEGA has a system that can detect x-rays that are causing process changes. This system places a second detector outside of the radiation beam of the primary detector. The second detector only monitors x-ray interference. The second detector has a frequency output that wires to the auxiliary input of the primary detector. The primary detector's programming triggers the x-ray alarm when the counts of the secondary detector are above a threshold. Contact VEGA for more information about the x-ray interference detection method.

Figure 19 illustrates the current loop output. You can set the parameters of the output. Refer to "Appendix I: Initial Factory Setup".

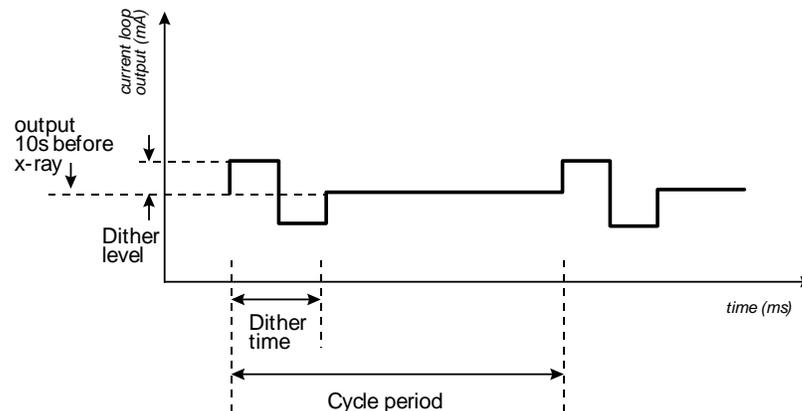


Figure 19: X-ray interference alarm output

History information

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

- RAM corrupt
- Sensor EEPROM corrupt
- 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

Diagnostics and Repair

- Process out of range
- Sensor voltage out of spec

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

Hardware diagnostics

There are two circuit boards in the DSGH that are field replaceable. Figure 20 identifies these two circuit boards.

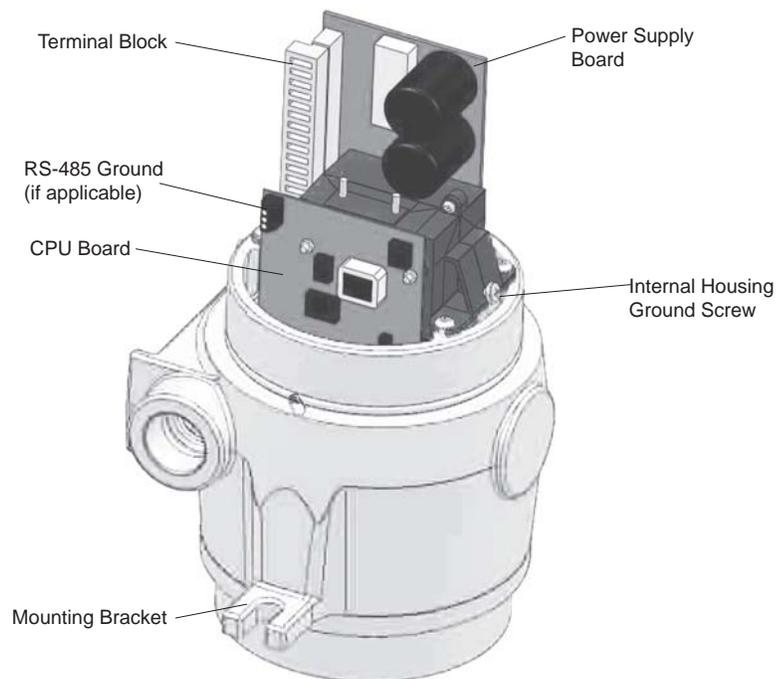


Figure 20: Circuit board identifications

Refer to Figure 21 for help in finding test points, fuses, jumpers, and connectors on the CPU circuit board.

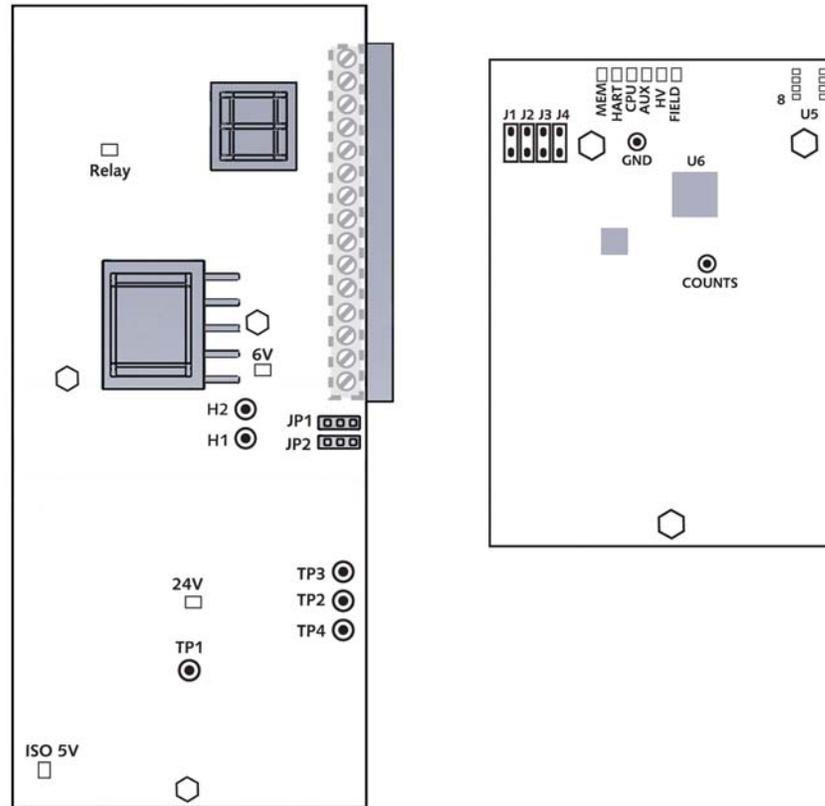


Figure 21: CPU board and power supply board simplified component layout

Test points

Test points are located on the power supply and CPU board. Table 8 lists and describes the power supply board test point labels.

Table 8: Power supply board test point labels and descriptions

Power supply board test point label	Description
H1	HART connection
H2	HART connection
TP1	Isolated ground
TP2	Loop current test point 200mV/mA loop current. Referenced to isolated ground.

Table 9 lists and describes the CPU test point labels.

Table 9: CPU test point labels and descriptions

CPU test point label	Description
Count	Raw input signal coming from preamp.
GND	Logic ground
U5 pin 8	+5V power supply test points referenced to Logic ground.

Jumpers

Jumpers JP1 and JP2 on the power supply board set the current loop source or sink mode. Do not change the jumpers from the current setting without consulting VEGA 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 (DSGH current loop is self-powered)	JP1 1–2, JP2 2–3
Sink mode (DSGH current loop is DCS-powered)	JP1 2–3, JP2 1–2

The DSGH does not use jumpers J1-J4 on the CPU board.

LED indicators

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

See the Tables on page 76 for a summary of the LED indications. Figure 22 illustrates the LED indicators.

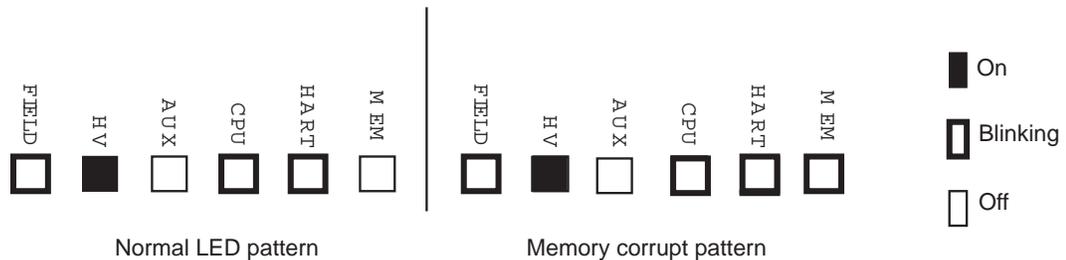


Figure 22: LED indicators

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 Figure 22.

Call VEGA Field service to report this condition.

Table 11: Power supply board LED summary

Power Supply Board LED summary table

LED	Description	Normal condition	Error condition	Recommendation
+6V	+6V DC voltage level to electronics	ON	OFF—electronics are not receiving +6V DC voltage required for functioning.	Verify +6V on test points. Check fuse on Power Supply board. Check power input terminals 1, 2.
+24V	Analog output loop voltage	ON	OFF—24V not present on 4 ... 20 mA output. 4 ... 20 mA output and HART communications are bad.	Check loop wiring and jumpers JP1, JP2 on Power Supply board. Replace Power Supply board.
Relay	Relay condition indicator	ON when relay is energized. OFF when relay is de-energized.	None	Check against relay output terminals 3, 4, & 5. If no relay output, replace Power Supply board.

CPU Board LED summary table

Table 12: CPU board LED summary

LED	Description	Normal condition	Error condition	Recommendation
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 VEGA Field Service.
HART	HART communication indicator	ON—blinks when receiving HART messages	None	Check HART device connection on loop and HART device functioning.
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.
Aux	Auxiliary input frequency signal indicator	Blinks if auxiliary input present. OFF if no auxiliary input present	None	Check auxiliary input wiring terminals 11 and 12 with a meter for frequency signal. Check auxiliary input equipment.
HV	Sensor high voltage	ON—high voltage is in spec	OFF—high voltage is out of spec	Call VEGA Field Service
Field	Radiation field indicator	Cycles in proportion to radiation field intensity at detector. ON for 10 seconds for each mR/hr, then off for two seconds. (Can use LED 5 that blinks 1 time/sec to time LED 9 for field indicator.)	None	A 1mR/hr (2,580nC/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
- DSGH transmitter not responding
- Measurement not correct

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

- CPU board
- Power supply board

Maintenance and repair

Periodic maintenance schedule

Since the DSGH 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 13: 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 DSGH 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 DSGH 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 28: To record 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 29: To check the due date of the 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

Contact VEGA Field Service at +1 513-272-0131 for parts, service, and repairs.

Outside the U.S., contact your local VEGA representative for parts, service, and repairs.

Field repair procedures

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

- CPU circuit board
- Power supply circuit board

Use great care to prevent damage to the electrical components of the gauge. VEGA recommends appropriate electrostatic discharge procedures.

Replacing the CPU or power supply board

You may have to replace a circuit board if there is damage to one of its components. Before replacing a circuit board, check the troubleshooting flowcharts or call VEGA 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 30: To replace the CPU or power supply board

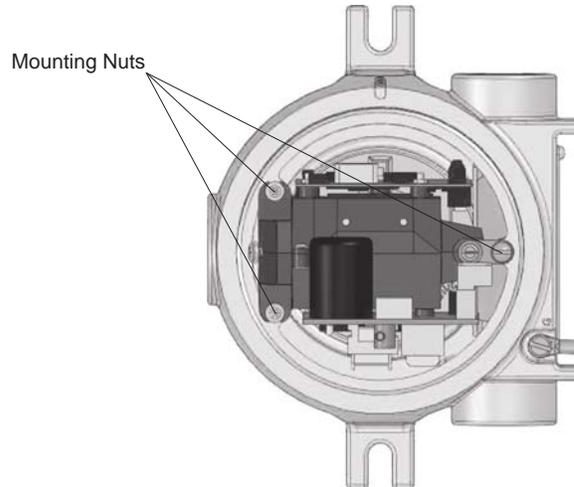
1. Turn off power to the gauge
2. Remove the housing cover
3. Remove the plastic electronics cover
4. Remove the terminal wiring connector
5. Remove the three (3) screws holding the electronics package in place
6. Carefully pull the electronics package out of the housing.
7. Remove the appropriate board from the clamshell assembly by removing the three (3) mounting nuts.

Note

If you are changing the CPU board, you must move the old firmware chip to the new board if the new board firmware is different.

8. Carefully reconnect any ribbon cables.
9. Install the electronics package in the housing.
10. Replace the three (3) mounting nuts.
11. Reconnect the terminal wiring connector.
12. Install the plastic electronics cover.
13. Install the housing cover.
14. Turn on the power to the unit.

Note: If you change the CPU board, a **New Hardware Found** error message normally appears when you connect with the HART communicator. In Ohmview2000, click **Diagnostics, New hardware, New CPU**, and click **OK** for a new backup of EEPROMS.



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 VEGA

When calling VEGA to arrange repair service, be ready with the following information:

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

Returning equipment for repair

Procedure 31: Returning equipment for repair

1. Call VEGA 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. VEGA assigns the job a material return authorization (MRA) number

Please note: VEGA 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:
VEGA Americas, Inc.
Attention: Repair Department
4170 Rosslyn Drive
Cincinnati, OH 45209-1599 USA

Note: You must first contact VEGA and receive a material return authorization number (MRA) before returning any equipment to VEGA. VEGA 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
- 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

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/cm^3).

Setting the process units for density applications

Procedure 32: Setting the process units for density

1. From the Main menu, select Initial setup
2. From the Initial setup menu, select Process parameters
3. From the Process parameters menu, select Process units
4. From the Process units menu, select 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 33: Setting custom units

1. From the Main menu, select Initial setup

2. From the Initial setup menu, select Process parameters
3. From the Process parameters menu, select Process units
4. From the Process units menu, select Custom units
5. From the Custom units screen, select Conversion to 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 calibration, linearizer curve, and standardization.

Warn % cal span

Warning percentage span calibration is the difference between the two 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 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 DSGH alarms to indicate that a standardize procedure is due if the diagnostic alarm, Standardize due, is toggled on.

Setting the calibration parameters

Procedure 34: Setting the calibration parameters

1. From the Main menu, select Initial setup
2. From the Initial setup menu, select Process parameters
3. From the Process parameters menu, select Cal parameters
4. From the **Cal parameters** menu, select the calibration parameters to view or edit, as needed. Refer to the help screens (F1) or page 84 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 DSGH offers a choice of signal filters, RC exponential or rectangular window. The DSGH 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.

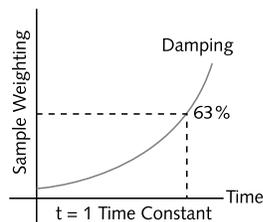


Figure 23: RC exponential filtering

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.

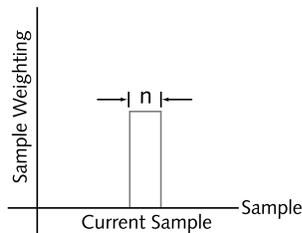


Figure 24: Rectangular window filtering

Damping

The damping 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 DSGH to respond immediately to large step changes while filtering the smaller variations in the signal caused by noise and normal process variations. To turn off the fast cutoff filter, set the value to zero.

Selecting a filter type, damping, and fast cutoff

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

1. From the Main menu, select Initial setup
2. From the Initial setup menu, select Process parameters
3. From the Process parameters menu, select Filtering
4. From the **Filtering** menu, select **Filter type**
5. On the **Filter type** screen, the currently used filter type 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 85 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 85 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 DSGH 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 a calibration. You must perform a new calibration procedure if the values for the process span Min or Max densities change.

Modify the span setting if the DSGH 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 a calibration.

Setting process span

Procedure 36: Setting the process span

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

Current loop span

The current loop span is the lowest and highest density to be indicated by the 4 ... 20 mA 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 1.0SpG:

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
0.5SpG	1.0SpG	1.0SpG	0.5SpG

Procedure 37: Setting the current loop span

1. From the Main menu, select Initial setup
2. From the Initial setup menu, select Process parameters
3. From the **Process parameters** menu, select **Spans**
4. From the **Spans** menu, select **Current loop span**
5. From the Current loop span menu, select 4 mA Density
6. In the **4 mA Density** screen, enter the minimum value for the measurement span
7. From the Current loop span menu, select 20 mA Density
8. In the **20 mA 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 38: 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 DSGH 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 39: 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 40: 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

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 41: 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 42: 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 VEGA 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 43: 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 44: 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 45: 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 DSGH 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 DSGH. In addition, if the DSGH 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 69 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 46: 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 VEGA 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 47: 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 48: 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 **22 mA** or **2 mA**
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 49: 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 causes a false low reading and adversely affects any control based on the gauge output.

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

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

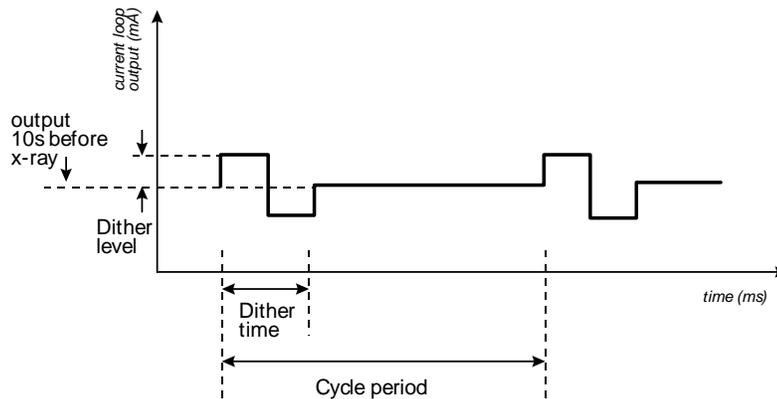


Figure 25: X-ray interference alarm output

Note: Only VEGA 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 50: To set 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 51: To set 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 DSGH 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 52: 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 DSGH gauge input

The DSGH can receive raw sensor output from another slave DSGH that the HART current loop cannot use. The master DSGH receives the input and uses the incoming signal to modify its output. For example, you may use this feature to make the master DSGH 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 VEGA Field Service at 513-272-0131 for advice.

Custom

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

Notes

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 VEGA 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.

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

A heater kit option is available for the DSGH 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 $30\text{ }^{\circ}\text{C}$ ($54\text{ }^{\circ}\text{F}$) degrees.

The features of the heater are as follows:

- The heater kit does not affect the functionality of the DSGH in any way. There is no requirement for special firmware
- The factory installs the internal heater kit if you order it with the DSGH
- Three different kits are available, one for 115VAC, one for 220VAC, and one for 24VDC. The part numbers are shown below:

Table 19: Heater kit part numbers

Heater kit power	VEGA Part Number
115 VAC	240723
220 VAC	240724
24 VDC	241912

Changes to specifications

The power rating changes from the specifications on page 17 of this manual when you install the heater kit on the DSGH.

With the installation of the heater, the maximum power consumption increases to 25watts. The unit is either 115VAC \pm 10%, 220VAC \pm 10%, instead of the standard 90–270VAC range or 24VDC.

Process temperature—compensated density

You will need a temperature probe and a DSGH with an analog input board to adjust the density indication to reflect the process density at a reference temperature. The temperature probe measures the process temperature, sends an analog signal to the DSGH, and then the DSGH sends a 4 ... 20 mA output signal with calibration and temperature compensation for control and HART communication.

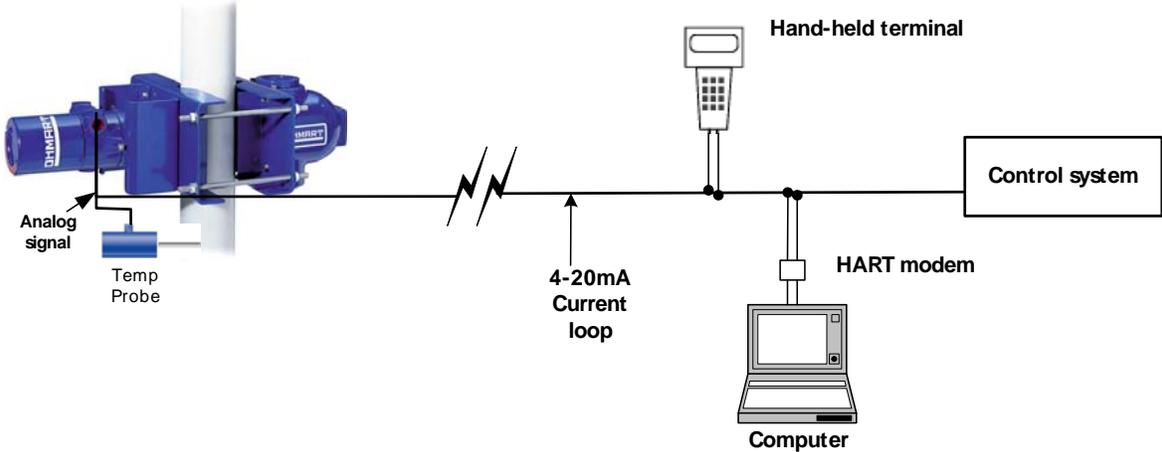


Figure 26: Temperature compensation system

Installation requirements

Use of an RTD temperature probe requires an VEGA analog input circuit board (p/n 243409). The analog input circuit board mounts to the top of the unit with mounting a bracket. (p/n 243563). The analog input kit's part number is 243585.

Interconnect for RTD temperature probe

Use the J1 4-pin connector to wire the analog circuit board to the RTD.

Table 20: Analog circuit board to RTD pin and connections

J1 pin	RTD connection
1	-Signal
2	+Signal
3	+RTD
4	-RTD

The analog input circuit board interfaces with the power supply board through the 14-pin connector.

Table 21: Analog circuit board to GEN2000 power supply board pin and connections

P1 pin	Analog Input Board
8	+6V
9	GND
11	Freq +
12	Freq -

We recommend using shielded 18AWG or 20 AWG cable for the input signal. The maximum length for an externally generated voltage signal depends on the signal loss in the cable. To compensate for signal loss associated with wire length, use a 4-wire connection. Figure 27 and Figure 28 illustrate the DSGH power supply, analog input board, and RTD wiring and jumper connections.

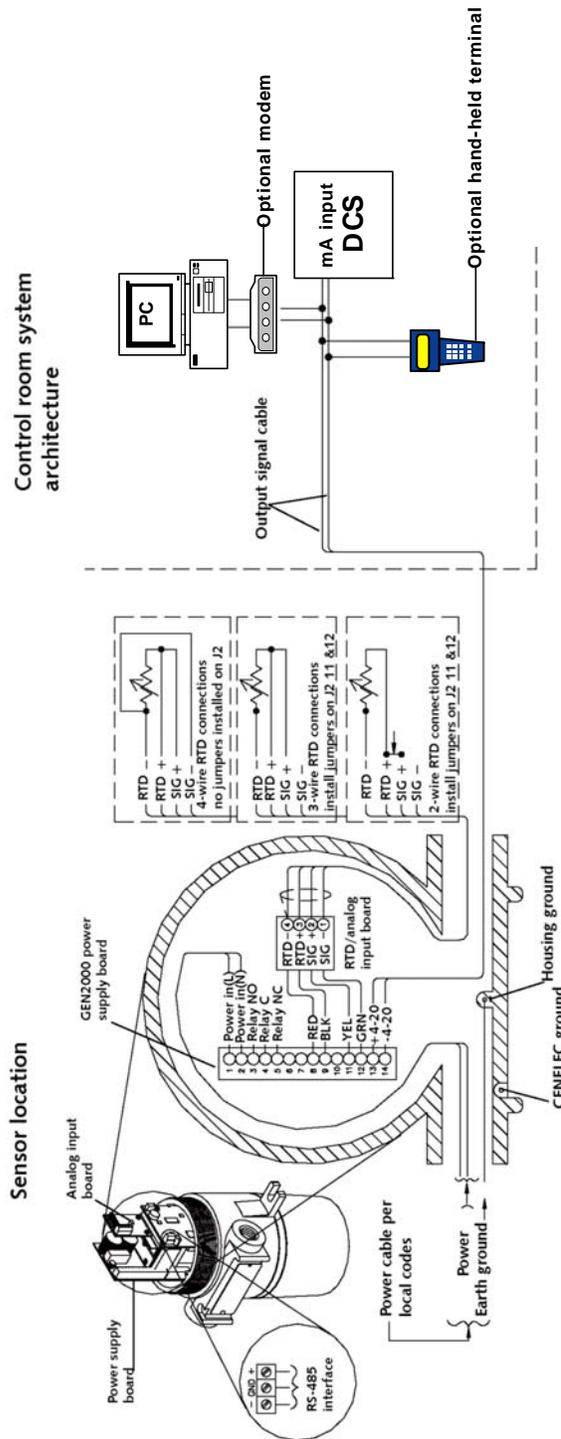


Figure 27: RTD input interfaces with circuit board

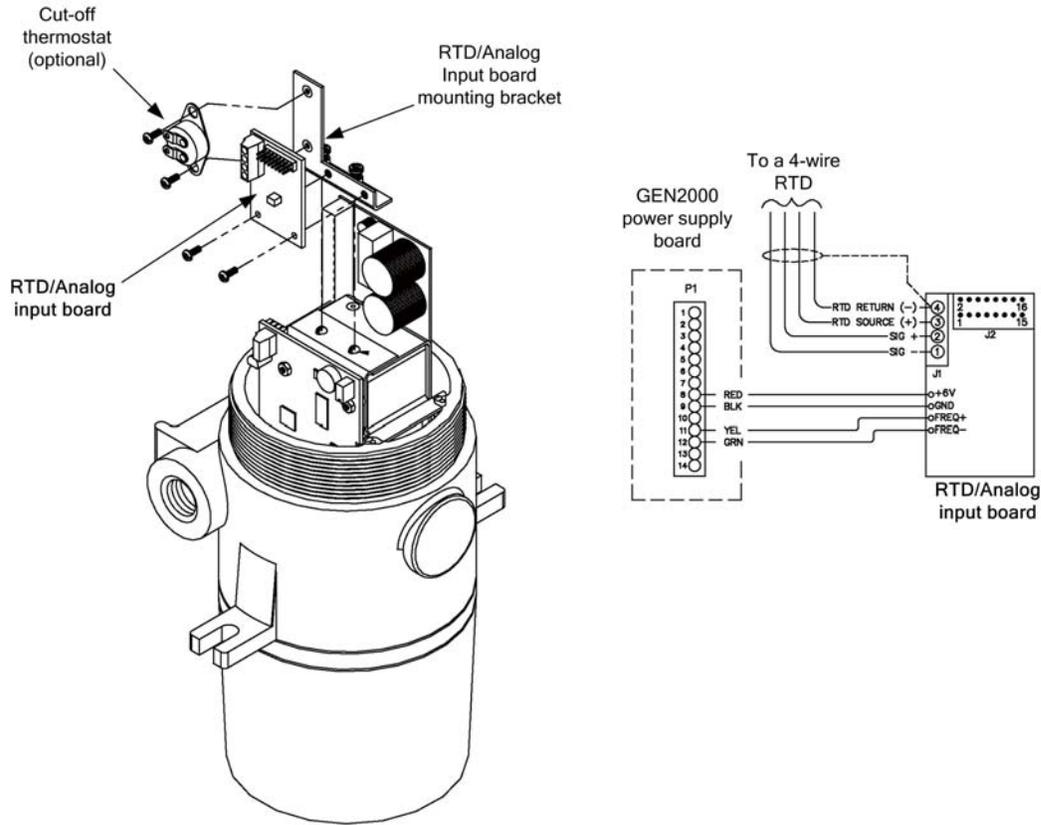


Figure 28: DSGH wiring and jumper connections

Table 22: J2 Jumper block configuration

RTD/Analog Use	—	All jumpers open
0 ... 5 mA	1 and 2	11 and 12
0 ... 10 mA	3 and 4	11 and 12
0 ... 20 mA	5 and 6	11 and 12
0 ... 50 mA	7 and 8	11 and 12
0 ... 100 mA	9 and 10	11 and 12
0 ... 1 V	—	11 and 12
0 ... 10 V	13 and 14	11 and 12
0 ... 25 V	15 and 16	11 and 12

Analog input circuit board calibration

It is usually unnecessary to calibrate the analog input circuit board. If it requires calibration, refer to “Calibrating the Analog Input” on page 120.

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 23: 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.	$P_0 - P_3$

The process temperature is measured using a PT100 platinum RTD. If using another linear device, refer to page 111, “Working with a linear temperature device.”

The algorithm for a linear correction for process temperature is:

$$d_c = d_m + [P_0 + P_1 (t_{ref}-t)]$$

Where:

d_c = corrected density reading

d_m = measured density reading

P_0 = offset term = 0

P_1 = process temperature coefficient

t_{ref} = temperature that the density readings is adjusted to

t = measured process temperature

Determining process coefficient P_1 :

$$P_1 \equiv \frac{d_L - d_H}{t_L - t_H}$$

Where:

d_L = density at low temperature

d_H = density at high temperature

t_L = low process temperature

t_H = high process temperature

Initial settings and calibration requirements

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

Setting up temperature compensation

Procedure 53: 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.

Note: When using Ohmview 2000 to set up your temperature compensation, verify that you have selected the correct temperature unit.

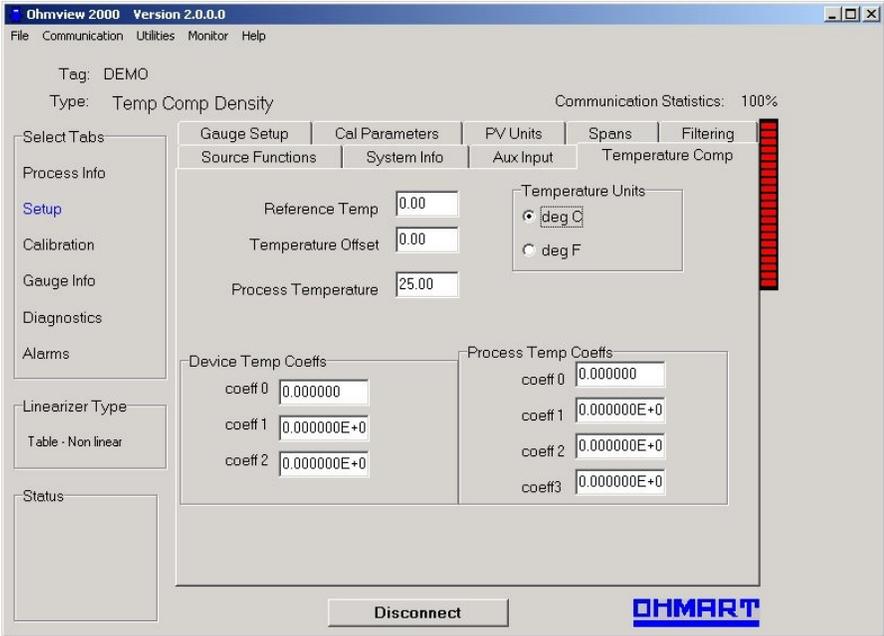


Figure 29: Ohmview 2000 Temperature Compensation tab

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.

Special Applications

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

The device temperature coefficients are polynomial coefficients to linearize the temperature measurement device. The default coefficients are for a Platinum 100 RTD.

Caution! Do not alter these coefficients unless you have a different temperature device and consult with VEGA.

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
D_0	$D_0=-243.50029$	D_0	-135.2779
D_1	$D_1=0.01909$	D_1	0.010606
D_2	$D_2=7.9066 \times 10^{-8}$	D_2	4.3892×10^{-8}

For a linear temperature device, the coefficient D_2 (Coeff2) must be set to zero. D_0 is the offset term and D_1 is the linear term. (See “Working with a Linear Temperature Device” on page 111)

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 52 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 24 gives the conversion of temperature in degrees C to the frequency output of the Platinum 100 RTD.

Table 24: 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 54: To set 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.

For example, suppose you have a 0 to 10V temperature measurement device with a temperature span of 20 °C ... 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 29,760 Hz.

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

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 DSGH, 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.

Installation requirements

Interconnect for flow meter to DSGH

Use of a flow meter input requires an VEGA analog input circuit board (p/n 243409). The analog input circuit board mounts to the top of the unit with mounting rackets (p/n 243563). The analog input kit is part number 243585.

Use the J1 4-pin connector to wire the analog input board to the flow meter:

Table 25: Flow meter pin and connections

J1 pin	Flow meter connection
1	-Signal
2	+Signal
3	Not used
4	Not used

The analog input circuit board interfaces with the CPU board through the 14-pin connector.

Jumper settings for analog input board

A jumper is required to select the type of analog input from the flow meter.

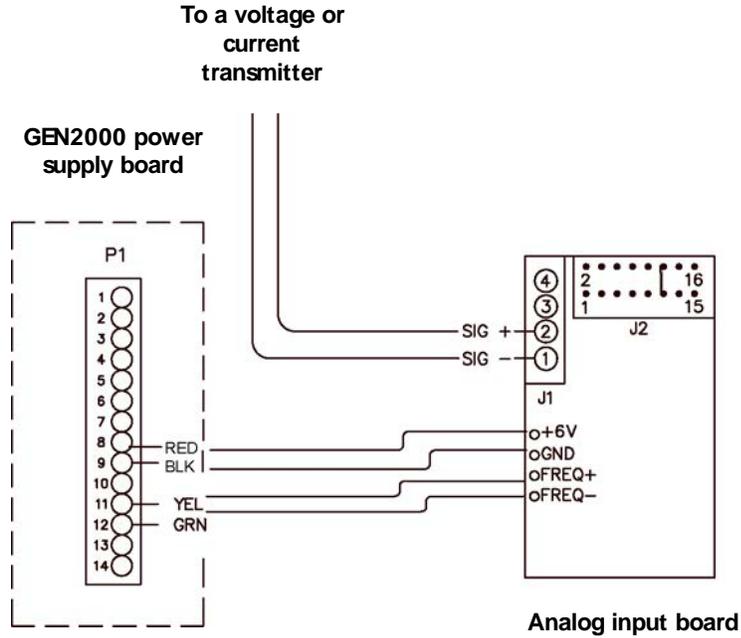


Figure 30: Mass flow Jumper settings

Table 26: J2 Jumper block configuration

RTD/Analog Use	—	All jumpers open
0 ... 5 mA	1 and 2	11 and 12
0 ... 10 mA	3 and 4	11 and 12
0 ... 20 mA	5 and 6	11 and 12
0 ... 50 mA	7 and 8	11 and 12
0 ... 100 mA	9 and 10	11 and 12
0 ... 1 V	—	11 and 12
0 ... 10 V	13 and 14	11 and 12
0 ... 25 V	15 and 16	11 and 12

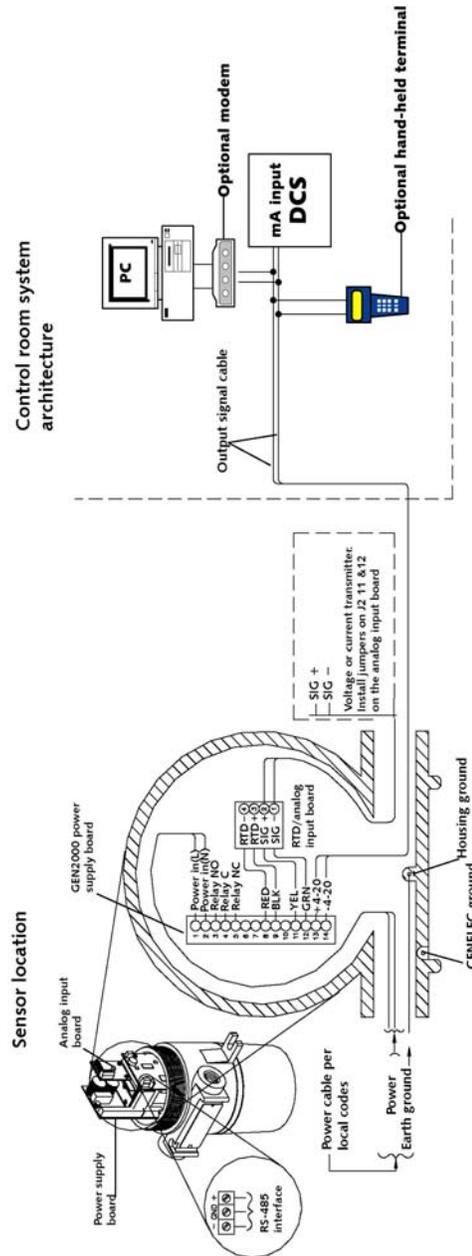


Figure 31: Mass flow input interfaces with the circuit board

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 120.

Algorithm for mass flow

The mass flow algorithm allows the final indication of the DSGH 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 DSGH 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 55 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 55: To set 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 136).
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 56: To set 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 "Calibration" section of the manual (page 38)
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 27: 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:

Note: When using Ohmview 2000 to set up you mass flow, verify that you have selected the correct flow units.

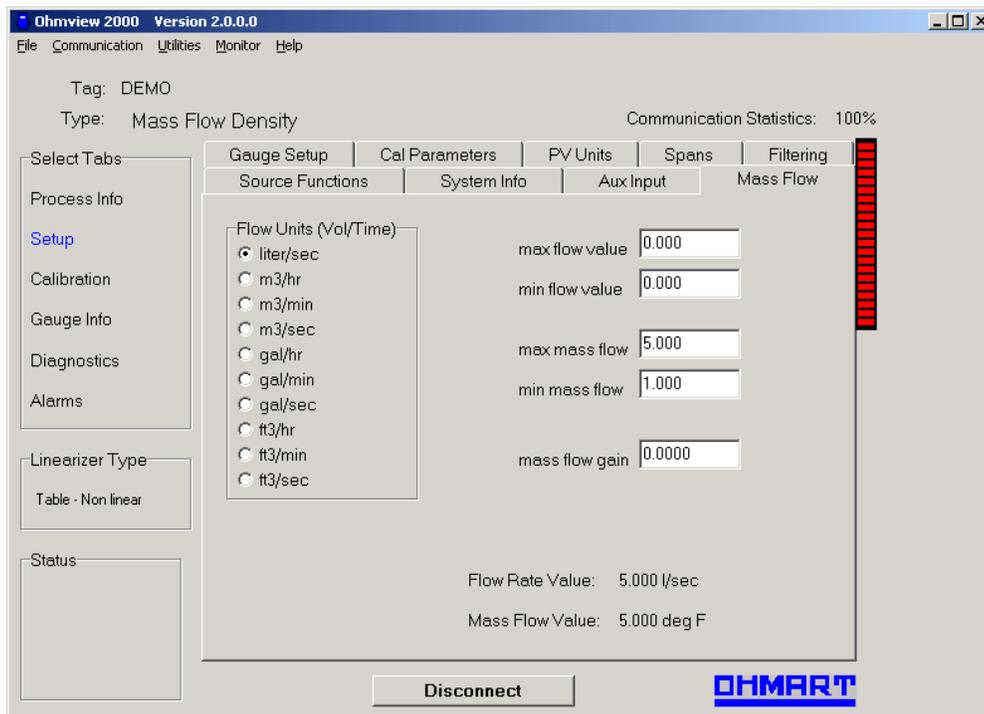


Figure 32: Ohmview 2000 Mass Flow tab

Flow meter units

Units of the flow rate; choose from:

Table 28: 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 ... 20 mA output as selected by the software:

Table 29: Mass flow unit output options

kg/sec	kg/min	
lb/sec	lb/min	ton/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

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 30 kHz 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 56: To calibrate 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 30: Output frequencies based on applied input signal

Input Signal	Selected Range	Frequency Output
4 mA	0 ... 20 mA	6,000 Hz
20 mA	0 ... 20 mA	30,000 Hz
5V	0 ... 10 V	15,000 Hz
2.5V	0 ... 25 V	3,000 Hz

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

You can use the DSGH 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

This feature requires special firmware. Contact you VEGA representative for further information concerning this feature.

GEN2000 Local RS-485 Network

This feature supports gauging systems that require two or more measurement systems that interact to provide a single compensated measurement.

The RS-485 network has the following gauge types:

- Master
- Responder

The gauges use the half-duplex RS-485 communication network. The gauges transfer specific information between each other in the field with only the master gauge actually communicating with the control room.

The master gauge has the following features:

- Initiates all communication on the network
- Keeps a list of expected gauges on the network and cycles through each gauge requesting a response
- Update the tag, count information from the responder gauges, and track the network health

The responder gauges have the following features:

- Have a unique address for their reply
- Have a table listing other network gauges with information that it requires and the function of that data.
- Can listen to all of the responses of the other gauges, which enables each responder gauge to update the count information from other gauges (if setup to do so)

Installation requirements

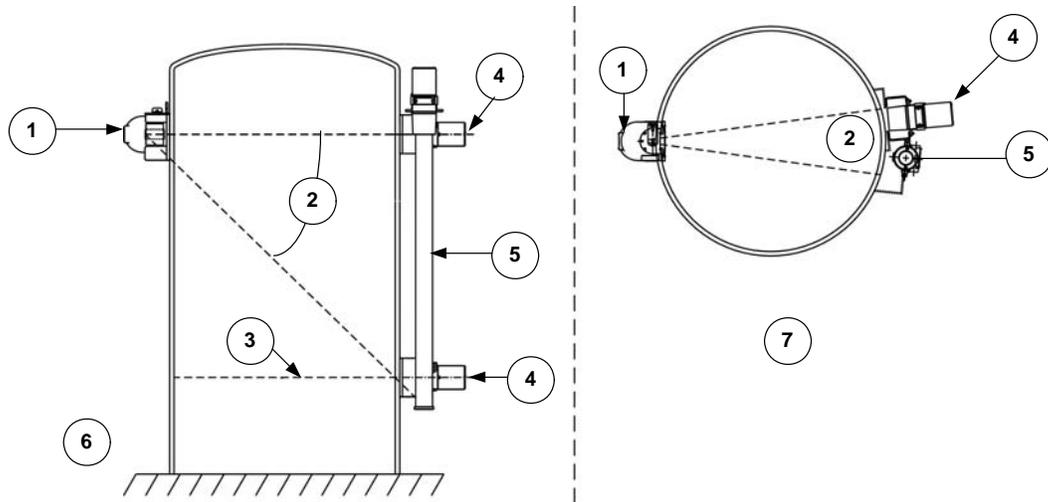


Figure 33: Typical installation—RS-485 local network

Figure notes:

1. Radiation source holder
2. Radiation beam
3. Minimum process density measured
4. Radiation detector DSG with HART protocol output using RS-485
5. Radiation detector(s) level with HART protocol output using RS-485
6. Side view
7. Top view

Detector wiring

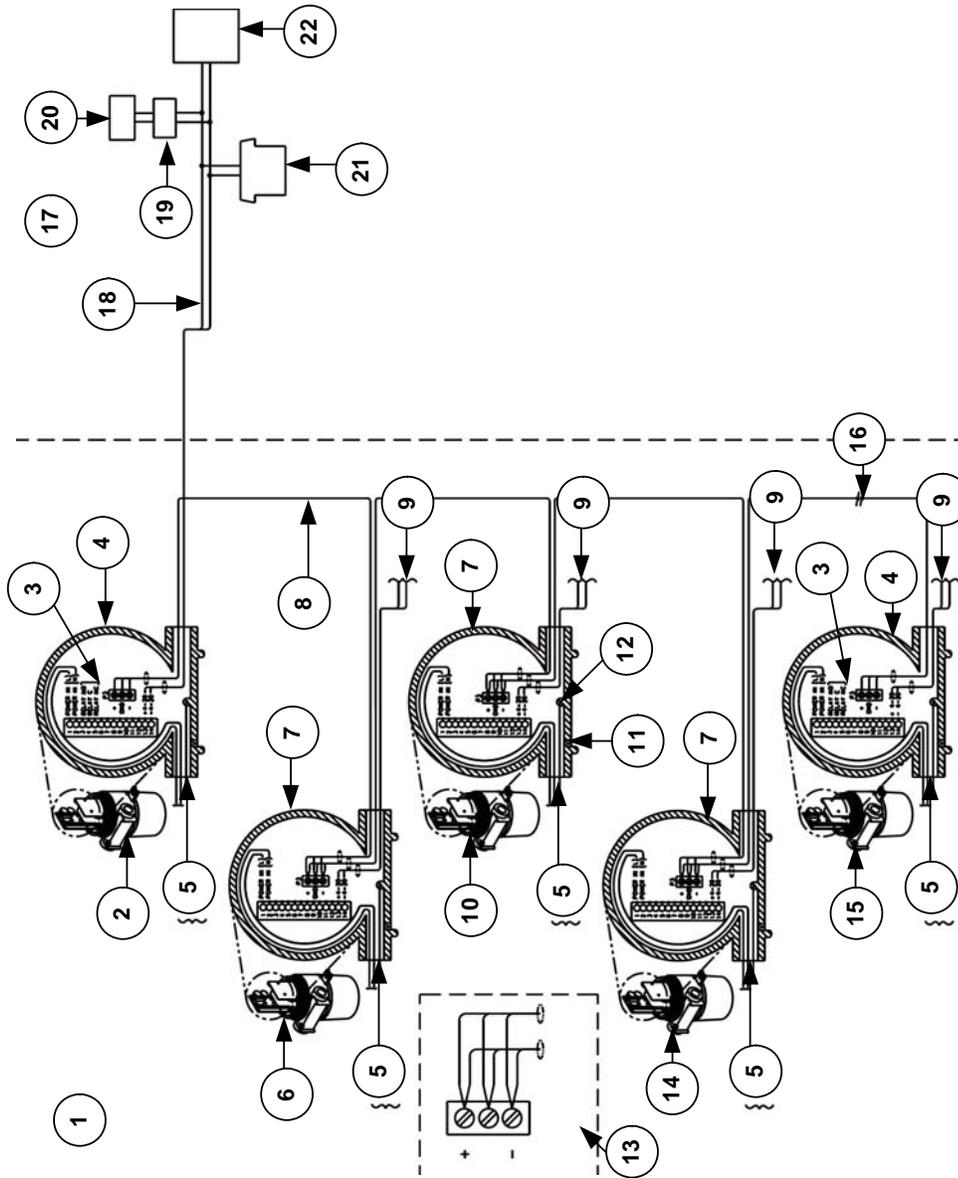


Figure 34: Interconnect—GEN2000 RS-485 multiple detectors/transmitters

Special Applications

Figure notes:

- | | | |
|-----------------------------------|-----------------------------------|--------------------------------|
| 1. Sensor location | 9. 4 ... 20 mA output | 17. Control room |
| 2. High level alarm vapor density | 10. Middle level | 18. 4 ... 20 mA output signal |
| 3. Relay | 11. CENELEC ground | 19. Modem |
| 4. DSGH detector | 12. Housing ground | 20. PC |
| 5. Power/Earth ground | 13. RS-485 connection enlarged | 21. Handheld terminal (option) |
| 6. Top level | 14. Bottom level | 22. mA input DCS |
| 7. LFXG-H or LSGH | 15. Low level alarm auto zero | |
| 8. RS-485 signal cable | 16. Additional detectors (option) | |

Software

To setup the RS-485 network you must have firmware version 2000.30 or 2000.30C or higher, Ohmview 2000 version 2.0.0 or higher, and a HART modem with a connection to a communication port.

The Ohmview 2000 Launcher program has the RS-485 feature. Select this feature to setup the RS-485 network, choose compensation types, and view information about the gauges.

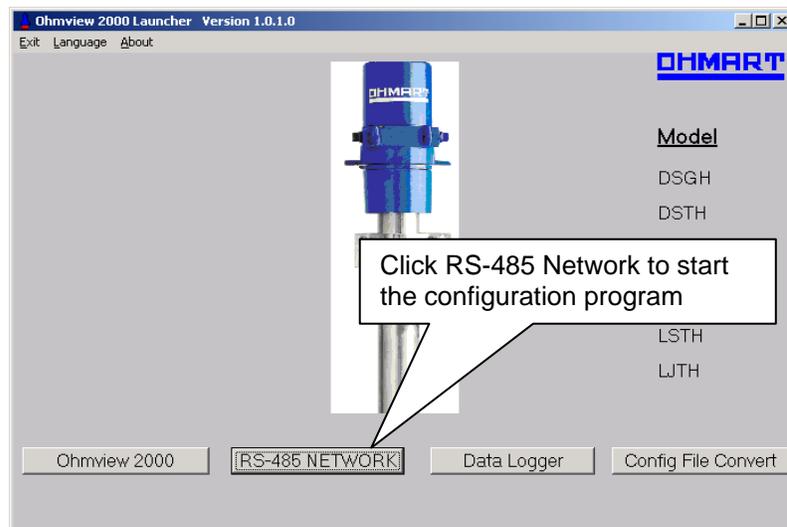


Figure 35: Ohmview 2000 Launcher program

Note: If it does not connect, click Disconnect, click Exit and entirely close Ohmview 2000. Wait for 30 seconds and open the program again using the Launcher program. Select another port. After selecting the proper port with the HART modem, the program remembers the last port used and selects it again.

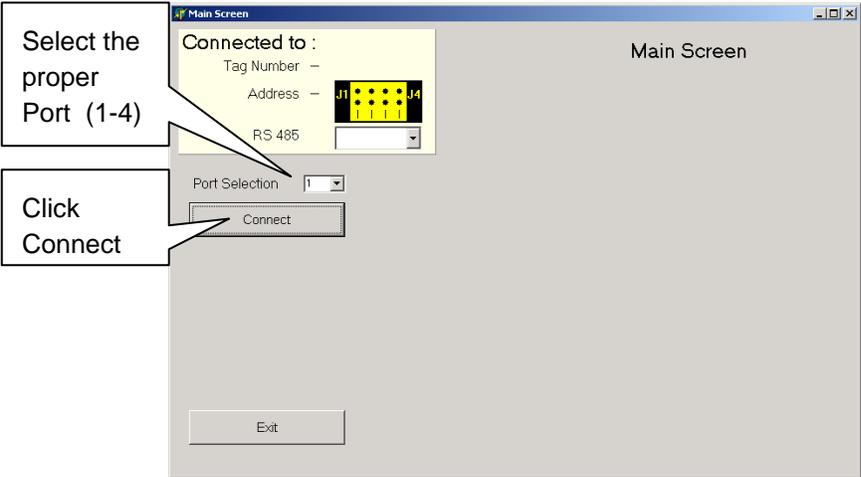


Figure 36: Ohmview 2000 RS-485 main screen

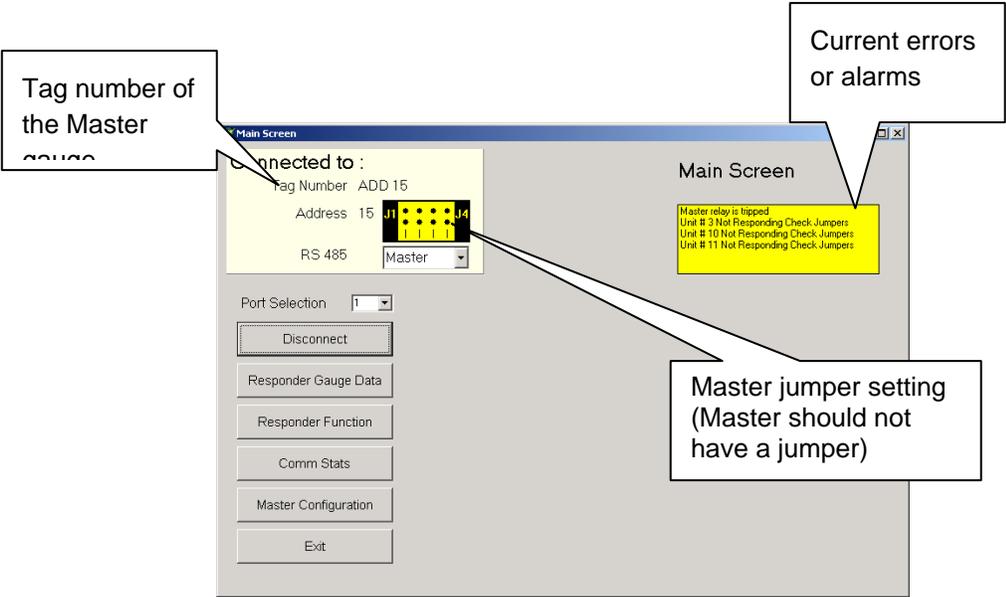


Figure 37: RS-485 Master Main menu screen

The Main menu for the master contains the following selections:

- Connect or Disconnect—Click to connect or disconnect from the gauge

Special Applications

- Responder Gauge Data—see page 126
- Responder Function—see page 127
- Comm Stats—see page 128
- Master Configuration—see page 129
- Exit—Click to exit program

Responder Gauge Data

This screen displays the units and the counts for each Responder gauge as selected. If a unit does not display a count, it has not been set up to do so or is not on the network.

Figure 38: RS-485 Responder gauge data screen

Unit #	Count	Tag Id	Display
Unit 1			<input type="checkbox"/>
Unit 2			<input type="checkbox"/>
Unit 3	0.0		<input checked="" type="checkbox"/>
Unit 4			<input type="checkbox"/>
Unit 5			<input type="checkbox"/>
Unit 6			<input type="checkbox"/>
Unit 7	11.2	ADD7_TOP	<input checked="" type="checkbox"/>
Unit 8			<input type="checkbox"/>
Unit 9			<input type="checkbox"/>
Unit 10			<input type="checkbox"/>
Unit 11	33.7	ADD 11	<input checked="" type="checkbox"/>
Unit 12			<input type="checkbox"/>
Unit 13			<input type="checkbox"/>
Unit 14			<input type="checkbox"/>
Unit 15			<input type="checkbox"/>

Responder Function

Use this screen to select the function for different units.

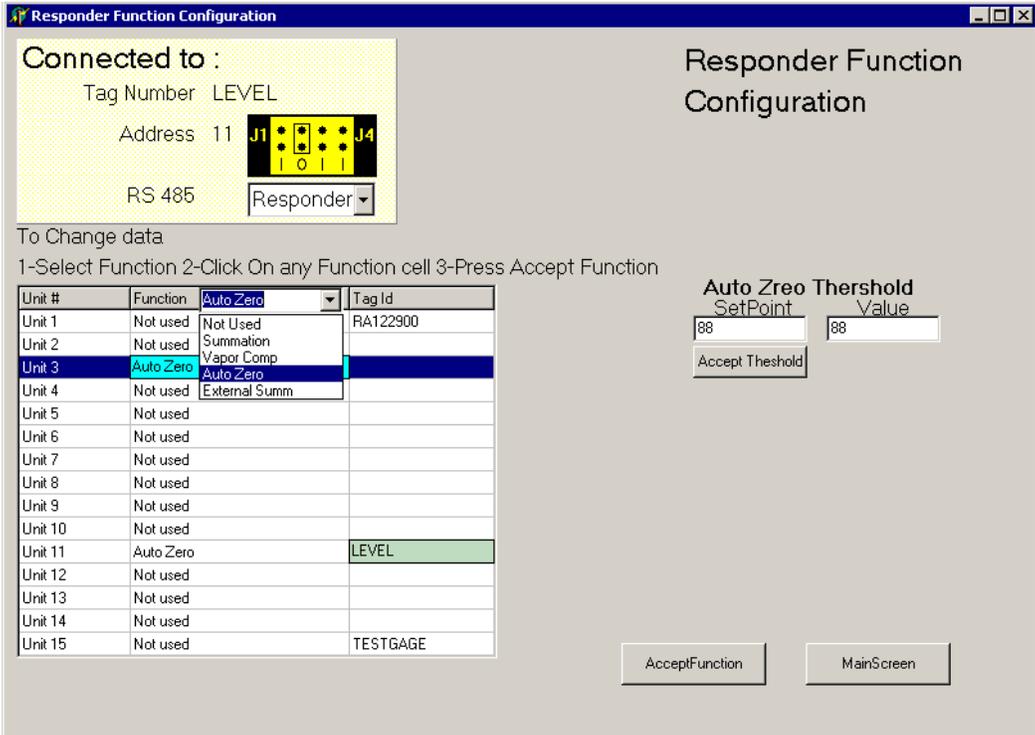


Figure 39: RS-485 Responder Function screen

The functions available for each responder are:

- Not Used
- Summation
- Vapor Comp
- Auto Zero
- External Summation

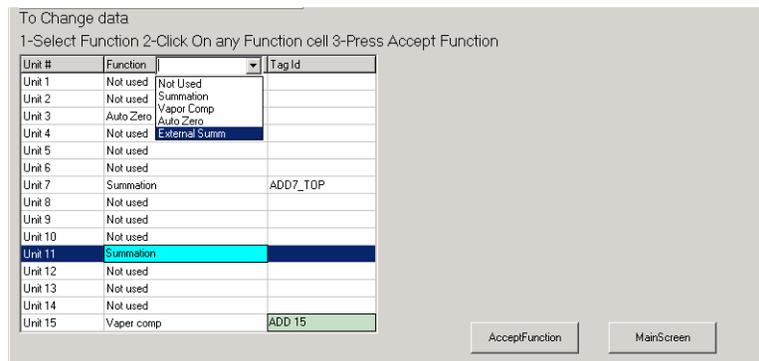


Figure 40: Responder function pull-down menu

To change the function for a unit, perform the following steps:

Procedure 57: Changing the Responder unit function

1. Select the Function cell next to the unit number
2. From the pull-down menu, select the proper function type
3. Click Accept Function

Communication Statistics

Use this screen to view the number of times the Master unit has sent messages to the Responder units and the number of times the responder units have replied.

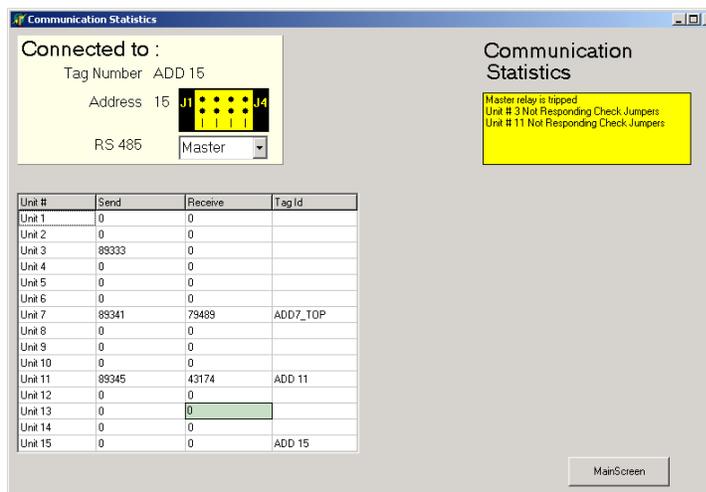


Figure 41: RS-485 Communication Statistics screen

Master Configuration

Use this screen to setup the Polling requirements for each unit. Polling activates the function for the unit.

To turn the polling On or Off, double-click on the Poll cell next to the unit number.

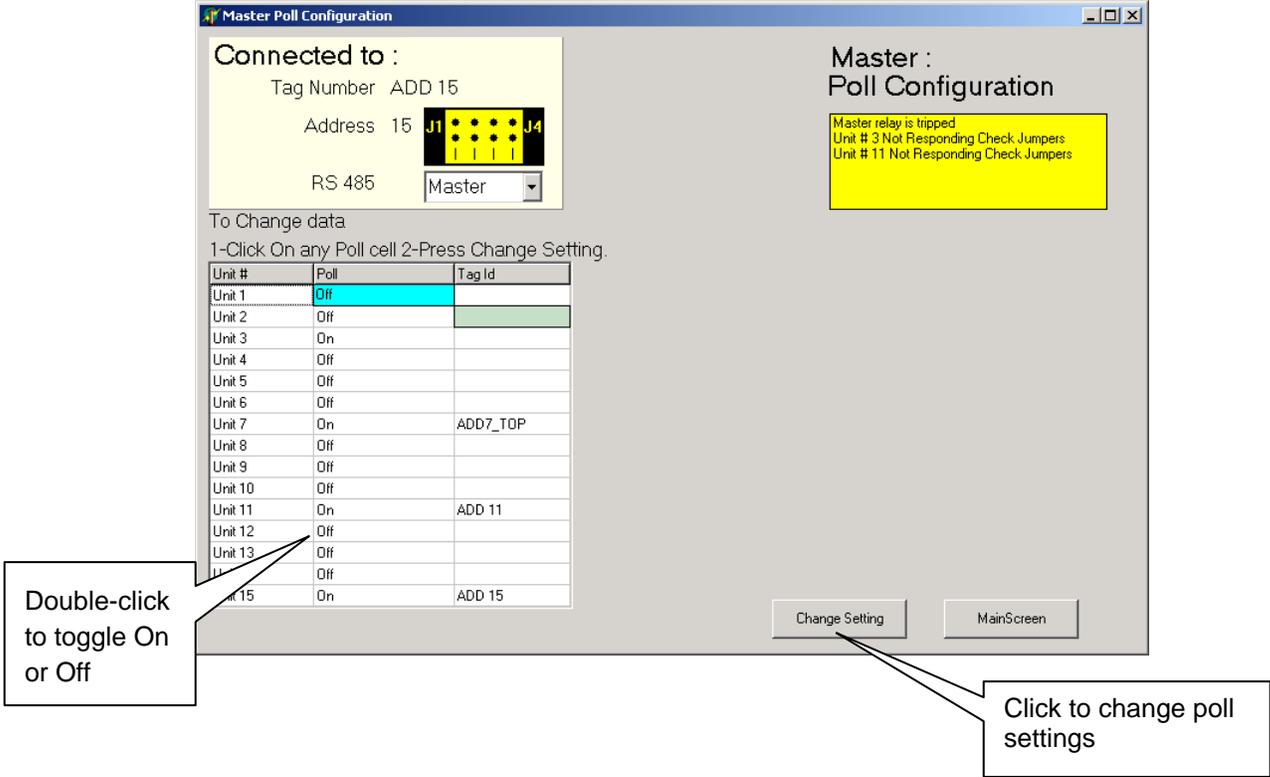


Figure 42: RS-485 Master Configuration screen

Responder Main menu

To setup and test a specific responder unit, connect the HART modem jumpers anywhere along the 4 ... 20 mA output.

Procedure 58: To connect directly to a Responder

1. Open Ohmview 2000 Launcher
2. Select the communication port number that connects to the HART modem
3. Click Connect

The Responder Main Menu screen displays

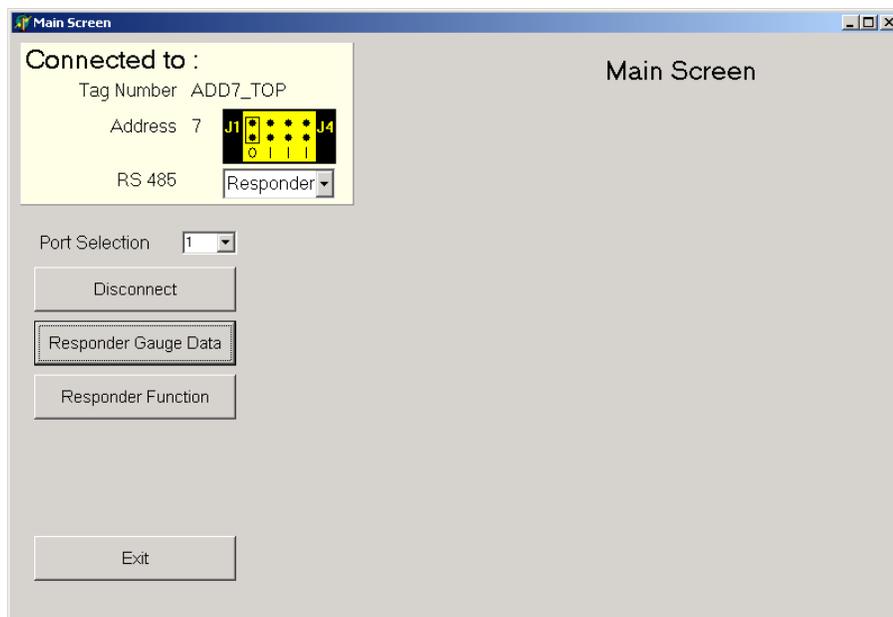


Figure 43: Responder Main Screen

The following choices are available on this menu:

- Responder Gauge Data (see page 126)
- Responder Function (see page 127)
- Connect or Disconnect –Click to connect or disconnect from gauge
- Exit—Click to close program

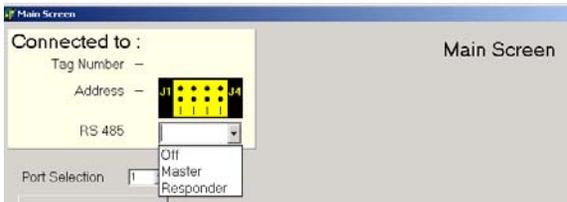
Initial setup

Perform the following steps to set up the GEN2000 RS-485 local network:

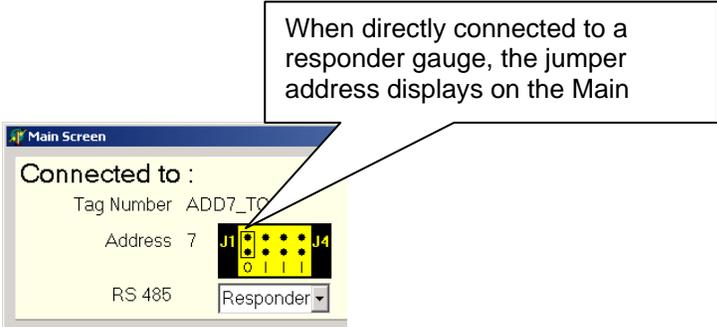
Procedure 59: To set up the GEN2000 RS-485 local network

- 1. Check the wiring connections for power, network and analog output for all gauges
- 2. Disconnect the RS-485 network from the master gauge
- 3. Verify that the master gauges has no jumpers made (address F)
- 4. Power up the master gauge
- 5. Use the RS-485 configuration program to disable the RS-485 local network

From the Main Screen pull-down menu, select Off



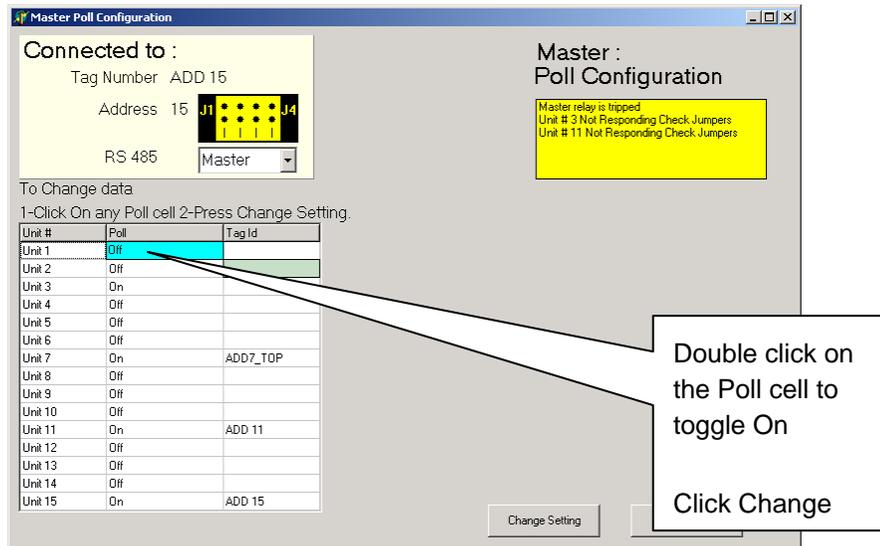
- 6. Re-connect the RS-485 wiring on the master gauge
- Note:** Wire the Master gauge relay as the RS-485 Network Fault relay. Failure to use this relay can result in significant measurement error from incorrect compensation or no compensation
- 7. Confirm that all of the gauges have a unique address jumper configuration



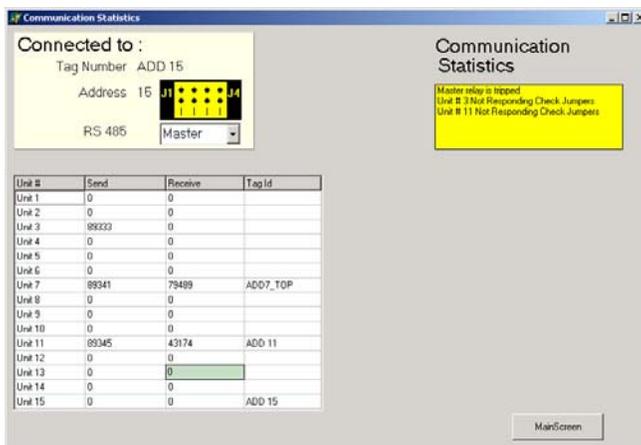
- 8. Power up all network gauges
- 9. Confirm all hardware is functioning properly

Procedure 60: To set up the GEN2000 RS-485 local network (continued)

- Run the RS-485 configuration program and configure the master gauge to poll all of the gauges on the network



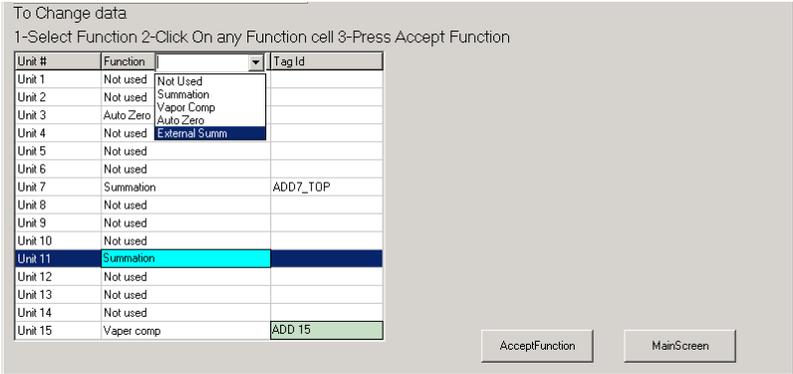
- Verify all gauges are communicating as expected



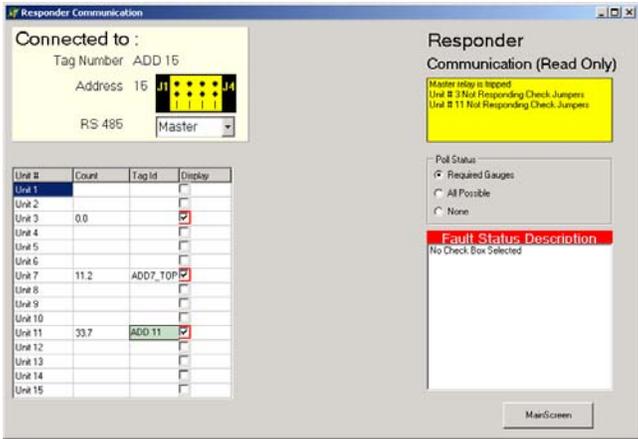
- Populate the master table to continuously poll all gauges
- Enable the RS-485 local network using the configuration program – continuous communication starts
- Continue to monitor the RS-485 network to verify that all of the gauges are responding as expected and that the relay is not in an alarm condition

Procedure 60: To set up the GEN2000 RS-485 local network (continued)

- 15. For each gauge on the RS-485 local network:
 - Use the RS-485 Configuration software to configure the Responder table



- Verify that the Responder table contains all of the units required for the particular gauge
- Verify the Responder table is updating



- 16. Connect to each gauge using Ohmview 2000 and setup each gauge for the particular application. Access the Ohmview 2000 electronic manual under Help for further information on setting up the gauge.

Auto Zero feature

Use this feature with the RS-485 network to provide data to the primary level gauge. The counts feed into the level gauge from the low point indicator on the vessel. When the level gauge senses a preset threshold value, it implements the Auto Zero feature. This feature resets the zero point.

Setting up the Auto Zero feature

To enable this feature using Ohmview 2000's RS-485 Network program, you must have firmware 2000.30 or 30C or higher for GEN2000 instruments.

Notes

Appendix III: Special Units Indication

Percent solid or percent solution indication

The DSGH 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 DSGH 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 DSGH 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 DSGH is set up as a percent solid or percent solution gauge, the current loop (4 ... 20 mA) 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 DSGH The DSGH calculates the percent solid for slurries with the following equation:

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

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:

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

The DSGH 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 DSGH 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	82
Set process span (Min density, Max density), with the appropriate values in %solids or %solution units	Span settings, process span	88
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	45
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	46
Set current loop span (4 mA density, 20 mA density) with the appropriate values in %solid or %solution units	Span settings, current loop span	88

Degrees API indication

The DSGH 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 DSGH 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 DSGH indicates degrees API, it is indicating a derived quantity.

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

The DSGH calculates degrees API with the following equation:

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

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

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

Initial settings and calibration requirements

To use the DSGH 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	82
Set process span (Min density, Max density), with the appropriate values in degrees API units	Span settings, process span	88
Calibrate on low density	Set low density	45
Calibrate on high density	Set high density	46
Set current loop span (4 mA density, 20 mA density) with the appropriate values in degrees API units	Span settings, current loop span	88

Degrees Twaddle indication

The DSGH 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 DSGH locks on the last valid reading, either 0° Twaddle or 200° Twaddle.

The DSGH 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 DSGH indicates degrees Twaddle, it is indicating a derived quantity.

The DSGH 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 DSGH is indicating degrees Twaddle, the following equation calculates the specific gravity:

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

$$\text{SpG} = \frac{145}{(145.0 - {}^{\circ}\text{Be}_{(\text{heavy})})}$$

Initial settings and calibration requirements

To use the DSGH 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	82
Set process span (Min density, Max density), with the appropriate values in degrees Twaddle units	Span settings, process span	88
Calibrate on low density	Set low density	45
Calibrate on high density	Set high density	46
Set current loop span (4 mA density, 20 mA density) with the appropriate values in degrees Twaddle units	Span settings, current loop span	88

Degrees Baume indication

The DSGH 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 DSGH 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 DSGH indicates degrees Baume, it is indicating a derived quantity.

Note: When the DSGH is set up as a degrees Baume gauge, the current loop (4 to 20mA) 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 DSGH 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

To use the DSGH 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	82
Set process span (Min density, Max density), with the appropriate values in degrees Baume light or Baume heavy units	Span settings, process span	88
Calibrate on low density	Set low density	45
Calibrate on high density	Set high density	46
Set current loop span (4 mA density, 20 mA density) with the appropriate values in degrees Baume units	Span settings, current loop span	88

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 DSGH that enables the use of a look-up table to enter any linearizer.

Note: VEGA 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:

Non-linear table

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 VEGA 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 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 calibration when using a linearizer table.

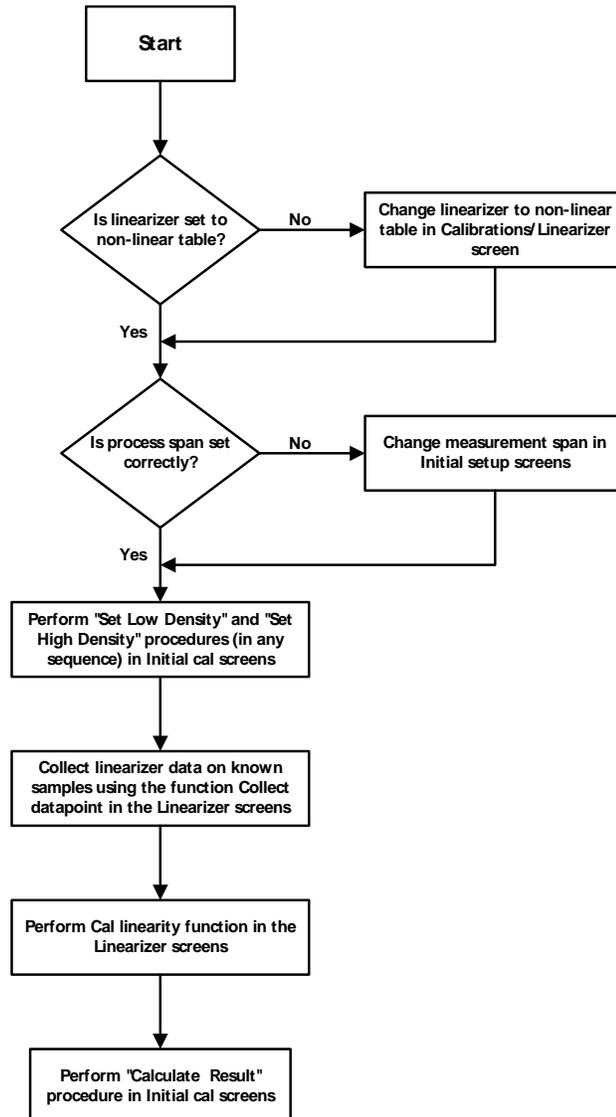


Figure 44: Calibration with non-linear table linearizer flow chart

Note: The procedures for performing the two-point calibration are found in the “Calibration” chapter beginning on page 45.

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 DSGH 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 60: To collect 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 61: 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 calibration when using a linearizer table.

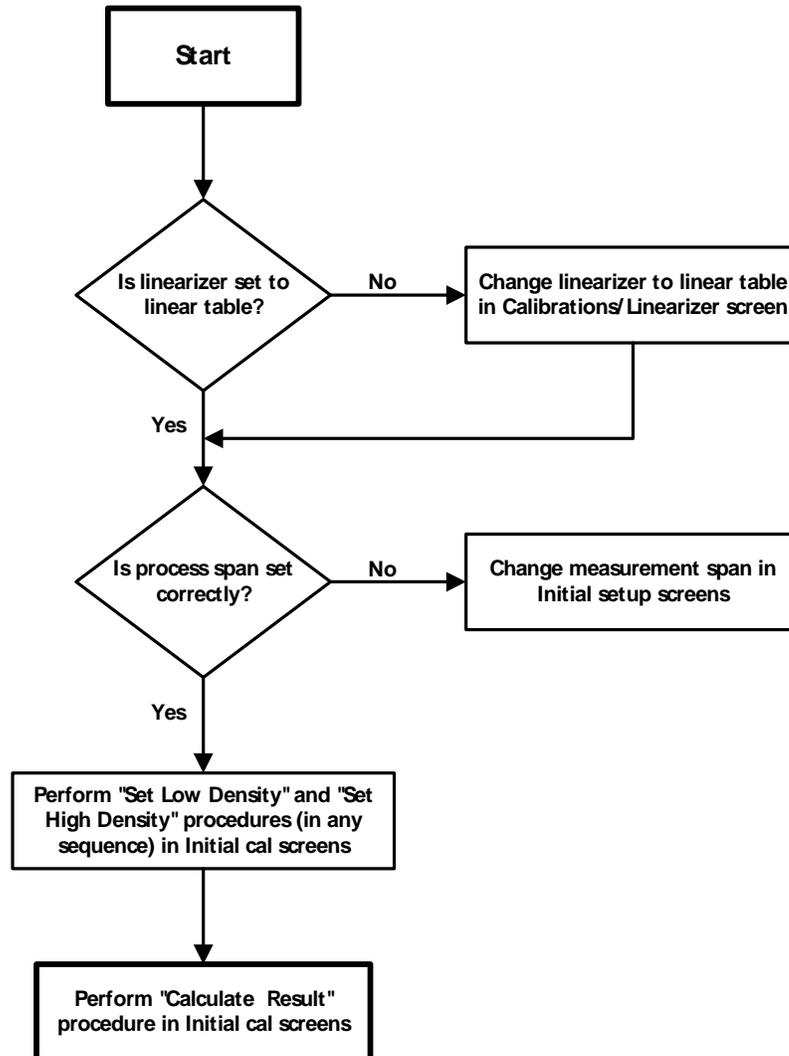


Figure 45: Calibration with a linear table linearizer flow chart

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