

Rosemount™ 56

Dual Channel Transmitter



Safety information

Read this page before proceeding.

Your instrument purchase from Emerson is one of the finest available for your particular application. These instruments have been designed and tested to meet many national and international standards. Experience indicates that its performance is directly related to the quality of the installation and knowledge of the user in operating and maintaining the instrument. To ensure its continued operation to the design specifications, personnel should read this document thoroughly before proceeding with installation, commissioning, operation, and maintenance of this instrument. If this equipment is used in a manner not specified by the manufacturer, the protection provided by it against hazards may be impaired.

⚠ WARNING

Failure to follow the proper instructions may cause any one of the following situations to occur: loss of life, personal injury, property damage, damage to this instrument, and warranty invalidation.

Read all instructions prior to installing, operating, and servicing the product.

⚠ WARNING

Follow installation guidelines.

Failure to follow these installation guidelines could result in death or serious injury. If this equipment is used in a manner not specified by the manufacturer, the protection it provides against hazards may be impaired.

- Follow all warnings, cautions, and instructions marked on and supplied with the product.
 - Install equipment as specified in this document.
 - Ensure that only qualified personnel perform the installation, operation, and maintenance of the product.
 - Inform and educate your personnel in the proper installation, operation, and maintenance of the product.
 - Follow appropriate local and national codes.
 - If you do not understand any of the instructions, contact your Emerson representative for clarification.
-

⚠ WARNING

Risk of electrical shock

Installation and servicing of this product may expose personnel to dangerous voltages.

- Equipment protected throughout by double insulation.
 - Disconnect main power, wired to separate power source, before servicing.
 - Do not operate or energize instrument with case open.
 - Signal wiring connected in this box must be rated at least 240 V for European mains operation.
 - Non-metallic cable strain reliefs do not provide grounding between conduit connections. Use grounding type bushings and jumper wires.
 - Unused cable conduit entries must be securely sealed by non-flammable closures to provide enclosure integrity in compliance with personal safety and environmental protection requirements. Seal unused conduit openings with Type 4X or IP66 conduit plugs to maintain the ingress protection rating (Type 4X).
 - Electrical installation must be in accordance with the National Electrical Code (ANSI/National Fire Protection Association [NFPA]-70) and/or any other applicable national or local codes.
 - Operate only with front panel fastened and in place.
 - Safety and performance require that this instrument be connected and properly grounded through a three-wire power source.
 - Proper use and configuration is the user's responsibility.
-

⚠ WARNING

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental in protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

NOTICE

Ensure that you have received the correct model and options from your purchase order. Verify that this document covers your model and options.

NOTICE

Use only factory documented components for repair. Tampering or unauthorized substitution of parts and procedures can affect the performance and cause unsafe operation of your process.

NOTICE

This product generates, uses, and can radiate radio frequency energy, and this can cause radio communication interference. Improper installation or operation may increase such interference.
As temporarily permitted by regulation, this device has been tested for compliance within the limits of Class A computing devices, pursuant to subpart J of part 15 of Federal Communication Commission (FCC) rules, which are designed to take whatever measures may be required to correct the interference. Operation of this equipment in a residential area may cause interference, in which case the operator, at their own expense, will be required to take whatever measures are needed to correct the interference.

NOTICE

This product is not intended for use in the light industrial, residential, or commercial environments per the instrument's certification in ENG1226-1: 2006.

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1 Descriptions and specifications

1.1 Features and applications

The Rosemount 56 Dual Channel Transmitter is an adaptable, multi-parameter device with a high-resolution color display, designed for a wide range of liquid measurement applications, featuring dual sensor inputs, multiple language support, and advanced diagnostics, with various digital communications options including HART® and PROFIBUS®.

This multi-parameter transmitter serves industrial, commercial and municipal applications with the widest range of liquid measurement inputs and digital communications available.

The Rosemount 56 Dual Channel Transmitter supports continuous measurement of liquid analytical inputs from one or two sensors. The modular design allows signal input boards to be field replaced, making configuration changes easy. The high resolution full-color display gives unsurpassed visibility and functionality for liquid analytical instrumentation.

Dual input instrument

Single or dual measurement of the following:

- pH/ORP
- Resistivity/Conductivity
- % Concentration
- Total Dissolved Solids
- Total Chlorine
- Free Chlorine
- Monochloramine
- Dissolved Oxygen
- Dissolved Ozone
- Turbidity
- Pulse Flow
- Temperature
- 4-20 mA Input

Full color display

The high resolution full-color display allows at-a-glance viewing of process readings — indoors or outdoors. Six additional process variables or diagnostic parameters are displayed for quick determination of process or sensor condition. You can adjust the contrast of backlit display and customize the main screen to meet your requirements.

Digital communications

HART version 5 and 7 digital communications are available on the transmitter. An optional PROFIBUS DP digital communications board is available for Profibus installations. HART transmitters communicate with the 475 HART handheld communicator and HART hosts, such as AMS Intelligent Device Manager. PROFIBUS transmitters are fully compatible with PROFIBUS DP networks and Class 1 or Class 2 masters. HART and PROFIBUS DP configured transmitters will support any single or dual measurement transmitter configurations.

Menus

Easily-managed window screens for easy navigation to local configuration and routine calibration. **Quick Start** and all menu screens are available in multiple locally displayed languages. Alphanumeric keypad allows easy entries during configuration and calibration.

Quick Start programming

Popular Quick Start screens appear the first time the transmitter is powered. The transmitter auto-recognizes each measurement input type and prompts you to configure each sensor loop in a few quick steps for immediate commissioning.

Help screens

A complete user guide and troubleshooting manual is embedded in the transmitter's memory and easily accessed via the **INFO** key on the local display. Detailed instructions and troubleshooting tips in multiple languages are intended to provide adequate guidance to resolve most problems on site.

Hazardous area approvals and safety approvals

None.

Enclosure

The transmitter enclosure fits standard ½ DIN panel cutouts. The versatile enclosure design supports panel-mount, pipe-mount, and surface/wall-mount installations.

No enclosure ratings.

Security access codes

Two levels of security access are available. Program one access code for routine maintenance and hold of current outputs; program another access code for all configuration menus and functions.

Diagnostics

The transmitter continuously monitors itself and the sensor(s) for `Fault` and `Warning` conditions. To visually alert field personnel, a display banner flashes:

- Red to indicate a `Fault` condition
- Yellow for a `Warning` condition

To access details and troubleshooting information for any specific `Fault` or `Warning` press the **INFO** key.

Local languages

Emerson extends its worldwide reach by offering nine menu languages:

- English
- French
- German
- Italian
- Spanish
- Portuguese
- Chinese
- Russian

- Polish

Every transmitter includes the following in all nine languages:

- Programming menus
- Calibration routines
- Faults and Warnings
- **Help** screens

Current outputs

Every transmitter includes four 4–20 mA or 0–20 mA electrically isolated current outputs, giving the ability to transmit the measurement value and the temperature for both sensors. Users have wide latitude to assign any measurement value or live diagnostic to any current output for reporting. You can enable output dampening with time constants from 0 to 999 seconds. HART digital communications transmitted via current output 1 is standard on all transmitters (option code HT).

1.2 Enhanced features

The Rosemount 56 is a versatile instrument that provides high-resolution trending graphs, extensive data logging, USB data transfer, Proportional, Integral, and Derivative (PID) control, programmable alarm relays, specialized timer functions, and wireless capability with the THUM™ Adapter. The transmitter supports advanced measurement functions for a variety of sensors.

Process trending graphs

You can display high-resolution color graphs of measurement data on-screen to pinpoint process disruptions or measurement problems and to estimate probe maintenance frequency. The transmitter has the ability to zoom in to a specific narrow time frame of process measurements for detailed on-screen evaluation.

Data logger and event logger

Extensive onboard data storage captures measurement data from both channels every 30 seconds for 30 days for on-screen display or local upload to a USB 2.0 memory device. 300 significant transmitter events are recorded, including:

- Start-up time
- Calibrations
- Hold outputs
- Configurations
- Alarms
- Power interruptions
- Faults

All process data and events are time/date stamped.

USB 2.0 data transfer port

A USB port is built in to allow local data transfer of process data and events using a standard USB memory device. Cleanly formatted EXCEL data is useful for evaluation of process data on a computer and identification of critical alarm or fault events.

PID control

PID settings allow the analog current outputs to adjust a control device that has continuous adjustability by acting on process measurements or temperature. PID is typically used on modulating control devices, such as automated control valves or variable volume pumps. You can program any current output can be programmed for PID functions.

Alarm relay capabilities

Four single pole double throw alarm relays are fully assignable and programmable to trigger alarms upon reaching measurement or diagnostics setpoints or fault conditions. Further relay settings include time Proportional Control (TPC), synchronized interval timers, and four specialized timer functions described below. All relays are independently activated. Failsafe operation and programming of relay default state (normally open or normally closed) is software selectable.

Timer functions

Basic TPC settings are available. Interval timers set relays by interval time, on-time, and recovery time for discrete on/off control devices based on measurement inputs. In addition, four real-time clock relay functions are implemented including:

- Bleed and feed
- Day and time interval timers
- Delay timer
- Flow totalizer

These advanced timer features support a number of specialized applications that normally require dedicated timer control devices or Distributed Control System (DCS) programming.

Wireless THUM adapter cap

Enable wireless transmissions of process variables and diagnostics from hard-to-reach locations where it is impractical to run wires for current outputs. When commissioned with the THUM Adapter, HART® transmitters can communicate on Emerson wireless networks using HART 7 wireless protocol.

SMART-enabled pH

Rosemount SMART pH capability can eliminate field calibration of pH probes through automatic upload of calibration data and history — fully calibrating the pH loop. pH probe changes are literally plug and play using SMART pH sensors with Variopol (VP) cables connections.

Advanced functions

Among the several specialty measurements supported are:

- High reference impedance pH
- Ion selective electrode measurements
- pH loop calibration by entering pH slope and reference offset
- Isopotential point for pH
- Inferred pH determination using dual contacting conductivity inputs
- Differential conductivity
- Differential flow
- Totalized flow

- Current input from any 4–20 mA source
- Dual range calibration for chlorine sensors
- Programmable polarizing voltage for amperometric oxygen sensors
- Software selectable normally open or normally closed alarm relays

1.3 General specifications

Refer to the [Rosemount 56 Dual Channel Transmitter Product Data Sheet](#) for specifications.

1.4 Contacting conductivity (codes -20 and -30)

Measures conductivity in the range 0 to 600,000 $\mu\text{S}/\text{cm}$ (600 mS/cm).

Measurement choices are:

- Conductivity
- Resistivity
- Total dissolved solids
- Salinity
- % concentration

You can disable temperature compensation can be disabled, allowing the transmitter to display raw conductivity.

Note

When two contacting conductivity sensors are used, the transmitter can derive an inferred pH value. Inferred pH is calculated pH, not directly measured pH. Inferred pH is calculated from straight and cation conductivity. It is applicable only if the alkalizing agent is NaOH or NH_3 and the major contaminant is NaCl. It is strictly an application for power plants.

Performance specifications - Analyzer

Measurement Range:	See Figure 1-1 .
Solution temperature compensation:	Manual slope ($\text{X}\% / ^\circ\text{C}$), high purity water (dilute sodium chloride), and cation conductivity (dilute hydrochloric acid).
Salinity:	Uses Practical Salinity Scale.
Total Dissolved Solids:	Calculated by multiplying conductivity at 25 $^\circ\text{C}$ by 0.65.
Five percent concentration curves:	0-12% NaOH, 0-15% HCl, 0-20% NaCl, 0-25% or 96-99.7% H_2SO_4 . The conductivity concentration algorithms for these solutions are fully temperature compensated.
Four temperature compensation options:	Manual slope ($\text{X}\% / ^\circ\text{C}$), high purity water (neutral salt), cation conductivity (dilute hydrochloric acid) and raw.
Input filter:	Time constant 1 - 999 sec, default 2 sec.

Response time: 3 seconds to 95% of final reading

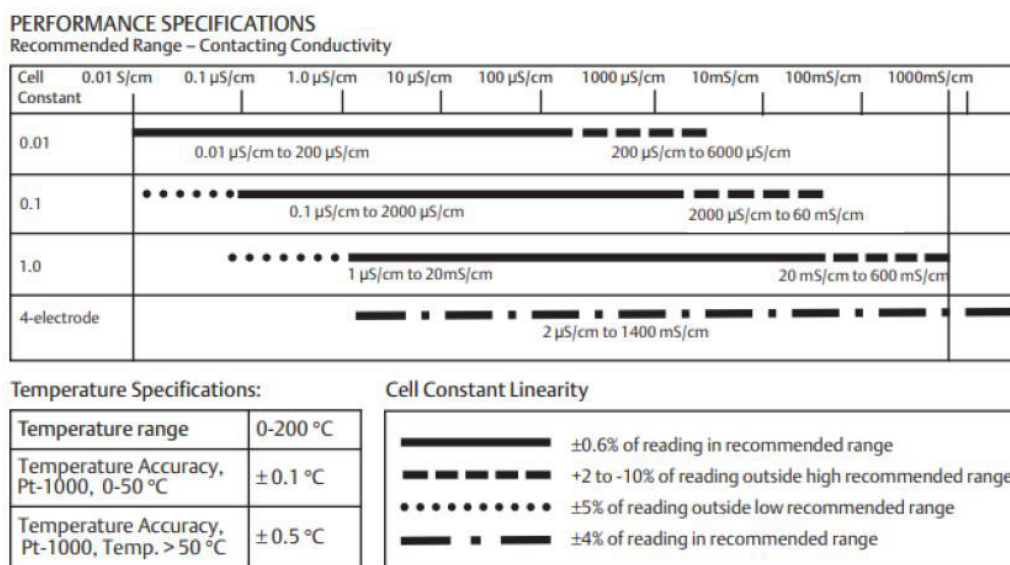
Recommended sensors for contacting conductivity

All Rosemount ENDURANCE 400 series conductivity sensors (Pt 1000 RTD) and 410VP 4-electrode high-range conductivity sensor.

Table 1-1: Temperature specifications:

Temperature specifications	0-200 °C
Temperature Accuracy, Pt-1000, 0-50 °C	± 0.1 °C
Temperature Accuracy, Pt-1000, Temp. > 50 °C	± 0.5 °C

Figure 1-1: Performance specifications



1.5 Toroidal conductivity specifications (codes -21 and -31)

The transmitter measures conductivity in the range of 1 μ S/cm to 2,000,000 μ S/cm (2 S/cm).

Measurement choices are:

- Conductivity
- Resistivity
- Total dissolved solids
- Salinity
- Percent concentration

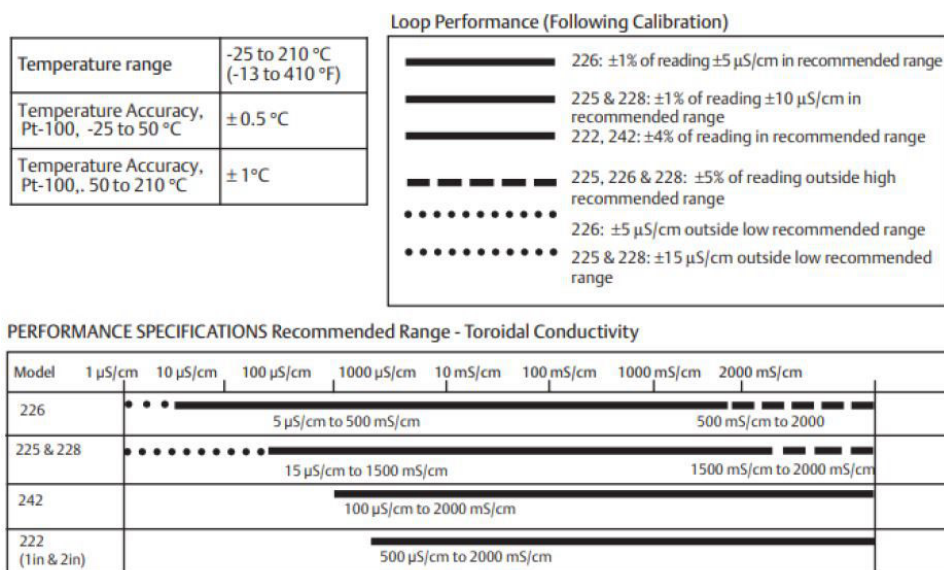
You can disable temperature compensation, allowing the transmitter to display raw conductivity.

For more information concerning the use and operation of toroidal conductivity sensors, refer to the sensor product data sheets.

Transmitter performance specifications

Measurement range See [Figure 1-2](#).

Figure 1-2: Performance specifications



Repeatability ±0.25 percent ±5 µS/cm after zero calibration

Salinity Uses Practical Salinity Scale

Total dissolved solids Calculated by multiplying conductivity at +77 °F (+25 °C) by 0.65

Five percent concentration curves 0-12 percent NaOH

0-15 percent HCl

0-20 percent NaCl

0-25 percent or 96 -99.7 percent H₂SO₄

The conductivity concentration algorithms for these solutions are fully temperature compensated. For other solutions, the transmitter accepts as many as five data points and fits either a linear (two points) or a quadratic function (three or more points) to the data. You can also adjust reference temperature and linear temperature slope for optimum results.

Three temperature compensation options Manual slope (X%/° C)
Neutral salt (dilute sodium chloride)
Raw

Input filter Time constant: 1 - 999 seconds, default 2 seconds

Response time 3 seconds to 95 percent of final reading

Recommended sensors All Rosemount submersion/immersion and flow-through toroidal sensors

1.6 pH/oxidation reduction potential (ORP) specifications

Codes -22 and -32. Code -P.

You can use the transmitter with any standard pH or ORP sensor.

For use with any standard pH or ORP sensor, including SMART pH sensors with SMART preamplifiers from Emerson.

Measurement choices are:

- pH
- ORP
- Redox
- Ammonia
- Fluoride
- Custom ISE

The automatic buffer recognition feature uses stored buffer values and their temperature curves for the most common buffer standards available worldwide. The transmitter recognizes the value of the buffer being measured and performs a self stabilization check on the sensor before completing the calibration. You can select manual or automatic temperature compensation from the menu. You can use a programmable temperature coefficient to compensate for a change in pH due to process temperature coefficient.

For more information concerning the use and operation of the pH or ORP sensors, refer to the sensor Product Data Sheets.

The transmitter can also derive an inferred pH value called pHCalc (calculated pH). The transmitter can derive and display pHCalc when using two contacting conductivity sensors (Rosemount 1056-0X-20-30-AN).

The transmitter can also derive an inferred pH value. The transmitter can derive and display inferred pH when you use two contacting conductivity sensors.

2 Installation

2.1 Unpack and inspect

Procedure

Inspect the shipping container.

- If it is damaged, then contact the shipper immediately for further instructions.
- If there is no apparent damage, then unpack the container. Ensure all items shown on the packing list are present. If items are missing, then notify Emerson immediately.

2.2 General installation information

Install the transmitter in shaded areas away from extreme temperatures using a sunshield. Mount the transmitter away from interference and high voltage, ensure it's accessible and properly sealed and that it complies with electrical codes to prevent shock.

⚠ WARNING

Risk of electrical shock

Electrical installation must be in accordance with the National Electrical Code (ANSI/ National Fire Protection Association [NFPA]-70) and/or any other applicable national or local codes.

- Although the transmitter is suitable for outdoor use, Emerson does not recommend installation in direct sunlight or in areas of extreme temperatures unless using a sunshield. Note the ambient temperature specifications in the [Rosemount 56 Dual Channel Transmitter Product Data Sheet](#). Do not operate the transmitter in ambient (shaded) conditions greater than +140 °F (+60 °C).
- Install the transmitter in an area where vibration and electromagnetic and radio frequency interference are minimized or absent.
- Keep the transmitter and sensor wiring at least 12 in. (30.5 cm) from high voltage conductors. Verify that there is easy access to the transmitter.
- The transmitter is suitable for panel, pipe, or surface mounting.
- Install cable fittings and plugs as needed to properly seal the transmitter on all six enclosure openings. The USB port cover must be fully installed on the front cover to ensure proper transmitter sealing.

Installation dimensions

Note

Dimensions are displayed with inches above and millimeters below.

Figure 2-1: Panel mount front view

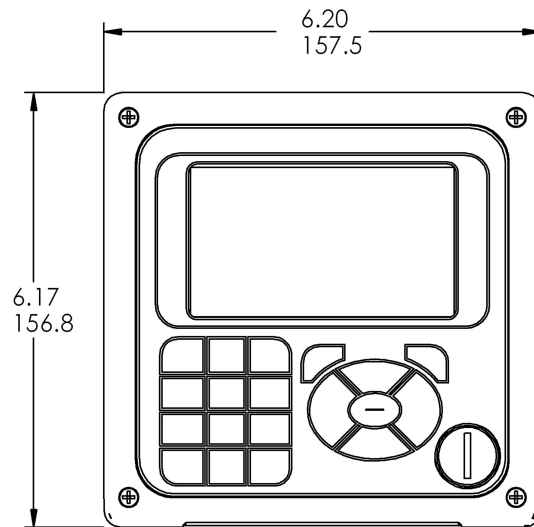
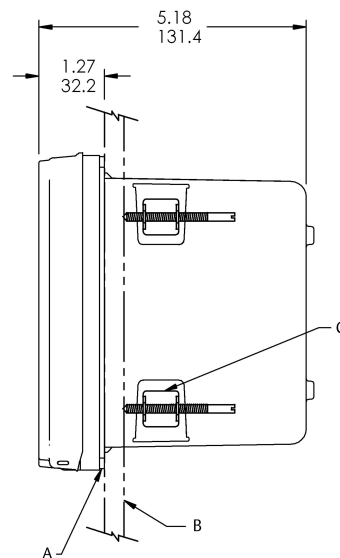


Figure 2-2: Panel mount side view



- A. Panel mount gasket
- B. Panel supplied by others. Maximum thickness: 0.375 in. (10 mm)
- C. Four mounting brackets and screws provided with transmitter

4X Ø .86 21.8
A

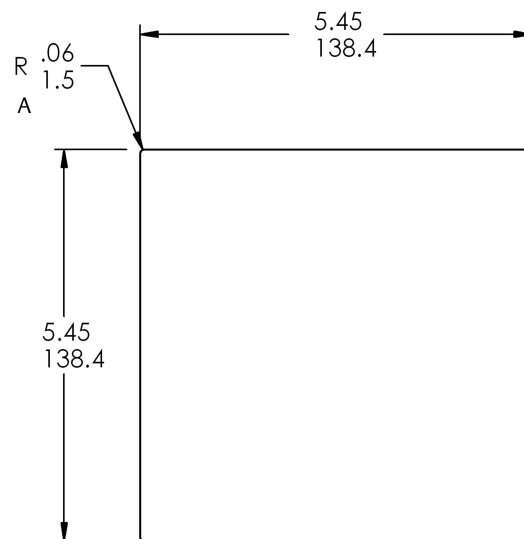
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1.56
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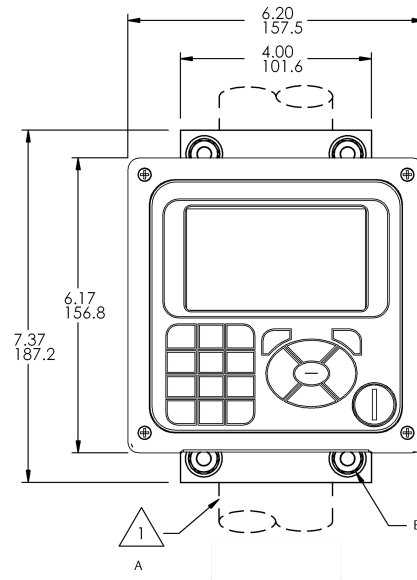
5.18
131.4

Figure 2-4: Panel cut-out



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Figure 2-5: Wall/surface mount front view



- A. 2-inch pipe supplied by customer
- B. Four cover screws

Figure 2-6: Wall/surface mount side view

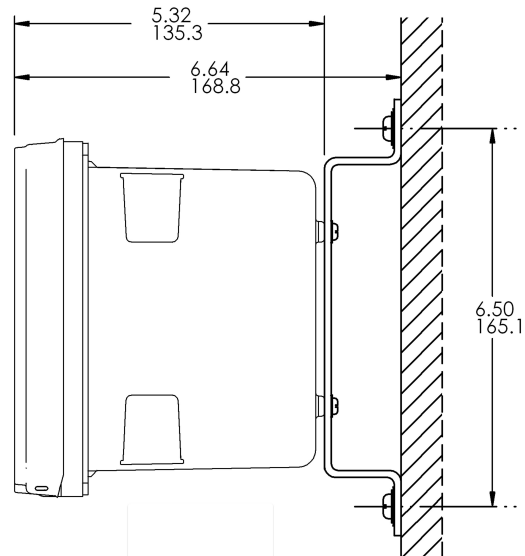
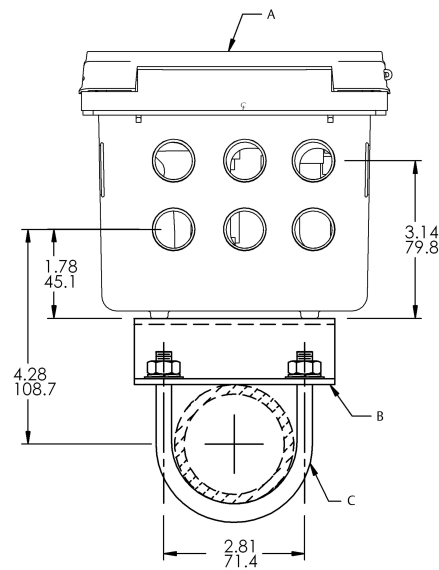
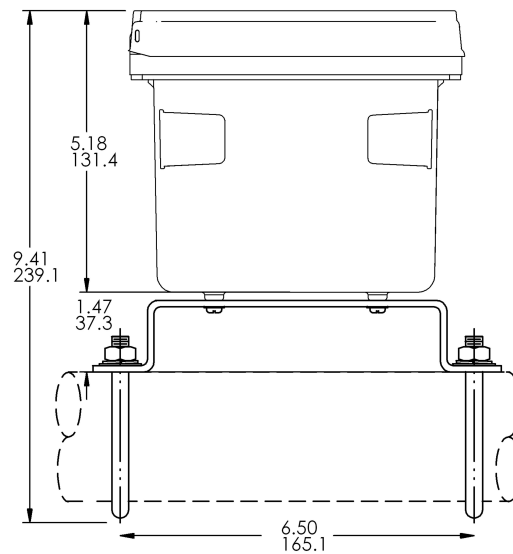


Figure 2-7: Pipe mount bottom view



- A. Front panel
- B. 2-inch pipe mount bracket

Figure 2-8: Pipe mount side view



Shown with mounting kit, PN 23820-00

3 Wiring

3.1 General wiring information

The transmitter is designed for simple installation, featuring detachable connectors, slide-out input boards, and a hinged front panel that swings down for convenient wiring access.

The transmitter is easy to wire. It includes removable connectors and slide-out signal input boards. The front panel is hinged at the bottom. The panel swings down for easy access to the wiring locations.

3.1.1 Removable connectors and signal input boards

The transmitter facilitates wiring and installation with its three slots for easily removable signal input and communication boards, allowing partial or full board removal from the enclosure.

The transmitter uses removable signal input boards and communication boards to facilitate wiring and installation. You can remove each of the signal boards either partially or completely from the enclosure for wiring. The transmitter has three slots for placement of up to two signal input boards and one communication board.

Slot 1 - left	Slot 2 - center	Slot 3 - right
Profibus® board	Signal board 1	Signal board 2

3.1.2 Wire the signal input boards

For wiring the transmitter's signal input measurement boards, connect sensor leads according to marked positions on the board, slide the board into an enclosure slot, manage excess cable through the gland, and secure it, noting that Emerson is the exclusive supplier for replacement boards.

Slots 2 and 3 are for signal input measurement boards.

Procedure

1. Wire the sensor leads to the measurement board following the lead locations marked on the board.
2. Carefully slide the wired board fully into the enclosure slot and take up the excess sensor cable through the cable gland.
3. Tighten the cable gland nut to secure the cable and ensure a sealed enclosure.

Note

For the purpose of replacing factory-installed signal input boards, Emerson is the sole supplier.

3.1.3 Digital communications

The Rosemount 56 features standard HART® digital communications with selectable versions 5 and 7 via the local keypad and offers optional PROFIBUS® DP communication for integration with a host system.

The Rosemount 56 Transmitter has HART communications as a standard feature and PROFIBUS DP as an option.

HART versions 5 and 7 are standard on the transmitter. You can switch between HART versions using the local keypad. A PROFIBUS DP communication board is available as an option for transmitter communication with a host. HART communication supports Bell 202 digital communication over an analog 4-20 mA current output. PROFIBUS DP is an open communication protocol which operates over a dedicated digital line to the host.

For more information, refer to the [Rosemount 56 HART manual](#) or Profibus DP Addendum manual.

3.1.4 Alarm relays

The transmitter's alarm system includes four relays with customizable functions for process measurements, temperature, fault alarms, interval timers, user-programmable logic, deadband, and failsafe operations with USP alarming available for conductivity when using the appropriate measurement board.

Emerson supplies four alarm relays with the switching power supply (85 to 264 Vac, 03 order code) and the 24 Vdc power supply (20 - 30 Vdc, 02 order code). You can use all relays for process measurement(s) or temperature. You can also configure any relay as a fault alarm instead of a process alarm. In addition, you may configure any relay independently and program it as an interval timer (typically used to activate pumps or control valves).

All process alarms, alarm logic (high or low activation or USP*), and deadband are user-programmable. Customer-defined failsafe operation is supported as a programmable menu function to allow all relays to be energized or not energized as a default condition upon powering the transmitter. You may program the USP* alarm to activate when the conductivity is within a user-selectable percentage of the limit. USP* alarming is available only when a contacting conductivity measurement board is installed.

3.2 Preparing conduit openings

The transmitters features six conduit openings for wiring, with four sealed by plugs for shipment, designed to accommodate ½-inch conduit fittings or PG13.5 cable glands, requiring watertight fittings to maintain a watertight case.

There are six conduit openings in all configurations of the transmitter.

Note

Four of the openings are fitted with plugs for shipment.

Conduit openings accept ½-inch conduit fittings or PG13.5 cable glands. To keep the cases watertight, block unused openings with Type 4X or IP66 conduit plugs.

NOTICE

Use watertight fittings and hubs that comply with your requirements. Connect the conduit hub to the conduit before attaching the fitting to the transmitter.

3.3 Preparing sensor cable

The Rosemount 56 is intended for use with all Rosemount sensors. Refer to the sensor Quick Start Guide for details on preparing sensor cables.

3.4 Power, output, and sensor connections

3.4.1 Power wiring

The transmitter offers two power supply options: a 24 Vdc supply with an order code of -02 and an 85-265 Vac switching power supply with an order code of -03, both connectable via clearly marked leads on a vertically-mounted board in the main enclosure, with the grounding plate of the -03 supply also providing connections for certain sensors to reduce radio frequency interference.

Emerson offers two power supplies for the transmitter:

- 24 Vdc (20 - 30 V) Power Supply (-02 order code)
- 85 - 265 Vac Switching Power Supply (-03 order code)

AC main leads and 24 Vdc leads are wired to the power supply board, which is mounted vertically on the left side of the main enclosure cavity. Each lead location is clearly marked on the power supply board. Wire the power leads to the power supply board using the lead markings on the board.

The grounding plate is connected to the earth terminal of the -03 order code (85 - 265 Vac) power supply. The green screws on the grounding plate are intended for connection to some sensors to minimize radio frequency interference. The green screws are not intended for safety purposes.

3.4.2 Current output wiring

Emerson ships all transmitters with four 4-20 mA current outputs. Wiring locations for the outputs are on the main board, which is mounted on the hinged door of the transmitter.

Wire the output leads to the correct position on the main board using the lead markings (+/positive, -/negative) on the board. Emerson provides male mating connectors with each transmitter.

NOTICE

Twisted pairs are required to minimize noise pickup in the 4-20 mA current outputs. For high Electromagnetic Interference (EMI)/Radio Frequency Interference (RFI) environments, shielded sensor wire is required. Emerson recommends shielded sensor wire in all other installations.

3.4.3 Alarm relay wiring

Emerson supplies four alarm relays with the switching power supply (85 to 265 Vac, 03 order code) and the 24 Vdc power supply (20-30 Vdc, 02 order code).

Wire the relay leads on each of the independent relays to the correct position on the power supply board using the printed lead markings (NO/Normally open, NC/Normally closed, or COM/Common) on the board. See [Figure 3-1](#)

Figure 3-1: Alarm relay wiring for Rosemount 1056 switching power supply (03 ordering code)

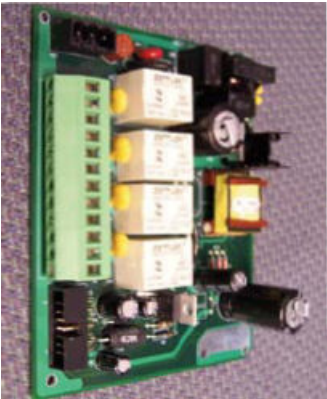


Table 3-1: Relays

NO1	Relay 1
COM1	
NC1	
NO2	Relay 2
COM2	
NC2	
NO3	Relay 3
COM3	
NC3	
NO4	Relay 4
COM4	
NC4	

4 Display and operation

4.1 User interface

The transmitter has a large display which shows two live measurement readouts in large digits and up to six additional process variables or diagnostic parameters concurrently.

The display is back-lit, and you can customize the format to meet your requirements. Use the **ENTER/MENU** key to access **Calibration**, **Hold** (of current outputs), **Programming**, **Display**, **Data**, and **HART** functions. In addition, you can use a dedicated **INFO** key to access useful diagnostic and instrument information regarding installed sensor(s) and any problematic conditions. The display flashes a red banner to indicate a **Fault** condition and a yellow banner for a **Warning** condition. The transmitter displays **Help** screens for fault and warning conditions to guide you in troubleshooting. During calibration and programming, press keys step-by-step through procedures. An alpha-numeric keypad, similar to a cell phone keypad, is available to allow you to enter data during programming and calibration or lengthy tags to describe process points, sensors, or instrumentation.



4.2 Instrument keypad

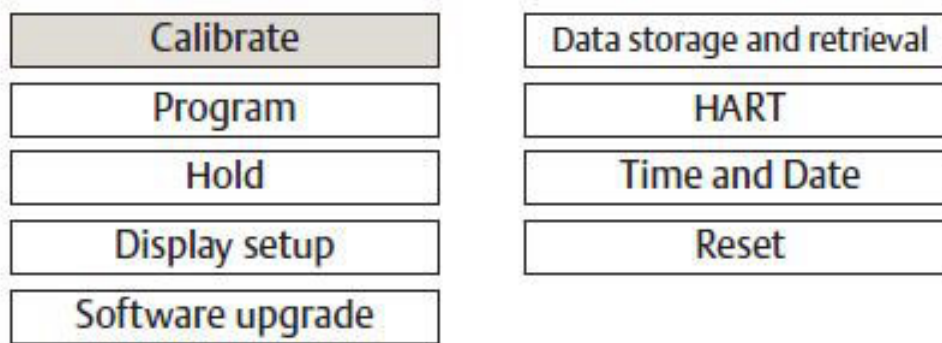
There are three Function keys, four Navigation keys and an alpha-numeric keypad on the instrument keypad.

Function keys

The **ENTER/MENU** key is used to access menus for programming and calibrating the instrument as well as retrieving stored data. Eight top-level menu items appear when pressing the **ENTER/MENU** key from the main display of live readings:

- **Calibrate:** Calibrate attached sensors and analog outputs.
- **Program:** Program outputs, relays, measurement, temperature, and security codes.
- **Hold:** Suspend current outputs.

- **Display Setup:** Program graphic trend display, brightness, main display format, tags, language, and warnings.
- **Data storage and retrieval:** Enable data and event storage, download data, and view events.
- **HART or Profibus:** Program HART® and Profibus communication parameters.
- **Time and Date:** Set and view real-time clock settings.
- **Reset:** Reset all instrument settings, calibration settings or current outputs to factory defaults.



The **ENTER/MENU** key is also used to enter selections or enable programming and calibration steps.

The **EXIT** key returns to the previous menu level.

The **INFO** key provides detailed instructions and explanations during programming and calibrating procedures. It also provides troubleshooting tips for all faults and warnings that may occur during calibration or continuous operation in process.

Navigation keys

The four Navigation keys arranged around the **ENTER/MENU** key operate in an intuitive manner similar to the navigation keys on a computer keyboard. During menu operation, these keys are used to move the highlighted screen selection to another adjacent screen item. During tag entry, the left key is used to delete entries during active alpha-numeric character entry.

Alpha-numeric keypad

The alpha-numeric keypad has 12 keys as outlined below:

- Nine keys are alpha-numeric
- One key is a dedicated "1" key
- One key is a dedicated "0" key
- One key is a dedicated "." (decimal point) key

The alpha-numeric keypad operates the same as entries on a mobile phone. The nine alpha-numeric keys have multiple characters that can be entered for tag entries or during programming and calibration steps. Character selections are made by pressing the key multiple times to toggle to characters that are available on each key.

4.3 Main display

The 56 displays one or two primary measurement values, up to six secondary measurement values, fault and warning banner, alarm relay flags, and a digital communications icon.

Process measurements

Two process variables are displayed if two signal boards are installed. One process variable and process temperature are displayed if one signal board is installed with one sensor. The Upper display area shows the Sensor 1 process reading. The Center display area shows the Sensor 2 process reading. For dual conductivity, refer to the Quick Start Guide.

For single input configurations, the Upper display area shows the live process variable and the Center display area can be assigned to Temperature or blank.

Secondary values

Up to six secondary values are shown in six display quadrants at the bottom half of the screen. All six secondary value positions can be programmed by the user to any display parameter available.

4.4 Menu system

For information about the menu system, refer to the [Rosemount 56 Quick Start Guide](#).

4.5 USB data port

⚠ CAUTION

Not all USB memory devices will physically fit into the Rosemount 56 data port. After removing the USB cover and seal, make sure that the USB memory device can be easily and fully inserted into the USB data port without any mechanical conflict with the USB data port flange. The USB communications port is protected by a Type 4-rated seal and cover. Do not remove the cover during cleaning of the analyzer housing. Never remove the USB port cover when the instrument is operated in a hazardous rated area.

The Rosemount 56 menu system is similar to a computer. A USB 2.0 data port is accessible on the front panel of the Rosemount 56 instrument. The USB data port can be used for download of measurement data and events using a USB memory device. It can also be used to download and upload complete analyzer configurations to copy all programmed settings to another Rosemount 56 analyzer.

Note

Only Rosemount 56 units which display the **Transfer Configurations** tab under the **Data Storage and Retrieval** menu are capable of downloading and uploading analyzer configurations.

The USB data port is easily accessed by inserting a coin in the vertical slot of the cover and rotating counterclockwise one quarter turn to remove the cover and Type 4 seal.

Note

The data logger and event logger are disabled by default setting upon initial startup from the factory. Always enable the data logger and event logger under the **Data Storage and Retrieval** menu to initiate internal recording of process data and event data.

4.6 Rosemount 56 data logger and event logger download procedures

4.6.1 Description

The Rosemount 56 supports download of stored data logger and event logger data at the device. The download process is performed using a USB 2.0 flash drive memory device inserted into the USB data port on the front panel of the Rosemount 56 analyzer. The data can be uploaded to a PC for viewing in preformatted Excel tables.

4.6.2 Rosemount 56 data logger download procedure

Procedure

1. From the main menu, select **Data storage and retrieval**.
2. Select the **Download** tab.
3. Select **Download measurement** data.
4. With the Rosemount 56 analyzer powered, remove the **NEMA** cap from the front display by inserting a coin into the cap's vertical slot and rotating counterclockwise. Remove the USB cap to access the data port.
5. Carefully insert a USB 2.0 flash drive into the USB port on the Rosemount 56. Note that the USB insertion connector is keyed.
6. The **Download** screen will report **Earliest data available** and **Latest data available** that can be downloaded from the internal data logger file.
7. With a USB 2.0 flash drive properly inserted, choice **Selected Range (default)** or **All Data**.
8. If **Selected Range** is chosen, define the **Start Date** and **End Date** in the screen fields. Note that the **Start Date** and **End Date** reported will default to the current data that is recognized by the analyzer.
9. If **All Data** is selected, all stored date (up to 30 days) will be downloaded.
10. Select **START** and press **ENTER**.
11. A **Data download information and instruction** screen is displayed while data logger files are being downloaded. The download process will be completed in a few minutes.
12. When the data logger download is complete, a confirmation screen is display with the reported range of dates that were downloaded to the USB flash drive.
13. Carefully remove the USB 2.0 flash drive from the USB port.
14. Insert the **NEMA** cap into the Rosemount 56 USB front display opening.
15. You may exit the **Download completed** screen by selecting **BACK**.
16. To view data logger files, insert the USB flash drive into a computer. On the designated drive associated with the USB flash drive, individual data logger files for each day can be opened as Excel formatted files in the root directory of the USB drive. Note that the data codes are assigned file names based on the analyzer's recognized dates.

4.6.3 Rosemount 56 event logger download procedure

Procedure

1. From the main menu, select **Data storage and retrieval**.
2. Select the **Download** tab.
3. Select **Download events**.
4. With the Rosemount 56 analyzer powered, remove the **NEMA** cap from the front display by inserting a coin into the cap's vertical slot and rotating counterclockwise. Remove the USB cap to access the data port.
5. Carefully insert a USB 2.0 flash drive into the USB port on the Rosemount 56. Note that the USB insertion connector is keyed.
6. A **Download events information** screen is briefly displayed while events files are being downloaded. The download process may require a few minutes to complete.
7. When the events download is complete, a confirmation screen appears.
8. Carefully remove the USB 2.0 flash drive from the USB port.
9. Insert the Type 4 cap into the Rosemount 56 USB front display opening.
10. You may exit the **Download completed** screen by selecting **BACK**.
11. To view event logger files, insert the USB flash drive into a computer. On the designated drive associated with the USB device, the single event logger file can be opened as an Excel formatted file in the root directory of the USB drive. Note that the data codes are assigned file names based on the analyzer's recognized dates.

4.7 Software upgrade

4.7.1 Description

All Rosemount 56 advanced analyzers with serial number J12- or later (October 2012) allow software upgrades using the device's USB data port. To download and install software upgrades, refer to [Rosemount 56 Dual Channel Transmitter](#).

4.7.2 Software upgrade checklist

Before upgrading, confirm:

- Serial Number date codes of the 56 analyzer is J12 (October 2012) or later.
- Confirm that Safe Area requirements are met before installing software.
- USB 2.0 flash drive memory device is available.

4.7.3 Software upgrade procedure

Procedure

1. Download the Rosemount 56 software upgrade file to a computer. Access software **HERE**. Save the file to the main root directory of a USB flash drive memory stick. Only one Rosemount 56 software upgrade file should be present at the root directory.
2. Save all user settings before upgrading the software by copying the analyzer's configuration to a flash drive. Access this procedure at the local Rosemount 56 device menu location: **MENU/Data storage and retrieval/Transfer Configuration**.

3. Download the Data Logger measurement data and the Events before upgrading the software. Access these procedures at Rosemount 56 menu location: **MENU/Data storage and re-trieval/Download/Download measurement data and at /Download/Download Events**.
4. With the Rosemount 56 analyzer powered up and the front enclosure panel completely closed, remove the Type 4 cap from the front display by inserting a coin into the cap's vertical slot and rotating counterclockwise. Remove the USB cap and seal to access the data port.
5. Carefully insert a USB 2.0 flash drive into the USB port on the Rosemount 56. The USB insertion connector is keyed. Note that some USB devices will not fit into the USB port due to mechanical restrictions.
6. Press the **ENTER/MENU** key. Select **Software upgrade** in the main menu.
7. Select **NEXT**. Press **ENTER/MENU** to start software upgrade. The current software version and the new software version are reported on the screen.
8. Select **NEXT**. Press **ENTER/MENU**. **Software upgrade in process** and a progress bar will appear. The process may require up to 5 minutes to complete.
9. The **Time and Date** screen will appear. Enter local real time clock and date information. Press **ENTER/MENU**.
10. The main screen will appear reporting live process values. Programming of settings and calibration may be required.

4.8 Configuration transfer

4.8.1 Description

All Rosemount 56 unit with serial number J12- or later (October 2012) will support the function of Configuration Transfer from one Rosemount 56 analyzer to another, or multiple Rosemount 56 analyzers. The transfer is done by using a version 2.0 USB flash drive (USB memory stick) for downloading the existing configuration and uploading to another instrument.

4.8.2 Transfer configuration process user notes

Procedure

1. Configuration Transfer can only be performed between instruments of identical configuration. The analyzers must have the same signal boards installed.
2. Several text files downloaded to the flash drive can be saved to a PC and used later.
3. Only one set of configuration files will be stored on the flash drive. The files that are downloaded will over-write any existing files stored in the root directory of the flash drive.

4.8.3 Transfer configuration procedure user notes

Procedure

1. Confirm all user settings before transferring configuration.
2. From the main menu, select **Data storage and retrieval**.
3. Select the **Transfer Configuration** tab.
4. Select **Copy analyzer configuration to the flash drive**.

5. With the Rosemount 56 analyzer powered, remove the **NEMA** cap from the front display by inserting a coin into the cap's vertical slot and rotating counterclockwise. Remove the USB cap to access the data port.
6. Carefully insert a USB 2.0 flash drive into the USB port on the Rosemount 56. Note that the USB in-section connector is keyed.
7. Select **Copy data**. Press **ENTER**.
8. An **information** screen appears warning users that any configuration files that exist in the root directly of the flash drive will be overwritten upon configuration transfer. If **No** is selected (default setting), existing configuration files will not be overwritten. Select **Yes** to transfer the configuration file to the flash drive.
9. The configuration file will be transferred (downloaded) in about 20 seconds. A screen will report that the configuration file has been transfused.
10. Carefully remove the USB 2.0 flash drive from the USB port.
11. Insert the **NEMA** cap into the Rosemount 56 USB front display opening.
12. Follow Steps 2-3 above on the instrument that will receive the copied configuration.
13. On the Rosemount 56 analyzer instrument that will receive the copied configuration, remove the Type 4 cap from the front display.
14. Carefully insert the USB 2.0 flash drive containing the configuration file into the USB port.
15. Select **Copy configuration from the flash drive to the analyzer**. Press **ENTER**.
16. There are two options for configuration transfer. Select one of the following and press **ENTER**:
 - Copy configuration data only to the analyzer.
 - Copy configuration and calibration data to the analyzer.
17. Select **Copy data**. Press **ENTER**.
18. The configuration file will be transferred (uploaded) in about 20 seconds. A screen will report that the configuration file has been transfused.
19. Carefully remove the USB 2.0 flash drive from the USB port.
20. Insert the **NEMA** cap into the Rosemount 56 USB front display opening.

5 Programming the analyzer - Basics

5.1 General

Typical programming steps include the following listed procedures. Each of these programming functions are easily and quickly accomplished using the intuitive menu systems:

- Changing the measurement type, measurement units and temperature units
- Choose temperature units and manual or automatic temperature compensation mode
- Configure and assign values to the current outputs
- Set a security code for two levels of security access
- Accessing menu functions using a security code
- Enabling and disabling Hold mode for current outputs
- Choosing the frequency of the AC power (needed for optimum noise rejection)
- Resetting all factory defaults, calibration data only, or current output settings only

5.2 Changing startup settings

Procedure

1. To change the measurement type, measurement units, or temperature units that were initially entered in Quick Start Guide, choose the **Reset** function or access the Program menus for Sensor 1 or Sensor 2.

The following choices for specific measurement type, measurement units are available for each sensor measurement board:

Signal board	Available measurements	Measurements units
pH/ORP (-22, -32)	pH, ORP, Redox, Ammonia, Fluoride, Custom ISE	pH, mV (ORP) %, ppm, mg/L, ppb, µg/L, (ISE)
Contacting conductivity (-20, -30)	Conductivity, Resistivity, TDS, Salinity, NaOH (0-12%), HCl (0-15%), Low H ₂ SO ₄ , High H ₂ SO ₄ , NaCl (0-20%), Custom Curve	µS/cm, mS/cm, S/cm% (concentration)
Toroidal conductivity (-21, -31)	Conductivity, Resistivity, TDS, Salinity, NaOH (0-12%), HCl (0-15%), Low H ₂ SO ₄ , High H ₂ SO ₄ , NaCl (0-20%), Custom Curve	µS/cm, mS/cm, S/cm% (concentration)
Chlorine (-24, -34)	Free Chlorine, pH Independ. Free Cl, Total Chlorine, Monochloramine	ppm, mg/L
Oxygen (-25, -35)	Oxygen (ppm), Trace Oxygen (ppb), Percent Oxygen in gas, Salinity	ppm, mg/L, ppb, µg/L % Sat, Partial Pressure, % Oxygen In Gas, ppm Oxygen In Gas
Ozone (-26, -36)	Ozone	ppm, mg/L, ppb, µg/L

Signal board	Available measurements	Measurements units
Temperature (all)	Temperature	°C / °F

2. To change the measurement type, measurement units, or temperature units, access the **Reset** screens by pressing **ENTER/MENU** from the main screen.

S1: 7.00pH 25.2 °C S2: 0.056 µS/cm 52.1 °C

Reset what?

☒ All user settings (Returns to Quick Start)

☐ Sensor 1 calibration only

☐ Sensor 2 calibration only

☐ Output 1 calibration only

☐ Output 2 calibration only

☐ Output 3 calibration only

☐ Output 4 calibration only

APPLY BACK

3. To change the measurement type, measurement units, or temperature units, access the **Program** screens by pressing **ENTER/MENU** from the main screen.

S1: 7.00pH 25.2 °C S2: 0.056 µS/cm 52.1 °C

Outputs Relays **Measure** Temperature pH diagnostic setup Security

Measurement pH

Pre-amplifier location Analyzer

Filter 4 sec

Reference Impedance Low

Wiring Normal

Resolution 0.01 pH

NEXT BACK

5.3 Programming temperature

Most liquid analytical measurements (except ORP) require temperature compensation. The Rosemount 56 performs temperature compensation automatically by applying internal temperature correction algorithms. Temperature correction can also be turned off. If temperature correction is off, the Rosemount 56 uses the temperature entered by the user in all temperature correction calculations.

Procedure

To select automatic or manual temp compensation, set the manual reference temperature, and to program temperature units as °C or °F, access the **Temperature** screens by pressing **ENTER/MENU** from the main screen.

S1: -71.29pH 999.9°C				S2: 0.0000GPM	
Outputs	Relays	Measure	Temperature	pH diagnostic setup	Security
Enter security codes (three digits maximum). 000 means no security. For more information press INFO.					
Calibration/Hold		0			
All		0			
BACK					
Warning					

5.4 Configuring and ranging the current outputs

The Rosemount 56 accepts inputs from two sensors and has four analog current outputs. Ranging the outputs means assigning values to the low (0 or 4 mA) and high (20 mA) outputs. This section provides a guide for configuring and ranging the outputs. ALWAYS CONFIGURE THE OUTPUTS FIRST.

Procedure

To configure the outputs, access the **Outputs** screen by pressing **ENTER/MENU** from the main screen.

S1: 7.00pH 25.2 °C		S2: 0.056 µS/cm 52.1 °C	
Outputs	Relays	Measure	Temperature
pH diagnostic setup			
Security			
Output	1		
Analog/PID/Simulate	PID		
Assign	S1 Measurement		
Range	4-20mA		
Setpoint	14.00 pH		
NEXT BACK			

5.5 Setting a security code

The security codes prevent accidental or unwanted changes to program settings, displays, and calibration. The Rosemount 56 has two levels of security code to control access and use of the instrument to different types of users.

The two levels of security are:

- **All:** This is the Supervisory security level. It allows access to all menu functions, including Programming, Calibration, Hold and Display.
- **Calibration/Hold:** This is the operator or technician level menu. It allows access to only calibration and Hold of the current outputs.

Procedure

To set security codes, access the **Security** screen by pressing **ENTER/MENU** from the main screen. Upon entry of the proper code, the following security screen will appear:

S1: -71.29pH 999.9°C				S2: 0.0000GPM	
Outputs	Relays	Measure	Temperature	pH diagnostic setup	Security

Enter security codes (three digits maximum). 000 means no security.
For more information press INFO.

Calibration/Hold

All

BACK

Warning

5.6 Security access

When entering the correct access code for the Calibration/Hold security level, the Calibration and Hold menus are accessible. This allows operators or technicians to perform routine maintenance. This security level does not allow access to the **Program** or **Display** menus. When entering the correct access code for All security level, the user has access to all menu functions, including Programming, Calibration, Hold and Display.

The Rosemount 56 menus use a security code, access the **Security** screen by pressing **ENTER/ MENU** from the main screen.

If a security code is currently programmed, the following security screen will appear. Enter the code.

Procedure

1. If a security code has been programmed, selecting the Calibrate, Hold, Program or Display top menu items causes the security access screen to appear.

S1: -71.29pH 999.9°C				S2: 0.0000GPM	
----------------------	--	--	--	---------------	--

Enter security code

BACK

2. Enter the three-digit security code for the appropriate security level.
3. If the entry is correct, the appropriate menu screen appears. If the entry is incorrect, the Invalid Code screen appears. The Enter Security Code screen reappears after 2 seconds.

5.7 Using Hold

The analyzer output is always proportional to measured value.

Procedure

1. To prevent improper operation of systems or pumps that are controlled directly by the current output, place the analyzer in Hold before removing the sensor for calibration and maintenance.
2. Remove the analyzer from Hold once calibration is complete.
During Hold, all outputs remain at the last value. Once in Hold, all current outputs remain on Hold indefinitely.
3. To hold the outputs and alarm relays, access the **Hold** screen by pressing **ENTER/MENU** from the main screen.

S1: 7.00pH 25.2 °C S2: 0.056 µS/cm 52.1 °C

Hold what? ☒ Sensor 1 output(s) and alarm relay(s)
☐ Sensor 2 output(s) and alarm relay(s)

Analyzer will remain in hold until taken out of hold. To take analyzer out of hold, move the cursor to the checked item and press ENTER.

APPLY BACK

5.8 Resetting factory default settings

This section describes how to restore factory calibration and default values. The process also clears all fault messages and returns the display to the first Quick Start screen.

The Rosemount 56 offers three options for resetting factory defaults:

- Reset all settings to factory defaults
- Reset sensor calibration data only
- Reset analog output settings only

Procedure

To reset to factory defaults, reset calibration data only or reset analog outputs only, access the **Reset** screen by pressing **ENTER/MENU** from the main screen.

S1: 7.00pH 25.2 °C		S2: 0.056 µS/cm 52.1 °C	
Reset what?	☒ All user settings (Returns to Quick Start) ☐ Sensor 1 calibration only ☐ Sensor 2 calibration only ☐ Output 1 calibration only ☐ Output 2 calibration only ☐ Output 3 calibration only ☐ Output 4 calibration only		
APPLY		BACK	

5.9 Programming alarm relays

The Rosemount 56 24 VDC (02 order code) and the AC switching power supply (03 order code) provide four alarm relays for process measurement or temperature. Each alarm can be configured as a fault alarm instead of a process alarm. Additionally, each relay can be programmed independently and each can be programmed as an interval timer or one of four advanced timer functions. This section describes how to configure alarm relays, simulate relay activation, and synchronize timers for the four alarm relays.

This section provides details to program the following alarm features.

To program the alarm relays, access the **Program** screen by pressing **ENTER/MENU** from the main screen and then select the **Relay** tab and the Configure relay control.

S1: 7.00pH 25.2 °C		S2: 0.056 µS/cm 52.1 °C	
Outputs	Relays	Measure	Temperature
pH diagnostic setup			
Security			
Explanation of relay actions Configure relay Simulate relay action			
BACK			

The following relay functions can be programmed to any relay from the **Configure Relay** screen:

1. Assign a relay
2. Define a relay function
3. Assign a Measurement
4. Set relay logic
5. Enter setpoints
6. Set deadband
7. Set normal state
8. Set USP Safety level (contacting conductivity)

To program these relay functions, access the **Configure Relay** screen by pressing **ENTER/MENU** from the main **Relay programming** screen.

Procedure

1. To assign a relay, highlight the desired Relay 1-4 and press **ENTER/MENU**.

The screenshot shows the 'Configure Relay' screen. At the top, it displays two sensor readings: 'S1: 7.00pH 25.2 °C' and 'S2: 0.056 µS/cm 52.1 °C'. Below this is a navigation bar with tabs: 'Outputs', 'Relays' (highlighted), 'Measure', 'Temperature', 'pH diagnostic setup', and 'Security'. The main area contains several dropdown menus and input fields: 'Relay' is set to '1', 'Type' is 'Setpoint', 'Assign' is 'S1 Measurement', and 'Logic' is 'High'. Below these are two input fields: 'Setpoint' with the value '14.00' and unit 'pH', and 'Deadband' with the value '0.00' and unit 'pH'. At the bottom right are 'NEXT' and 'BACK' buttons.

2. To define a relay function, select from **Setpoint**, **Interval Timer**, **TPC**, **Bleed and Feed**, **Water Meter**, **Delay timer**, **Date and Time**, **Fault** or **None** and press **ENTER/MENU**.
3. To assign a measurement to a specific relay, select the desired measurement or temperature input and press **ENTER/MENU**.
4. To set relay logic to activate alarms at a **High** reading or a **Low** reading, select high or low and press **ENTER/MENU**.
5. To enter setpoints for relays, enter the desired value for the process measurement or temperature at which to activate an alarm event and press **ENTER/MENU**.
6. To set deadband as a measurement value, enter the change in the process value needed after the relay deactivates to return to normal (and thereby preventing repeated alarm activation) and press **ENTER/MENU**.
7. To set the **Normal** alarm condition, select **Open** or **Closed** and press **ENTER/ MENU**. Program the normal state to define the desired alarm default state to normally open or normally closed upon power up.
8. To set USP Safety, enter the percentage below the limit at which to activate the alarm and press **ENTER/MENU**.

Note

USP Safety only appears if a contacting conductivity board is installed.

This section provides details to simulate relay action.

9. To simulate relays, access the **Program** screen by pressing **ENTER/MENU** from the main screen and then select the **Relay** tab.

S1: 7.00pH 25.2 °C		S2: 0.056 µS/cm 52.1 °C	
Outputs	Relays	Measure	Temperature
pH diagnostic setup			
Security			

Explanation of relay actions
Configure relay
Simulate relay action

BACK

S1: 7.00pH 25.2 °C		S2: 0.056 µS/cm 52.1 °C	
Outputs	Relays	Measure	Temperature
pH diagnostic setup			
Security			

Choose the relay to simulate

Relay 1

Energize relay
De-energize relay
Stop simulation

Pressing BACK or EXIT also stops simulation.

BACK

10. To simulate alarm relay conditions, access the **Simulate Relay Action** screen by pressing **ENTER/MENU** from the main **Relay programming** screen. Alarm relays can be manually set for the purposes of checking devices such as valves or pumps.
11. Under the **Alarms Settings** menu, this screen will appear to allow manual forced activation of the alarm relays. Select the desired alarm condition to simulate.

6 Programming - Measurements

6.1 Programming measurements – Introduction

The Rosemount 56 automatically recognizes each installed measurement board upon first power-up and each time the analyzer is powered. Completion of Quick Start screens upon first power up enable measurements, but additional steps may be required to program the analyzer for the desired measurement application. This section covers the following programming and configuration functions:

1. Selecting measurement type or sensor type (All sections)
2. Identifying the preamp location (pH: See [pH measurement programming](#).)
3. Enabling manual temperature correction and entering a reference temperature (All sections)
4. Enabling sample temperature correction and entering temperature correction slope (Selected sections)
5. Defining measurement display resolution ([pH measurement programming](#) and Amperometric)
6. Defining measurement display units (All sections)
7. Adjusting the input filter to control display and output reading variability or noise (All sections)
8. Selecting a measurement range (Conductivity: See [Contacting conductivity measurement programming](#) and [Toroidal conductivity measurement programming](#).)
9. Entering a cell constant for a contacting or toroidal sensor (See [Contacting conductivity measurement programming](#) and [Toroidal conductivity measurement programming](#).)
10. Entering a temperature element/RTD offset or temperature slope (Conductivity: See [Contacting conductivity measurement programming](#).)
11. Creating an application-specific concentration curve (Conductivity: See [Contacting conductivity measurement programming](#) and [Toroidal conductivity measurement programming](#).)
12. Enabling automatic pH correction for free chlorine measurement ([Chlorine measurement programming](#))

To fully configure the analyzer for each installed measurement board, you may use the following:

- Reset Analyzer function to reset factory defaults and configure the measurement board to the desired measurement. Follow the [Reset Analyzer menu](#) to reconfigure the analyzer to display new measurements or measurement units.
- Program menus to adjust any of the programmable configuration items. Use the following configuration and programming guidelines for the applicable measurement.

6.2 pH measurement programming

The section describes how to configure the Rosemount 56 analyzer for pH measurements. The following programming and configuration functions are covered:

1. Measurement type: pH Select pH, ORP, Redox, Ammonia, Fluoride, Custom ISE
2. Preamp location: Analyzer Identify preamp location
3. Filter: 4 sec Override the default input filter, enter 0-999 seconds
4. Reference Z: Low Select low or high reference impedance
5. Sensor wiring scheme: Normal or Reference to Ground
6. Resolution: 0.01pH Select 0.01pH or 0.1pH for pH display resolution
7. Enabling pH sensor diagnostics

To configure the pH measurement board, access the **Program** screen by pressing **ENTER/MENU** from the main screen and then select the **Measurement** tab.

Procedure

1. To select a Measurement type, select from: **pH**, **ORP**, **Redox**, **Ammonia**, **Fluoride**, and **Custom ISE**, and press **ENTER/MENU**.

2. To program the Preamp location, select Analyzer or Sensor/JBox, and press **ENTER/MENU**.
3. To Override the default input filter, enter 0-999 seconds and press **ENTER/MENU**.
4. To program Reference Impedance, select **Low** or **High** and press **ENTER/MENU**.
5. To choose the wiring scheme, select **Normal** or **Reference to Ground** and press **ENTER/MENU**.
6. To program the display resolution, select **0.01 pH** or **0.1 pH** and press **ENTER/MENU**.
7. To enable pH sensor diagnostics, select the **pH diagnostic setup** tab under **Programming**. Select **Sensor 1** or **Sensor 2**. Select **NEXT**. Select **On** under **sensor diagnostics** to enable pH diagnostics.

Note

pH sensor diagnostics must be enabled to include diagnostic values such as Glass Impedance and Reference Impedance in Excel data log sheets after data download to USB. Enabling pH sensor diagnostics also allows assignment of Glass Impedance and Reference Impedance to the two-dimensional on-screen process graph accessible under **Display Setup/View Graph**.

6.3 ORP measurement programming

The section describes how to configure the Rosemount 56 analyzer for ORP measurements.

The following programming and configuration functions are covered:

1. Measurement type: pH Select pH, ORP, Redox, Ammonia, Fluoride, Custom ISE
2. Preamplifier location: Analyzer Identify preamp location
3. Filter: 4 sec Override the default input filter, enter 0-999 seconds
4. Reference Z: Low Select low or high reference impedance
5. Sensor wiring scheme: Normal or Reference to Ground

Procedure

1. To configure the ORP measurement board, access the **Program** screen by pressing **ENTER/MENU** from the main screen and then select the **Measurement** tab.

2. To select a Measurement type, select **ORP** and press **ENTER/MENU**.
3. To program the Preamplifier location, select **Analyzer** or **Sensor/JBox**, and press **ENTER/MENU**.
4. To Override the default input filter, enter 0-999 seconds and press **ENTER/ MENU**.
5. To program Reference Impedance. Select **Low** or **High** and press **ENTER/MENU**.
6. Using the wiring scheme, select **Normal** or **Reference to Ground** and press **ENTER/MENU**.

6.4 Contacting conductivity measurement programming

The section describes how to configure the Rosemount 56 analyzer for conductivity measurements using contacting conductivity sensors.

The following programming and configuration functions are covered:

S1: -0.01 μ S/cm 999.9 $^{\circ}$ C		S2: 0.0000GPM	
Outputs	Relays	Measure	Temperature Security
Measurement		Conductivity	
Sensor type		2-Electrode	
Units		μ S/cm	
Cell constant		1.00000 /cm	
Filter		2 sec	
Range		Auto	
		NEXT BACK	

Warning

1. Measure: Conductivity. Select Conductivity, Resistivity, TDS. Salinity or % conc.
2. Type: 2-Electrode Select 2-Electrode or 4-Electrode type sensors.
3. Cell K: 1.00000/cm. Enter the cell Constant for the sensor.
4. Measurement units
5. Filter: 2 sec. Override the default input filter and enter 0-999 seconds.
6. Range: Auto Select measurement Auto-range or specific range.
7. Temp Comp: Slope Select Temp Comp: Slope, Neutral Salt, Cation or Raw.
8. Slope: 2.00% / $^{\circ}$ C. Enter the linear temperature coefficient.
9. Ref Temp: 25.0 $^{\circ}$ C. Enter the Reference temp.
10. Cal Factor: Default = 0.95000/cm. Enter the Cal Factor for 4-Electrode sensors from the sensor tag.

S1: -0.01 μ S/cm 999.9 $^{\circ}$ C		S2: 0.0000GPM	
Outputs	Relays	Measure	Temperature Security
Measurement		Conductivity	
Sensor type		2-Electrode	
Units		μ S/cm	
Cell constant		1.00000 /cm	
Filter		2 sec	
Range		Auto	
		NEXT BACK	

Warning

To configure the contacting conductivity measurement board, access the **Program** screen by pressing **ENTER/MENU** from the main screen and then select the **Measurement** tab.

Procedure

1. To program a Measurement type, select Conductivity, Select Conductivity, Resistivity, TDS. Salinity or % conc. and press **ENTER/MENU**.

S1: -0.01 μ S/cm 999.9°C		S2: 0.0000GPM	
Outputs	Relays	Measure	Temperature Security
Temp compensation		Conductivity	
Slope		2.000	%/°C
Reference temperature		25.0	°C

NEXT BACK

Warning

- To program a sensor type, select 2-Electrode Select 2-Electrode or 4-Electrode type sensors and press **ENTER/MENU**.
- To program the Cell constant, enter the exact cell constant value expressed as 1.XXXXX/cm the for the sensor and press **ENTER/MENU**.
- To program Measurement units, select uS/cm or mS/cm and press **ENTER/ MENU**.
- To Override the default input filter, enter 0-999 seconds and press **ENTER/ MENU**.
- To program the measurement range, select a specific range appropriate for your process and press **ENTER/MENU**.
- To program the Temp Comp method, choose Slope, Neutral Salt, Cation or Raw and press **ENTER/MENU**.
- To change the Temperature compensation Slope, enter the linear temperature coefficient expressed as X.XX% / °C and press **ENTER/MENU**.

6.5 Toroidal conductivity measurement programming

The section describes how to configure the Rosemount 56 analyzer for conductivity measurements using inductive/toroidal sensors. The following programming and configuration functions are covered:

S1: 7.00pH 25.2°C		S2: 0.056 μ S/cm 52.1°C	
Calibrate what?			
S1 Measurement	Output 1		
S1 Temperature	Output 2		
S2 Measurement	Output 3		
S2 Temperature	Output 4		

BACK

- Measure: Conductivity Select Conductivity, Resistivity, TDS. Salinity or % conc
- Sensor model: 228 Select sensor type / 225 Select sensor type
- Measurement units

4. Cell K: 3.00000/cm Enter the cell constant for the sensor (228 is 2.7/cm, 225 is 3.0/cm)
5. Temp Comp: Slope Select Temp Comp: Slope, Neutral Salt, Cation or Raw
6. Slope: 2.00% / °C Enter the linear temperature coefficient
7. Ref Temp: 25.0 °C Enter the Reference temp
8. Filter: 2 sec Override the default input filter, enter 0-999 seconds
9. Range: Auto Select measurement Auto-range or specific range

To configure the **Contacting conductivity measurement** board, access the **Program** screen by pressing **ENTER/MENU** from the main screen and then select the **Measurement** tab.

Procedure

1. To program a Measurement type, select Conductivity Select Conductivity, Resistivity, TDS, Salinity or % conc. and press **ENTER/MENU**.

S1: -54µS/cm 999.9°C S2: 0.0000GPM

Outputs Relays Measure Temperature Security

Reference temperature 25.0 °C

Filter 2 sec

Range Auto

BACK

2. To program the sensor model, select 228 or other toroidal model number and press **ENTER/MENU**.
3. To program Measurement units, select uS/cm or mS/cm and press **ENTER/MENU**.
4. To program the Cell constant, enter the exact cell constant value expressed as 3.XXXXX/cm the for the sensor and press **ENTER/MENU**.
5. To program the Temp Comp method, choose Slope, Neutral Salt, Cation or Raw and press **ENTER/MENU**.
6. To change the Temperature compensation Slope, enter the linear temperature coefficient expressed as X.XX% / °C and press **ENTER/MENU**.

6.6 Chlorine measurement programming

The section describes how to configure the Rosemount 56 analyzer for Chlorine measurements.

With a Chlorine measurement board installed, the Rosemount 56 can measure any of four variants of Chlorine:

- Free Chlorine
- Total Chlorine
- Monochloramine
- pH-independent Free Chlorine

6.7 Free chlorine measurement programming

This Chlorine sub-section describes how to configure the Rosemount 56 analyzer for Free Chlorine measurement using amperometric chlorine sensors. The following programming and configuration functions are covered:

1. Measure: Free Chlorine Select Free Chlorine, pH Ind. Free Cl. Total Cl, Monochloramine
2. Units: ppm Select units ppm or mg/L
3. Resolution: 0.001 Select display resolution 0.01 or 0.001
4. Free Cl Correct: Live Select Live/ Continuous pH correction or Manual
5. Manual pH: 7.00 pH For Manual pH correction, enter the pH value
6. Filter: 5 sec Override the default input filter, enter 0-999 seconds
7. Dual Slope Calibration: Enable or Disable

Procedure

1. To program the Measurement type, select Free Chlorine, pH Ind Free Cl., Total Cl, or Monochloramine and press **ENTER/MENU**.
2. To program the Measurement Units: select ppm mg/L and press **ENTER/MENU**.
3. To program the Measurement Resolution: Select 0.01 or 0.001 and press **ENTER/MENU**.
4. To program Free Cl Correction, select Live/Continuous pH correction or Manual and press **ENTER/MENU**.
5. To program for Manual pH correction, enter the pH value and press **ENTER/ MENU**.
6. To Override the default input filter, enter 0-999 seconds and press **ENTER/ MENU**.
7. To use Dual Slope Calibration, select Enable or Disable and press **ENTER/MENU**.

S1: 0.008ppm 999.9°C		S2: 0.0000GPM	
Outputs	Relays	Measure	Temperature Security
Filter		5	sec
Dual slope calibration		Disable	
BACK			

6.8 Total chlorine measurement programming

This Chlorine sub-section describes how to configure the Rosemount 56 analyzer for Total Chlorine measurement using amperometric chlorine sensors. The following programming and configuration functions are covered:

1. Measure: Free Chlorine Select Free Chlorine, pH Ind. Free Cl. Total Cl, Monochloramine
2. Units: ppm Select units ppm or mg/L
3. Resolution: 0.001 Select display resolution 0.01 or 0.001
4. Filter: 5 sec Override the default input filter, enter 0-999 seconds
5. Dual Slope Calibration: Enable or Disable

S1: 0.003ppm 999.9°C		S2: 0.0000GPM	
Outputs	Relays	Measure	Temperature Security
Measurement		Total Chlorine	
Units		ppm	
Resolution		0.001	
NEXT BACK			

Procedure

1. To program the Measurement type, select Free Chlorine, pH Ind Free Cl., Total Cl, or Monochloramine and press **ENTER/MENU**.
2. To program the Measurement Units: select ppm mg/L and press **ENTER/MENU**.
3. To program the Measurement Resolution: Select 0.01 or 0.001 and press **ENTER/MENU**.
4. To Override the default input filter, enter 0-999 seconds and press **ENTER/ MENU**.
5. To use Dual Slope Calibration, select Enable or Disable and press **ENTER/MENU**.

S1: 0.008ppm 999.9°C		S2: 0.0000GPM	
Outputs	Relays	Measure	Temperature Security
Filter		5	sec
Dual slope calibration		Disable	
BACK			

6.9 Monochloramine measurement programming

This Chlorine sub-section describes how to configure the Rosemount 56 analyzer for Monochloramine measurement using amperometric chlorine sensors. The following programming and configuration functions are covered:

1. Measure: Free Chlorine Select Free Chlorine, pH Ind. Free Cl. Total Cl, Monochloramine
2. Units: ppm Select units ppm or mg/L
3. Resolution: 0.001 Select display resolution 0.01 or 0.001
4. Filter: 5 sec Override the default input filter, enter 0-999 seconds
5. Dual Slope Calibration: Enable or Disable

S1: 0.757ppm 999.9°C		S2: 0.0000GPM	
Outputs	Relays	Measure	Temperature Security
Measurement		Monochloramine	
Units		ppm	
Resolution		0.001	
NEXT BACK			
Warning			

Procedure

1. To program the Measurement type, select Free Chlorine, pH Ind Free Cl., Total Cl, or Monochloramine and press **ENTER/MENU**.
2. To program the Measurement Units: select ppm mg/L and press **ENTER/MENU**.
3. To program the Measurement Resolution: Select 0.01 or 0.001 and press **ENTER/MENU**.
4. To Override the default input filter, enter 0-999 seconds and press **ENTER/ MENU**.
5. To use Dual Slope Calibration, select Enable or Disable and press **ENTER/ MENU**.

S1: 0.008ppm 999.9°C		S2: 0.0000GPM	
Outputs	Relays	Measure	Temperature Security
Filter		5	sec
Dual slope calibration		Disable	

BACK

6.10 Oxygen measurement programming

This section describes how to configure the Rosemount 56 analyzer for dissolved and gaseous oxygen measurement using amperometric oxygen sensors. The following programming and configuration functions are covered:

1. Sensor type: Select Water/Waste, Trace. BioRx, BioRx-Other, Brew, %O2 In Gas
2. Measure type: Select Concentration, % Saturation, Partial Pressure, Oxygen in Gas
3. Units: ppm Select ppm, mg/L, ppb, µg/L, % Sat, %O2-Gas, ppm Oxygen-Gas
4. Pressure Units: bar Select pressure units: mm Hg, in Hg., Atm, kPa, mbar, bar
5. Use Press: At Air Cal Select atmospheric pressure source – internal or mA Input
6. Salinity: 00.0‰ Enter Salinity as ‰
7. Filter: 5 sec Override the default input filter, enter 0-999 seconds
8. Partial Press: mmHg Select mm Hg, in Hg. atm, kPa, mbar or bar for Partial pressure

S1: 0.00ppm -41.6°C		S2: 0.0000GPM	
Outputs	Relays	Measure	Temperature Security
Type of sensor		Water/Wastewater	
Measurement type		Concentration	
Units		ppm	
Barometric press unit		mm Hg	
Salinity		0.0 ‰	

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6.11 Ozone measurement programming

This section describes how to configure the Rosemount 56 analyzer for ozone measurement using amperometric ozone sensors. The following programming and configuration functions are covered:

1. Units: ppm Select ppm, mg/L, ppb, µg/L

2. Resolution: 0.001 Select display resolution 0.01 or 0.001
3. Filter: 5 sec Override the default input filter, enter 0-999 seconds

6.12 Turbidity measurement programming

This section describes how to configure the Rosemount 56 analyzer for Turbidity measurements. The following programming and configuration functions are covered:

1. Measurement type: Turbidity Select Turbidity or TSS calculation (estimated TSS)
2. Sensor type: Select EPA or ISO
3. Measurement units: NTU, FTU, FNU
4. Filter: 20 sec Override the default input filter, enter 0-999 seconds
5. Bubble Rejection: On Intelligent software algorithm to eliminate erroneous readings caused by bubble accumulation in the sample.

S1: 0.002ppm 999.9°C
S2: 0.0000GPM

Outputs
Relays
Measure
Temperature
Security

Units ppm ▼
Resolution 0.001 ▼
Filter 5 sec

BACK

Warning

Procedure

1. To program the Measurement type, Select Turbidity or TSS calculation (estimated TSS) and press **ENTER/MENU**.
2. To program the Sensor type: Select EPA or ISO and press **ENTER/MENU**.
3. To program Measurement units: NTU, FTU, FNU and press **ENTER/MENU**.
4. To Override the default input filter, enter 0-999 seconds and press **ENTER/ MENU**.
5. To program Bubble Rejection, select On or Off and press **ENTER/MENU**.

S1: -,---NTU
S2: 0.0000GPM

Outputs
Relays
Measure
Security

Measurement Turbidity ▼
Sensor type EPA
Units NTU ▼
Bubble rejection On ▼
Filter 20 sec

BACK

Fault

6.13 Flow measurement programming

This section describes how to configure the Rosemount 56 analyzer for flow measurement when used with a compatible pulse flow sensor. The following programming and configuration functions are covered:

To program pulse flow, scroll to the desired item and press **ENTER**.

The following sub-sections provide you with the initial display screen that appears for each programming routine.

Procedure

1. To program Measurement type, select Pulse Flow or mA Current Input and press **ENTER/MENU**.
2. To program Measurement units: Select GPM, GPH, cu ft/min, cu ft/hour, LPM, L/hour, or m3/hr. and press **ENTER/MENU**.
3. To Override the default input filter (5 seconds), enter 0-999 seconds and press **ENTER/MENU**.

S1: -,---NTU S2: 0.0000GPM

Outputs Relays Measure Security

Type of input Pulse Flow

Units GPM

Filter 2 sec

BACK

Fault

6.14 Current input programming

This section describes how to configure the Rosemount 56 analyzer for current input measurement when wired to an external device that transmits 4-20 mA or 0-20 mA analog current output. The following programming and configuration functions are covered.

1. Measurement type mA input Override the default (Flow) and select mA current input
2. mA Input Temperature Select Temperature, Pressure, Flow or Other
3. Measurement units: °C. Select measurement units based on selected input device type
4. Input Range: 4-20 mA Select 4-20 mA or 0-20 mA
5. Low Value: 0.000oC Enter the low measurement value to assign to 4 mA
6. High Value: 100.0oC Enter the high measurement value to assign to 20mA
7. Filter: 05 sec Override the default input filter, enter 0-999 seconds

S1: -,---NTU		S2: -25.13mmHg	
Outputs	Relays	Measure	Security
Type of input		mA Input	
Measured property		Pressure	
Units		mm Hg	
Analog input range		4-20mA	

NEXT BACK

Warning

Procedure

1. To override the default the Measurement type (Flow) select mA current input and press **ENTER/MENU**.
2. To program the mA Input type, Select Temperature, Pressure, Flow or other and press **ENTER/ MENU**.
3. To program measurement units, Select measurement units based on selected input device type and press **ENTER/MENU**.
4. To program the Input Range: Select 4-20 mA or 0-20 mA and press **ENTER/ MENU**.
5. To program the Low input Value, enter the low measurement value to assign to 4mA and press **ENTER/MENU**.
6. To program the High input Value, enter the high measurement value to assign to 20mA and press **ENTER/MENU**.
7. To override the default input filter, enter 0-999 seconds and press **ENTER/ MENU**.

S1: -,---NTU		S2: -25.13mmHg	
Outputs	Relays	Measure	Security
0/4		0/4 mA	0.000 mmHg
		20 mA	100.5 mmHg
Filter		2	sec

BACK

7 PID control

7.1 Introduction

7.1.1 Measurement and set point (Feedback control)

The Rosemount 56 controller is given two items of information: measurement and set point. The controller reacts to the difference in value of these two signals and produces an analog output signal to eliminate that difference. As long as the difference exists, the controller will try to eliminate it with the output signal. When measurement and set point are equal, the condition of the controller is static and its output is unchanged. Any deviation of measurement from set point will cause the controller to react by changing its output signal.

7.1.2 Proportional mode

The simplest control is proportional control. In this control function, the error from set point, divided by the control range, is multiplied by the Gain constant to produce the output.

The control range is the percent of the analog output span (the difference between the 4 (or 0) mA and 20 mA settings) through which the measured variable must move to change the output from minimum to maximum.

The smaller the Gain, the less the controller reacts to changes in the measured variable. The larger the Gain, the more the controller reacts to changes in the measured variable.

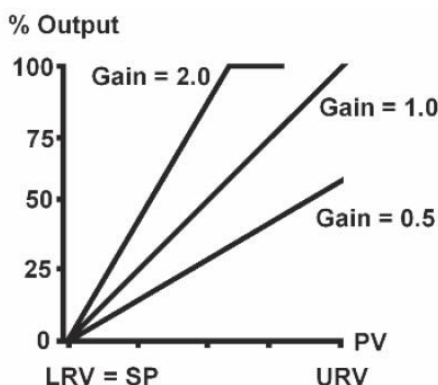
The proportional control output is given by the expression below. As can be seen, the overall gain is determined by the control range chosen (URV and LRV) and the Gain:

Proportional Output (%) = Gain * (PV – SP) * 100 / (URV, upper range value and LRV, lower range value).

Direct acting control action

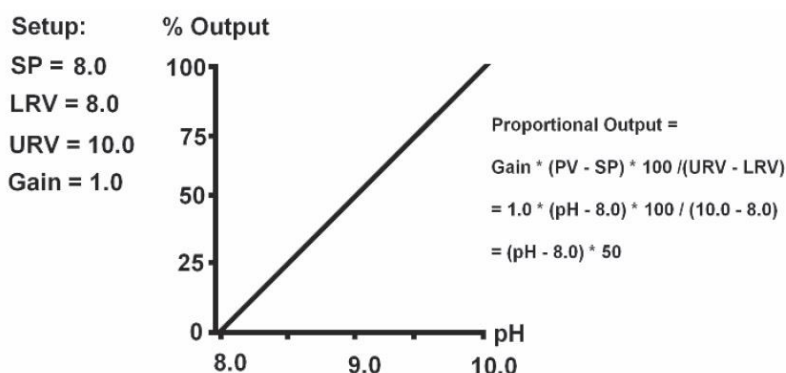
Direct acting control action increases the control output as the measured variable increases above the setpoint. The LRV is usually set to the setpoint value, so that the control output is 0% at the setpoint, and the URV is greater than the setpoint so that the 100% control output is at a higher measurement value. The Gain parameter can then be adjusted to produce the desired gain.

Figure 7-1: Direct Acting Control



Example of direct acting control: Lower the pH of a solution at 10 pH by adding acid to control it at 8 pH with the Gain parameter assumed to be 1.0. The higher the measured pH, the more acid is required to lower the pH toward the setpoint, but as the pH approaches the setpoint less acid is required:

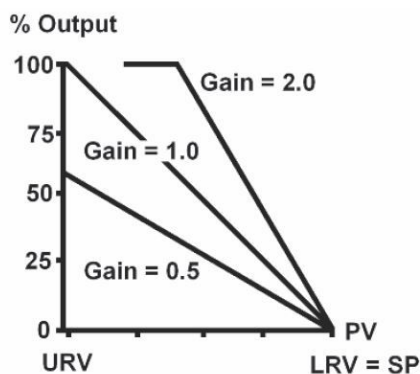
Figure 7-2: Example of Direct Acting Control



Reverse acting control action

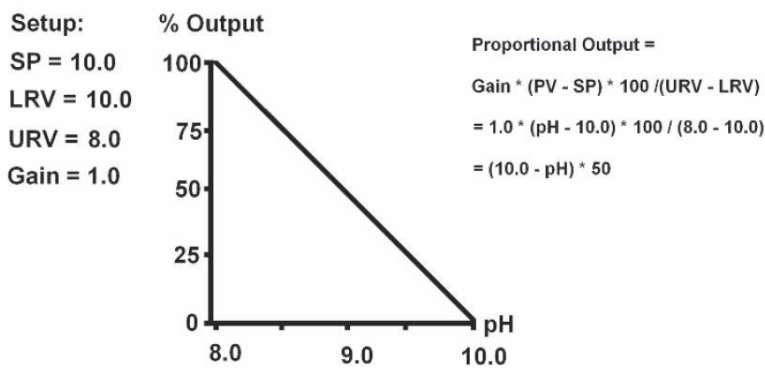
Reverse acting control action, decreases the control output as the measured variable increases toward the setpoint. The LRV is usually set to the setpoint value, so that the control output is 0% at the setpoint, and the URV is less than the setpoint value so that the 100% control output is at a lower measurement value. The Gain can then be adjusted to produce the desired gain.

Figure 7-3: Reverse acting control



Example of reverse acting control: Add base to a solution at 8.0 pH, to control the pH to 10.0 pH with an assumed Gain parameter of 1.0. The lower the measured pH, the more base is required to raise the pH toward the setpoint, but as the pH approaches the setpoint less base is required:

Figure 7-4:



7.1.3

Proportional bias

Most processes require that the measured variable be held at the set point. The proportional mode alone will not automatically do this, if an output greater than 0% is needed to keep the PV at setpoint. At setpoint, the control output is 0%, and if a non-zero control output is needed to keep the PV at the setpoint, proportional alone will only stabilize the measured variable at some offset (deviation) from the desired setpoint.

Bias is used to provide a constant control output at the setpoint to maintain PV at the setpoint. The effect of Bias is expressed as follows:

$$\text{Proportional Output ()} = [\text{Gain} * (\text{PV} - \text{SP}) * 100 / (\text{URV} - \text{LRV})] + \text{BIAS}$$

Figure 7-5: Direct Acting Control with Bias

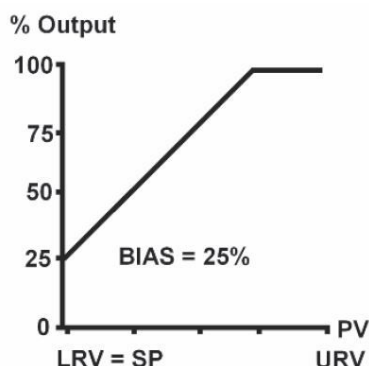
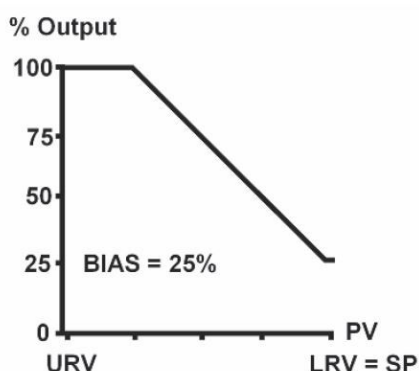


Figure 7-6: Reverse Acting Control with Bias



7.1.4 Proportional plus integral (Reset)

For the automatic elimination of deviation, Integral mode, also referred to as Reset, is used. The proportional function is modified by the addition of automatic reset, rather than a constant Bias value. With the reset mode, the controller continues to change its output until the deviation between measurement and set point is eliminated.

The action of the reset mode depends on the overall gain. The rate at which it changes the controller output is based on the overall gain band size and the reset time (I). The reset time is the time required for the reset mode to repeat the proportional action once. It is expressed as seconds per repeat, adjustable from 0-3,000 seconds.

The reset mode repeats the proportional action as long as an offset from the set point exists. Reset action is cumulative. The longer the offset exists, the more the output signal is increased. If the PV overshoots the setpoint, the reset action will decrease. When the measurement reaches the setpoint and the proportional control action becomes zero, there will be an accumulated integral control action to keep the process at the setpoint.

The controller configured with reset continues to change until there is no offset. If the offset persists, the reset action eventually drives the controller output to its 100% limit - a condition known as "reset windup".

Once the controller is "wound up", the deviation must be eliminated or redirected before the controller can unwind and resume control of the measured variable. The integral time can be cleared and the "windup" condition quickly eliminated by manually overriding the

Rosemount 56 analog output using the manual mode to reduce the control output and then setting the reset time to 0 seconds to make integral control action 0%. The reset time can then be changed to avoid reset windup.

The proportional plus integral control output is given below. Note that the larger the reset time (I), the slower the integral response will be:

$$\text{Output} = [\text{Gain} \times 100 / (\text{URV} - \text{LRV})] \times [(\text{PV} - \text{SP}) + 1/\text{I} (\text{PVt} - \text{SP}) \Delta t]$$

7.1.5 Derivative mode (Rate)

Derivative mode provides a 3rd control mode, which responds to the rate of change of the Proportional control output, multiplied by the Derivative parameter D which has units of seconds. The contribution of the derivative response is given below:

$$\text{Output} = [\text{Gain} \times 100 / (\text{URV} - \text{LRV})] \times \text{D} \times [(\text{PVt} - \text{SP}) - (\text{PVt-1} - \text{SP})] / \Delta t$$

The purpose of derivative action is to provide a quick control response to changes in the measured parameter. In general, it is not often used in concentration control, and in fact, it has been estimated that 90 to 95% of all control applications use only Proportional plus Integral control. Any noise in the measurement causes problems with derivative action. Temperature measurements tend to be less noisy than other measurements, and derivative action is most often used for temperature control.

7.1.6 Process characterization and tuning

Control loops are tuned by the choice of the control range and the selection of the control parameters. How these parameters are chosen should depend on how the process responds to controller output. The process response is characterized by certain behaviors, which are due to such factors as mixing and reaction time, response time of the process to control output changes, and the characteristics of the final operator, i.e. control valves, pumps, heaters, etc. With these characteristics known, initial control settings can be developed.

A good reference to PID control is provided by the book, "Control Loop Foundation—Batch and Continuous Processes", by Terrence Blevins and Mark Nixon, International Society of Automation, Research Triangle Park, NC, © 2011.

A guide to tuning control is provided by the book, "Good Tuning: A Pocket Guide", by Gregory K. McMillan, International Society of Automation, Research Triangle Park, NC, © 2005.

7.2 PID setup

7.2.1 PID control

The Rosemount 56 current -outputs (one or all four) can be programmed for PID control. PID control can be applied to any of the measurements provided by the sensor boards, such as pH, conductivity, and concentrations. In addition, PID control can be applied to temperature and any measurement input to the Rosemount 56 using the flow/4-20 mA board.

The output signal of PID control is used with a final control element, which can vary its output from 0 to 100% in response to the control signal. Final control elements can include control valves, pumps or heaters.

7.2.2 Selecting PID control

Select PID control, the analog output to be used, and the measurement and range from the main analog output setup window:

S1: 1.359ppm(f) 77.5°F		S2: 0.051% 77.4°F	
Outputs	Relays	Measure	Temperature
pH diagnostic setup			
Security			
Output	1		
Analog/PID/Simulate	PID		
Assign	S1 Measurement		
Range	4-20mA		
NEXT BACK			

Basic Definitions:

- Output – Select the analog output (1 through 4) to be configured for PID control.
- Analog/PID/Simulate – Choose PID
- Assign – Select the Measurement to be controlled. Note: This measurement can also be a 4-20 mA signal input brought in by the flow/ 4-20 mA board.
- Range – Select either 0-20 mA or 4-20 mA range, depending on the signal range used by the final control element, e.g. a pump or valve.
- Select Next to go to the PID Setup parameters.

7.2.3 PID setup parameters

The PID control setup window contains the PID control tuning parameters.

Also note that the upper portion of the screen shows the measurement chosen for control (PV), and the control output in mA and % Output. This makes it possible to observe the primary variable (PV) and the control output, in terms of percent and milliamps, while tuning PID control.

O1 assign: 1.363ppm		O1: 8.80mA		O1: 30.00%	
Outputs	Relays	Measure	Temperature	pH diagnostic setup	
Security					
Setpoint	4.000		ppm	Gain	1.00
LRV (0 or 4 mA)	14.00		ppm	Integral (reset)	0 sec
URV (20 mA)	0.000		ppm	Derivative (rate)	0 sec
Bias	10.0		%	Mode	Manual
				Value	30.0 %
NEXT BACK					

PID Control Parameters: Basic Definitions

- Setpoint – Select the desired setpoint.

- URV – The value of PV (in the above example, 14.00 pH) at which the control will be 20 mA or 100% output.
- LRV -- The value of PV (in the above example 0.00 pH) at which the control will be 0 or 4 mA or 0% output.

Note

If you want the control output to increase as PV (in this case pH) increases, URV should be greater than LRV. This is direct acting control action. Examples of direct acting control are the addition of acid to decrease pH and adding water to a solution to decrease the concentration.

Note

If you want the control output to decrease as PV increases, i.e. reverse acting control action, the URV should be less than LRV. Examples of reverse acting control are adding caustic to increase pH and adding a concentrated solution to water to make a solution of lower concentration.

- Bias (range: 0 to 100%; default 0%) – Bias is a fixed control output which allows the control output to be greater than zero when the measurement (PV) is at setpoint. It is used in proportional only control to prevent cycling resulting from the control output going to zero at the setpoint.
- Gain (range: 0.0 to 1000.0; default 0.0) – In proportional (P) only control, the output is directly proportional to the difference between the process variable (PV) and the set-point divided by the output span (URV – LRV). Gain is a factor which multiplies the proportional output to meet the requirements of the process being controlled. Using Gain values less than 1 reduce the proportional output while Gain values greater than 1 increase the proportional output.
- Integral (Reset, I) (range: 0 to 3,000 seconds; default 0 seconds) – Integral repeats the proportional action in a time period given by the reset time (I). The reset time is given in seconds per repeat and is adjustable from 0 to 3,000 seconds. Integral control acts as an automatic bias which increases or decreases the overall control output in response to the error (PV – SP) to keep the PV at the setpoint.
- Derivative (Rate, D) (range: 0 to 3,000 seconds; default 0 seconds) – Derivative action, gives an immediate control output in response to changes in the proportional output with time (derivative). The amount of increase or decrease depends on the rate of change of the error. The rate constant (D) allows the user to adjust the amount derivative control contributes to the control signal. Smaller values reduce the effect of derivative control.
- Mode: Mode has two settings, Auto (Automatic) and Man (Manual). In the Auto mode the control output is controlled automatically by the PID algorithm. In manual mode, the control output can be set to a constant value; this is useful during transmitter calibration or servicing.
- Value (Manual) (range: 0 100%) – When the Manual mode is chosen; this control appears on the screen and allows you to write the constant control output value in the Manual mode.
- Select Next to open the final PID control window.

7.2.4 Transport time

Transport Time makes it possible to apply PID control action to a process flowing in a pipe for a short period of time (run time), and then hold the control output fixed to allow the treated sample time to mix and travel to the pH or other analytical sensor (transport time). If properly tuned the PV should reach the setpoint after successive time periods.

It is best used when raw sample pH (or concentration) remains relatively steady for long periods of time, as is the case for samples flowing from a large body of water. It should not be used where process upsets are possible because the delay in applying control will make recovery from the upset slow, and can result in overshoot after the incoming sample has returned to a normal range.

S1: 1.359ppm(f) 77.6°F		S2: 0.051% 77.4°F	
Outputs	Relays	Measure	Temperature
pH diagnostic setup			
Security			
Transport time	On	100	sec
Run time	10	sec	
Fault	Live		
BACK			

Transport Time Parameters: Basic Definitions

- Transport Time (On/Off) – Turns the Transport Time feature on or off.
- Transport Time (range 1 to 600 seconds) – When Transport Time is turned On; a control appears at the right of it, which allows the value of the Transport Time to be enter. This will be the time period that PID control output is held constant, while the treated sample travels to the sensor.
- Run Time (range 0 to 60 seconds) – This is the time period that PID control action is automatic. It always must be a shorter time than Transport Time.

Fault: Basic Definitions

1. Fault – When a measurement fault occurs (either sensor or transmitter) the control output can be setup to continue providing a live control output or the output can be set to a fixed value. If the live reading is used during a fault condition, the control output could be based on an erroneous measurement, which might cause problems. Using a fixed value for control output during a fault condition can ensure that the control output goes to an acceptable value.
2. Fault Current – If a fixed value on fault is chosen, this parameter selects the output. The control output on fault can be set to a value to prevent a major upset or an unsafe condition.

Note

If a fixed fault current output is chosen and PID control Mode is set to Manual, the Manual output value will override the Fault Current value.

8 Time proportional control

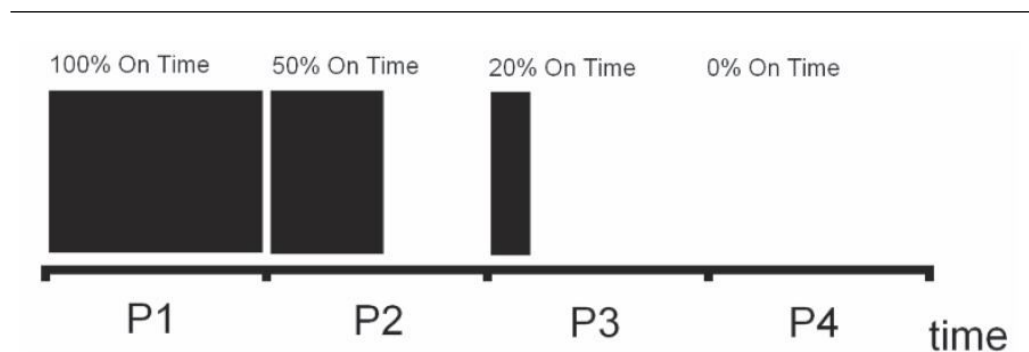
8.1 Introduction

8.1.1 Time Proportional Control

Time Proportional Control is more commonly known as Duty Cycle or Pulse Width Modulation. It applies PID control to the activation of a relay rather than using an analog output.

The TPC output is defined as the percent of time that a relay is on (% On Time), during a user selected time period (Time Period). As the control output increases the on time increases:

Figure 8-1: TPC periods and on time



The proportional, integral, and derivative are defined the same as analog PID control, but use % On Time instead of % Output:

Proportional On Time () = $[\text{Gain} \times (\text{PV} - \text{SP}) \times 100 / (\text{URV} - \text{LRV})] + \text{BIAS}$

Proportional and Integral Control:

On Time = $[\text{Gain} \times 100 / (\text{URV} - \text{LRV})] + [(PV - SP) + 1/I (PVt - SP) \Delta t]$

Derivative Mode:

On Time = $[\text{Gain} \times 100 / (\text{URV} - \text{LRV})] \times D \times [(PVt - SP) - (PVt-1 - SP)] / \Delta t$

As with analog PID control, TPC can be direct acting ($\text{URV} > \text{LRV}$) or reverse acting ($\text{LRV} > \text{URV}$). For more detail see Section 7.1, PID Control Introduction.

8.1.2 TPC setup

Selecting TPC

Procedure

Select TPC control, the relay to be used, and the measurement to be controlled from the main relay setup window:

S1: 1.358ppm(f) 77.5°F		S2: 0.051% 77.4°F	
Outputs	Relays	Measure	Temperature
		pH diagnostic setup	Security
Relay	1		
Type	TPC		
Assign	S1 Measurement		
NEXT BACK			

Basic Definitions

- Relay – Select the relay (1 through 4) to be use for TPC control.
- Type – Choose TPC.
- Assign – Select the Measurement to be controlled.

Note

This measurement can also be a 4-20 mA signal input brought in by the flow/ 4-20 mA board.

- Select **Next** to go to the PID Setup parameters.

TPC Setup Parameters

The TPC setup window contains the PID control tuning parameters.

Additionally, note that the upper portion of the screen shows the relay number and the value of the measurement assigned to it, the % On Time for the relay, and the current state of the relay, i.e. On or Off. This makes it possible to observe the primary variable (PV), the % On Time, and the relay state, while tuning time proportional control.

AL1 assign: 1.366ppm		AL1: 30.0%		AL1: On	
Outputs	Relays	Measure	Temperature	pH diagnostic setup	Security
Setpoint	4.000		ppm	Gain	1.00
100% on (URV)	14.00		ppm	Integral (reset)	0 sec
0% on (LRV)	0.000		ppm	Derivative (rate)	0 sec
Time period	30		sec	Mode	Manual
Bias	10.0		%	% on time	30.0 %
Relay default	Close				
BACK					

PID Control Parameters: Basic Definitions

- Setpoint – Select the desired setpoint.
- URV – The value of PV (in the above example, 14.00 pH) at which the control will be 100% On Time.
- LRV – The value of PV (in the above example 0.00 pH) at which the control will be 0% On Time.

Note

If you want the control output to increase as PV (in this case pH) increases, URV should be greater than LRV. This is direct acting control action. Examples of direct acting control are the addition of acid to decrease pH and adding water to a solution to decrease the concentration.

If you want the control output to decrease as PV increases, i.e. reverse acting control action, the URV should be less than LRV. Examples of reverse acting control are adding caustic to increase pH and adding a concentrated solution to water to make a solution of lower concentration.

- Time Period (range: 10 to 3,000 seconds; default 30) – The time period for each cycle of TPC.
- Bias (range: 0 to 100%; default 0%) – Bias is a fixed control output which allows the % on time to be greater than zero when the measurement (PV) is at setpoint. It is used in proportional only control to prevent cycling resulting from the % on time going to zero at the setpoint.
- Relay default (Close, Open, None) – Select the relay action during a fault condition.
- Gain (range: 0.0 to 1000.0; default 0.0) – In proportional (P) only control, the output is directly proportional to the difference between the process variable (PV) and the setpoint divided by the output span (URV – LRV). Gain is a factor which multiplies the proportional output to meet the requirements of the process being controlled. Using Gain values less than 1 reduce the proportional output while Gain values greater than 1 increase the proportional output.
- Integral (Reset, I) (range: 0 to 3,000 seconds; default 0 seconds) – Integral repeats the proportional action in a time period given by the reset time (I). The reset time is given in seconds per repeat and is adjustable from 0 to 3,000 seconds. Integral control acts as an automatic bias which increases or decreases the overall control output in response to the error (PV – SP) to keep the PV at the setpoint.
- Derivative (Rate, D) (range: 0 to 3,000 seconds; default 0 seconds) – Derivative action, gives an immediate control output in response to changes in the proportional output with time (derivative). The amount of increase or decrease depends on the rate of change of the error. The rate constant (D) allows the user to adjust the amount derivative control contributes to the control signal. Smaller values reduce the effect of derivative control.
- Mode: Mode has two settings, Auto (Automatic) and Man (Manual). In the Auto mode the control output is controlled automatically by the PID algorithm. In manual mode, the control output can be set to a constant value; this is useful during transmitter calibration or servicing.
- On Time (Manual) (range: 0 100%) – When the Manual mode is chosen, this control appears on the screen and allows you to write the constant On Time value in the Manual mode.

9 Alarm relay functions

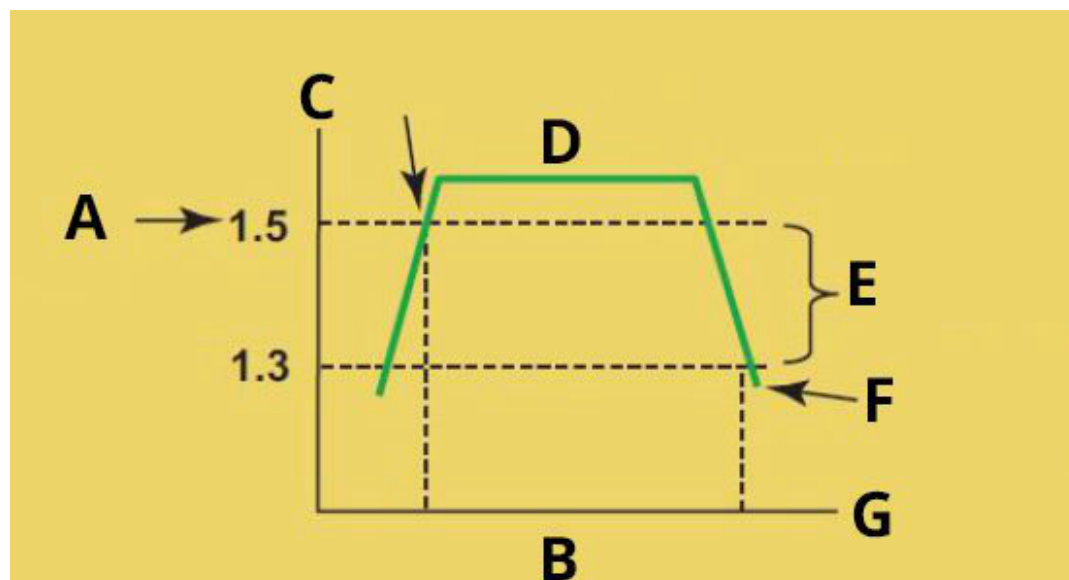
9.1 High/Low concentration alarm

9.1.1 Description

High/Low concentration alarms are setpoint alarms with adjustable deadband. These operate as simple on/off alarms used for applications requiring discrete on/ off control of pumps and valves. Typical applications include demineralizer bed regeneration and blowdown in boilers and cooling towers. Any active device variable in the Rosemount 56 Transmitter can be programmed as a high/low concentration alarm including the primary or secondary variables, temperature, raw values and diagnostics.

The following schematic describes the high/low concentration (setpoint) alarm operation:

Figure 9-1: High/Low Concentration Alarm Operation



- A. High alarm setpoint
- B. High alarm logic
- C. PV
- D. Alarm activates
- E. Deadband (0.2)
- F. Alarm deactivates
- G. Time

9.1.2 Set up High/Low Concentration alarm

Access high/low concentration (setpoint) alarms by pressing **ENTER/MENU** from the main screen and then **Program** → **Relays** → **Configure Relay**. From the main relay programming screen, program this feature as follows:

Procedure

1. Relay: Assign a relay by highlighting the desired relay 1-4 and press **ENTER/ MENU**.
2. Type: Select Setpoint as the relay type and press **ENTER/MENU**.
3. Assign: Assign S1 (sensor 1), S2 (sensor 2 if available), or other available parameters to the designated relay and press **ENTER/MENU**.
4. Logic: Set High for a high setpoint or Low for a low setpoint and press **ENTER/ MENU**.
5. Setpoint: Enter the desired setpoints value. Press **ENTER/MENU**.
6. Deadband: To set deadband as a measurement value, enter the change in the process value needed after the relay deactivates to return to normal (and thereby preventing repeated alarm activation). Press **ENTER/MENU**.
7. Select **NEXT**. Press **ENTER/MENU** to advance to the next setup screen.
8. Normal state: Set the normal alarm condition as Open or Closed and press **ENTER/ MENU**. Program the normal state to define the desired alarm default state to normally open or normally closed upon power up.

Table 9-1: Defaults and Programmable Limits

Relay function	Limits and selections	Default
Setpoint	NA	NA
Logic	Low/High	High
Setpoint	(1)	(1)
Deadband	(1)	0.000
On time	0 to 999.9 min	0 min
Delay time	0 to 999.9 min	0 min
Normal state	Close/Open	Open

(1) See Appendix 1 – HART and Device Variables

9.2 Delay Timer

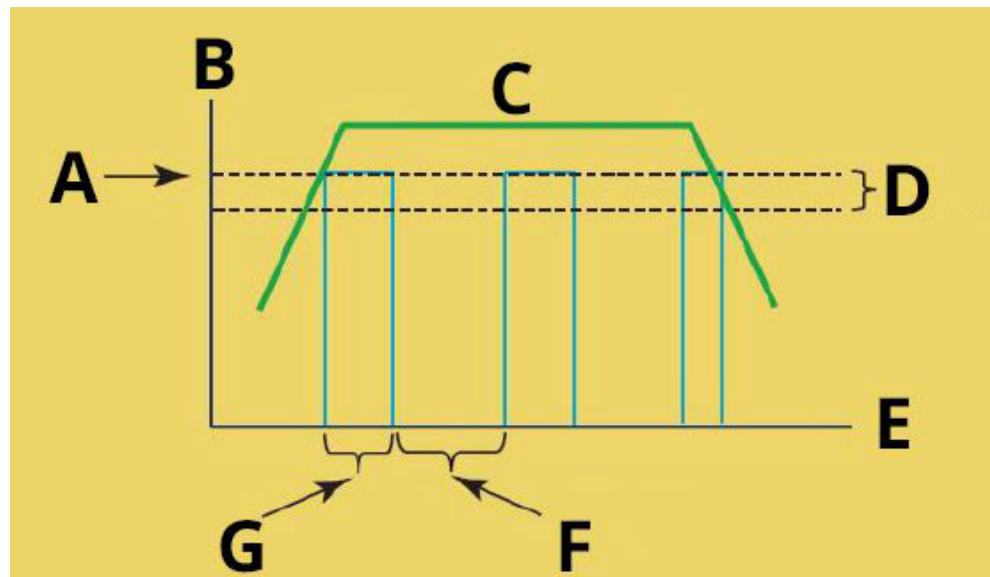
9.2.1 Description

Delay Timer is a concentration control scheme which delays live measurement after chemical addition using (one or all four) of the Rosemount 56 alarm relays. This ensures sufficient mixing time in a vessel or recirculation loop before live sensor measurement, preventing unmixed readings that might cause overshooting. Relay On time and Delay times are field-programmable. Typical applications that would utilize the Delay Timer are:

- Concentration control in vessels
- pH adjustments for neutralization
- Endpoint control for oxidation reduction reactions

A schematic of the Delay Timer operation is shown:

Figure 9-2: Delay Timer Alarm Operation



- A. High alarm setpoint
- B. PV
- C. Measurement
- D. Deadband
- E. Time
- F. On time
- G. Delay time

9.2.2 Set up Delay Timer

Access Delay Timer by pressing **ENTER/MENU** from the main screen and then **Program** → **Relays** → **Configure Relay**. From the main relay programming screen, program this feature as follows:

Procedure

1. Relay: Assign a relay by highlighting the desired relay 1-4 and press **ENTER/MENU**.
2. Type: Select Delay Timer as the relay type and press **ENTER/MENU**.
3. Assign: Assign S1 (sensor 1), S2 (sensor 2 if available), or other available parameters to the designated relay and press **ENTER/MENU**.
4. Logic: Set High for high reading setpoint logic or Low relay logic for low reading setpoint logic and press **ENTER/MENU**.
5. Setpoint: Enter the desired setpoints value. This will activate an alarm event when the process measurement reaches the entered setpoint value. Press **ENTER/MENU**. See [Table 9-3](#).
6. Deadband: To set deadband as a measurement value, enter the change in the process value needed after the relay deactivates to return to normal (and thereby preventing repeated alarm activation). Press **ENTER/MENU**.
7. Select **NEXT**. Press **ENTER/MENU** to advance to the next setup screen.
8. On time: Enter the time in minutes (X.X min) for the relay to remain energized.

The assigned measurement value will be on hold during this time.

9. Delay time: Enter the time in minutes (X.X min) to take the assigned measurement off hold after the relay is re-energized to begin reporting live values.
10. Normal state: Set the normal alarm condition as Open or Closed and press **ENTER/MENU**. Program the normal state to define the desired alarm default state to normally open or normally closed upon power up.

Table 9-2: Defaults and Programmable Limits

Relay functions	Limits and selections	Default
Delay timer	NA	NA
Logic	Low/High	High
Setpoint	(1)	(1)
Deadband	(1)	0.000
Normal state	Close/Open	Open

(1) See Appendix 1 – HART and Device Variables.

9.3 Bleed and Feed timer

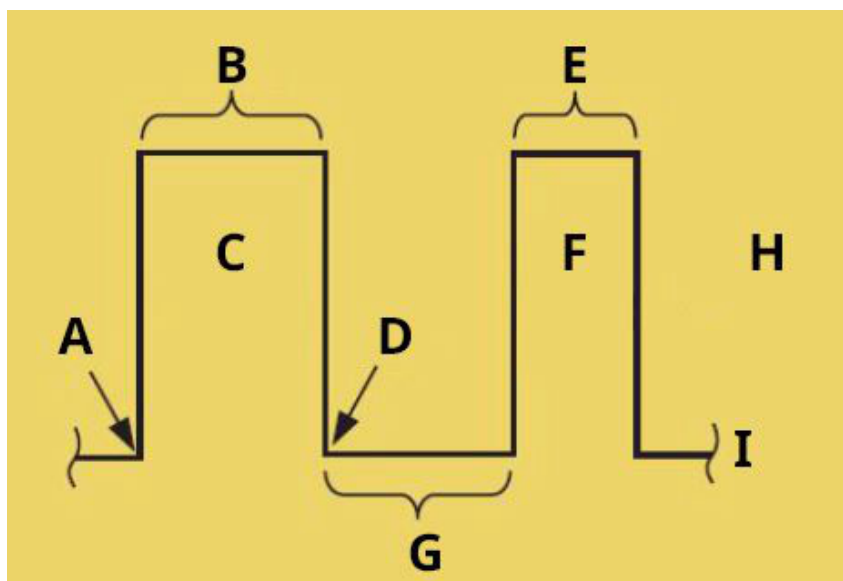
9.3.1 Description

A Bleed and Feed timer is typically used to replace chemicals lost during blowdown. It involves two or more relays. The bleed relay is a normal setpoint alarm relay. Once the bleed relay deactivates, one or more feed relays activate for a percentage of the time the bleed relay was on.

Bleed and Feed timers support continuous monitoring of blow-down water conductivity to determine the point of excessive conductivity. At a programmable maximum concentration value, dumping (bleeding) of the excessively dirty blow-down water is triggered. Subsequently, pumping (feeding) of additional make-up water chemicals is enabled to account for lost blow-down water. Through level control, make-up water is added in proportion to the volume of blowdown material lost through dumping and evaporation.

A schematic of the Bleed and Feed timer operation is shown:

Figure 9-3: Bleed and Feed timer alarm operation



- A. On
- B. Bleed on
- C. AL1 (bleed)
- D. Off
- E. Feed on
- F. AL2 (feed)
- G. Delay
- H. Feed time = X% of bleed time
- I. Time

9.3.2 Set up Bleed and Feed Timers

Access Bleed and Feed Timers by pressing **ENTER/MENU** from the main screen and then **Program** → **Relays** → **Configure Relay**. From the main relay programming screen, program this feature as follows:

Procedure

1. Relay: Assign relay 1 for Bleed and Feed and press **ENTER/MENU**.
2. Type: Select Bleed and Feed as the relay type and press **ENTER/MENU**.
3. Assign: Assign S1 (sensor 1), S2 (sensor 2 if available), or other available parameters to the designated relay and press **ENTER/MENU**.
4. Logic: Set High for high setpoint or Low for low setpoint and press **ENTER/ MENU**.
5. Setpoint: Enter the desired setpoints value. This will activate an alarm event when the process measurement reaches the entered setpoint value. Press **ENTER/MENU**. See [Table 9-2](#).
6. Select **NEXT**. Press **ENTER/MENU** to advance to the next setup screen.
7. Deadband: To set deadband as a measurement value, enter the change in the process value needed after the relay deactivates to return to normal (and thereby preventing re-peated alarm activation). Press **ENTER/MENU**.

8. Normal state: Set the normal alarm condition as Open or Closed and press **ENTER/MENU**. Program the normal state to define the desired alarm default state to normally open or normally closed upon power up.
9. Select **NEXT**. Press **ENTER/MENU** to advance to the next setup screen: **Configure feed relay**.
10. Feed relay: Assign relay 2, 3, or 4 as a feed relay and press **ENTER/MENU**.
11. Linked to bleed relay: No entry required. The relay originally programmed as the Bleed relay is displayed.
12. Delay time: Enter the time in minutes (X.X min) after the Bleed time is activated before triggering this feed relay.
13. Feed time equals: Enter the percent of time that the Bleed timer is on (X.X%) to activate this feed relay (for pumping make-up water chemicals).

Relay function	Limits and selections	Default
Bleed and feed	NA	NA
Logic	Low/High	High
Setpoint	(1)	(1)
Deadband	(1)	0.000
Normal state	Close/Open	Open
Feed relay	1, 2, 3, 4	Not assigned
Linked to bleed relay	1, 2, 3, 4	1
Delay time	0 - 999.9 min	1.0 min
Feed time equals	0 - 999.9% bleed time	10.0% of bleed time
Normal state	Close/Open	Open

(1) See Appendix 1 – HART and Device Variables.

9.4 Totalizer Based Relay Activation

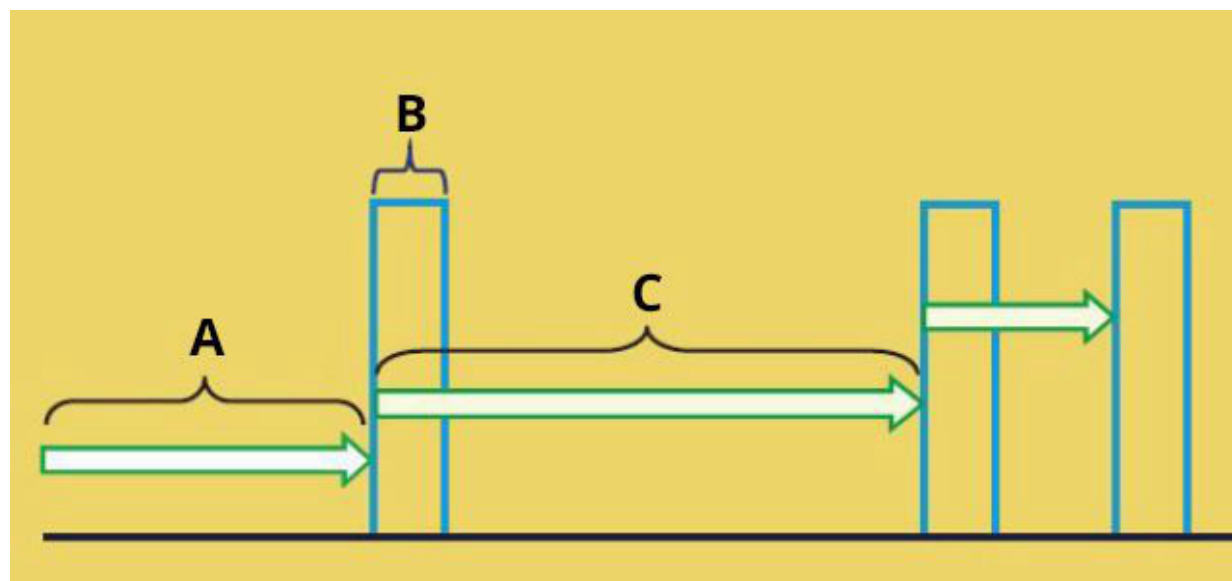
9.4.1 Description

A totalizer based timer feeds chemicals for a preset period every time a programmed volume of liquid has been added to or removed from a vessel. The relay energizes when the volume has been reached and remains energized for a fixed time. The process repeats once the volume has been reached again.

Totalizer Based Relay Activation triggers a relay at user-defined intervals based on accumulated totalized flow. The scheme uses pulse inputs from a flow meter or 4-20 mA current input(s) from a flow transmitter to calculate total flow (as volume).

A typical application for totalized flow relay activation is controlling chemical dosing in reactors. A schematic of the Totalizer timer operation is shown:

Figure 9-4: Totalizer Alarm Operation



- A. X-volume accumulated
- B. Relay on time
- C. X-volume accumulated
- D. Time

9.4.2

Set up Totalizer Based Relay Activation

Access Totalizer Timers by pressing **ENTER/MENU** from the main screen and then **Program** → **Relays** → **Configure Relay**. From the *main relay programming* screen, program this feature as follows:

Procedure

1. Relay: Assign a relay by highlighting the desired relay 1-4 and press **ENTER/ MENU**.
2. Type: Select Totalizer timer as the relay type and press **ENTER/MENU**.
3. Assign: Assign Pulse flow S1 (Sensor 1) or S2 (Sensor 2) as the measurement input and press **ENTER/MENU**.
4. Active relay after: Enter accumulated volume (XX.XXXX) and units of measurement:
 - gal
 - thousand gal
 - million Gal
 - trillion Gal
5. On time: Enter the time in minutes (X.X min) for the relay to remain energized. The assigned measurement value will be on hold during this time.
6. Normal state: Set the normal alarm condition as Open or Closed and press **ENTER/ MENU**. Program the normal state to define the desired alarm default state to normally open or normally closed upon power up.

Table 9-3: Defaults and Programmable Limits

Relay function	Limits and selections	Default
Totalizer Based Timer	NA	NA
Activate relay after	0 to 99.9990	10
units	Gal, Liters, cuft, m3 accumulated	E3gal (x1000 gal) accumulated
On time	0 to 999.9 min	0 min
Normal state	Close/Open	Open

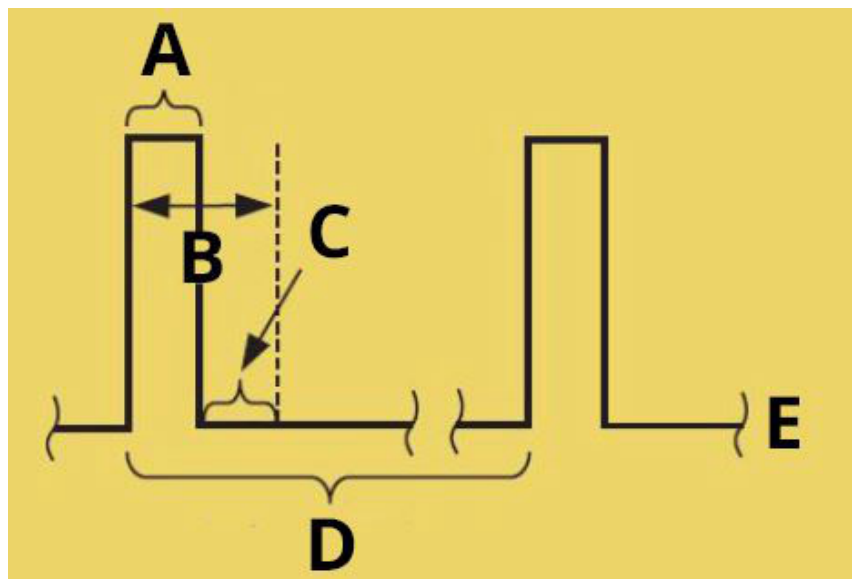
9.4.3 Interval timer

Description

The interval timer may be used for periodic sensor cleaning or periodic process adjustment. The cycle begins at the Interval time when the switch is turned on. When the Interval time has expired, the transmitter activates hold mode on the assigned measurement and the relay is energized for the On time period.

A schematic of the Interval timer operation is shown:

Figure 9-5: Interval Timer Alarm Operation



- A. On time
- B. Hold
- C. Recovery time
- D. Interval time
- E. Time

Set up interval timer

Access Interval timer by pressing **ENTER/MENU** from the main screen and then **Program** → **Relays** → **Configure Relay**.

From the *main relay programming* screen, program this feature as follows:

Procedure

1. Relay: Assign a relay by highlighting the desired relay 1-4 and press **ENTER/MENU**.
2. Type: Select Interval timer as the relay type and press **ENTER/MENU**.
3. Interval time: Enter the time in hours (XX.X hours) between complete interval cycles.
4. On time: Enter the time in minutes (X.X min) for the relay to remain energized. The assigned measurement value will be on hold during this time.
5. Recovery time: Enter the time in minutes (XX min) before the process is restored and live measurements can resume.
6. Hold while active⁽¹⁾: Select which sensors outputs should be on hold (S1, S2, or both) during the Interval timer activation time. Press **ENTER/MENU**.
7. Select **NEXT**. Press **ENTER/MENU** to advance to the next setup screen.
8. Normal state: Set the normal alarm condition as Open or Closed and press **ENTER/MENU**. Program the normal state to define the desired alarm default state to normally open or normally closed upon power up.

Table 9-4: Defaults and Programmable Limits

Relay function	Limits and selections	Default
Interval timer	NA	NA
Interval time	0 to 999.9 hr	24.0 hr
On time	0 to 999.9 sec	10 sec
Recovery time	0 to 999 sec	60 sec
Hold while active	0 to 999 sec	0 sec
Normal state	Sensor 1, Sensor 1, both	Sensor 1

9.4.4 Date and time activation

Description

This relay feature allows programming of 1 to 4 relays to activate on an assigned day of the week and time of day or night for an assigned interval. They function like sprinkler timers. The programmable timeframe cycle is two weeks.

An example application for Date and Time Activation is daily chlorine dosing in seawater-cooled condensers.

The ***Date and Time relay setup*** screen is shown:

⁽¹⁾ Rosemount 56 units with software ver. 2.1X and greater allow override of interval timer to ensure that all relays and outputs are held if desired.

Figure 9-6: Date and Time Alarm Operation

Live display

Outputs Relays Measure Temperature pH diagnostic setup Security

Enter duration in minutes.

Week 1	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
Start	hh mm	hh mm	hh mm	hh mm	hh mm	hh mm	hh mm
Duration							

Fault/warning banner

Set up Date and Time

Access Date and Time timer by pressing **ENTER/MENU** from the main screen and then **Program** → **Relays** → **Configure Relay**.

NOTICE

Date and Time timer operation depends on accurate setup of the internal real time clock. Emerson recommends continuous powered operation of the Rosemount 56 Transmitter to preserve programmed Date and Time timer clock settings.

From the *main relay programming* screen, program this feature as follows:

Procedure

1. Relay: Assign a relay by highlighting the desired relay 1-4 and press **ENTER/ MENU**.
2. Type: Select Date and Time timer as the relay type and press **ENTER/MENU**.
3. Select **NEXT**. Press **ENTER/MENU** to advance to the next setup screen.
The Week 1 calendar will appear.
4. Program the start relay activate time by entering day(s) of week, hour(s) of day, and minutes for each hour. Enter the duration of time in minutes (XX min) for relay activation.
Up to four relays can be simultaneously energized for any programmed times.
5. Select **NEXT**. Press **ENTER/MENU** to advance to the next setup screen.
The Week 2 calendar will appear.
6. Repeat the programming entries for Week 2 in the same manner as Week 1.
Up to four relays can be simultaneously energized for any programmed times.

10 Calibration

10.1 Introduction to calibration

Calibration is the process of adjusting or standardizing the transmitter to a lab test or a calibrated laboratory instrument, or standardizing to some known reference (such as a commercial buffer). The auto-recognition feature of the transmitter will enable the appropriate calibration screens to allow calibration for any single sensor configuration or dual sensor configuration of the transmitter. Completion of Quick Start upon first power up enables live measurements, but does not ensure accurate readings in the lab or in process. Perform calibration with each attached sensor to ensure accurate, repeatable readings.

This section covers the following programming and configuration functions:

1. Auto buffer cal for pH
2. Manual buffer cal for pH
3. Set calibration stabilization criteria for pH
4. Standardization calibration (1-point) for pH, ORP, and Redox
5. Entering the cell constant of a conductivity sensor
6. Calibrating the sensor in a conductivity standard Conductivity Cal
7. Calibrating the transmitter to a laboratory instrument
8. Zeroing an chlorine, oxygen, or ozone sensor
9. Calibrating an oxygen sensor in air
10. Calibrating the sensor to a sample of known concentration
11. Enter a manual reference temperature for temperature compensation of the process measurement.

10.2 pH calibration

New sensors must be calibrated before use. Regular recalibration is also necessary. Use auto calibration instead of manual calibration. Auto calibration avoids common pitfalls and reduces errors. The transmitter recognizes the buffers and uses temperature-corrected pH values in the calibration. Once the transmitter successfully completes the calibration, it calculates and displays the calibration slope and offset. The slope is reported as the slope at 77 °F (25 °C).

To calibrate the pH loop with a connected pH sensor, access the **Calibration** screen by pressing **ENTER/MENU** from the main screen, select S1 or S2 Measurement, and press **ENTER/MENU**. Press **INFO** at any time to learn more about this procedure. A yellow screen will appear with detailed instructions and information.

The following calibration routines are covered:

1. Auto Calibration - pH 2 point buffer calibration with auto buffer recognition
2. Manual Calibration - pH 2 point buffer calibration with manual buffer value entry
3. Standardization - pH 1 point buffer calibration with manual buffer value entry
4. Entering A Known Slope Value - pH Slope calibration with manual entry of known slope value

S1: 7.00pH 25.2°C		S2: 0.056 µS/cm 52.1°C	
Calibrate what?			
S1 Measurement	Output 1		
S1 Temperature	Output 2		
S2 Measurement	Output 3		
S2 Temperature	Output 4		
BACK			

Procedure

1. To Auto Calibrate the pH loop using 2 point buffer calibration with auto buffer recognition, select Auto Buffer and follow the step-by-step procedures displayed on-screen.
2. To Manual Calibrate the pH loop using 2 point buffer calibration with manual buffer value entry, select Manual Buffer and follow the step-by-step procedures displayed on-screen.
3. To Standardize Calibrate the pH loop using 1 point buffer calibration with manual buffer value entry, select Standardize and follow the step-by-step procedures displayed on-screen.
4. To Calibrate the pH loop using with manual entry of a Known Slope Value and Reference offset value, select Slope/Offset and follow the step-by-step procedures displayed on-screen.

S1: 0.031µS/cm 999.9°C		S2: -25.14mmHg	
Why is calibration necessary? To find out, press INFO. Otherwise, choose the desired calibration method.			
Auto buffer	Slope/offset		
Manual buffer			
Standardize (grab)			
Standardize (in process)			
BACK			

10.3 ORP calibration

For process control, it is often important to make the measured ORP agree with the ORP of a standard solution. During calibration, the measured ORP is made equal to the ORP of a standard solution at a single point.

Procedure

1. To calibrate the ORP loop with a connected ORP sensor, access the **Calibration** screen by pressing **ENTER/MENU** from the main screen.
2. Select S1 or S2 Measurement, and press **ENTER/MENU**.

Press **INFO** at any time to learn more about this screen with detailed instructions and information.

- The following calibration routine is covered:

To Standardize the ORP loop using 1 point buffer calibration with manual buffer value entry, follow the step-by-step procedures displayed on-screen.

S1: 7.00pH 25.2°C		S2: 0.056 μS/cm 52.1°C	
Calibrate what?			
S1 Measurement		Output 1	
S1 Temperature		Output 2	
S2 Measurement		Output 3	
S2 Temperature		Output 4	
BACK			
S1: 0mV 999.9°C		S2: -25.14mmHg	
Why is calibration necessary? To find out, press INFO. Otherwise, press ENTER.			
BACK			
Warning			

10.4 Contacting conductivity calibration

New conductivity sensors rarely need calibration. The cell constant printed on the label is sufficiently accurate for most applications.

Calibrating an in-service conductivity sensor

After a conductivity sensor has been in service for a period of time, recalibration may be necessary. There are three ways to calibrate a sensor:

- Use a standard instrument and sensor to measure the conductivity of the process stream. It is not necessary to remove the sensor from the process piping. The temperature correction used by the standard instrument may not exactly match the temperature correction used by the transmitter. To avoid errors, turn off temperature correction in both the transmitter and the standard instrument.
- Place the sensor in a solution of known conductivity and make the transmitter reading match the conductivity of the standard solution. Use this method if the sensor can be easily removed from the process piping and a standard is available. Be careful using standard solutions having conductivity less than 100 μ S/cm. Low conductivity standards are highly susceptible to atmospheric contamination. Avoid calibrating sensors with 0.01/cm cell constants against conductivity standards having conductivity greater

than 100 $\mu\text{S}/\text{cm}$. The resistance of these solutions may be too low for an accurate measurement. Calibrate sensors with 0.01/cm cell constant using method c.

- To calibrate a 0.01/cm sensor, check it against a standard instrument and 0.01/cm sensor while both sensors are measuring water having a conductivity between 5 and 10 $\mu\text{S}/\text{cm}$. To avoid drift caused by absorption of atmospheric carbon dioxide, saturate the sample with air before making the measurements. To ensure adequate flow past the sensor during calibration, take the sample downstream from the sensor. For best results, use a flow-through standard cell. If the process temperature is much different from ambient, keep connecting lines short and insulate the flow cell.

To calibrate the conductivity loop with a connected contacting conductivity sensor, access the **Calibration** screen by pressing **ENTER/MENU** from the main screen, select S1 or S2 Measurement, and press **ENTER/MENU**. Press **INFO** at any time to learn more about this procedure. A yellow screen will appear with detailed instructions and information.

The following calibration routines are covered:

1. Zero Cal Zero: the transmitter with the sensor attached.
2. In Process Cal: Standardize the sensor to a known conductivity.
3. Cell K: 1.00000/cm Enter the cell Constant for the sensor.
4. Meter Cal: Calibrate the transmitter to a lab conductivity instrument.
5. Cal Factor: 0.95000/cm Enter the Cal Factor for 4-Electrode sensors from the sensor tag.

S1: 7.00pH 25.2°C		S2: 0.056 $\mu\text{S}/\text{cm}$ 52.1°C	
Calibrate what?			
S1 Measurement	Output 1		
S1 Temperature	Output 2		
S2 Measurement	Output 3		
S2 Temperature	Output 4		
BACK			

Procedure

1. To Zero Calibrate the transmitter with the sensor attached, follow the step-by-step procedures displayed on-screen.

S1: 0.031 $\mu\text{S}/\text{cm}$ 999.9°C		S2: -25.14mmHg	
Why is calibration necessary? To find out, press INFO. Otherwise, choose the desired calibration method.			
Zero	Cell constant		
Standard solution	Meter		
In process			
Grab sample			
BACK			
Warning			

2. To perform an In-Process Calibration of the conductivity loop by Standardizing the sensor to a known conductivity, follow the step-by-step procedures displayed on-screen.
3. To calibrate the conductivity loop by entering a Cell constant, enter the cell Constant for the sensor and follow the step-by-step procedures displayed onscreen.
4. To Meter Cal Calibrate the transmitter to a lab conductivity instrument, follow the step-by-step procedures displayed on-screen.
5. To enter the Cal Factor to support calibration of a 4-Electrode sensors, enter the Cal Factor for the 4-Electrode sensors from the sensor tag and follow the step-by-step procedures displayed on-screen.

10.5 Toroidal conductivity calibration

Calibration is the process of adjusting or standardizing the transmitter to a lab test or a calibrated laboratory instrument, or standardizing to some known reference (such as a conductivity standard). This section contains procedures for the first time use and for routine calibration of the Rosemount 56 transmitter.

To calibrate the conductivity loop with a connected contacting conductivity sensor, access the **Calibration** screen by pressing **ENTER/MENU** from the main screen. Select S1 or S2 Measurement and press **ENTER/MENU**. Press **INFO** at any time to learn more about this procedure. A yellow screen will appear with detailed instructions and information.

The following calibration routines are covered:

1. Zero Cal: Zero the transmitter with the sensor attached.
2. In Process Cal: Standardize the sensor to a known conductivity.
3. Cell K: 1.00000/cm Enter the cell Constant for the sensor from sensor tag.

S1: 7.00pH 25.2°C S2: 0.056 µS/cm 52.1°C	
Calibrate what?	
S1 Measurement	Output 1
S1 Temperature	Output 2
S2 Measurement	Output 3
S2 Temperature	Output 4
BACK	

Procedure

1. To Zero Calibrate the transmitter with the sensor attached, follow the step-by-step procedures displayed on-screen.
2. To perform an In-Process Calibration of the conductivity loop by standardizing the sensor to a known conductivity, follow the step-by-step procedures displayed on-screen.
3. To calibrate the conductivity loop by entering a Cell constant, enter the cell Constant for the sensor and follow the step-by-step procedures displayed on-screen.

S1:-53µS/cm 999.9°C

Why is calibration necessary? To find out, press INFO.
Otherwise, choose the desired calibration method.

Zero Cell constant

Standard solution

In process

Grab sample

BACK

10.6 Chlorine calibration

With a chlorine measurement board and the appropriate sensor, the Rosemount 56 can measure any of four variants of chlorine:

- Free Chlorine
- Total Chlorine
- Monochloramine
- pH-independent Free Chlorine

The section describes how to calibrate any compatible amperometric chlorine sensor. The following calibration routines are covered in the family of supported chlorine sensors:

- Air Cal
- Zero Cal
- In Process Cal

10.6.1 Free chlorine calibration

A free chlorine sensor generates a current directly proportional to the concentration of free chlorine in the sample. Calibrating the sensor requires exposing it to a solution containing no chlorine (zero standard) and to a solution containing a known amount of chlorine (full-scale standard). The zero calibration is necessary because chlorine sensors, even when no chlorine is in the sample, generate a small current called the residual current. The transmitter compensates for the residual current by subtracting it from the measured current before converting the result to a chlorine value. New sensors require zeroing before being placed in service, and sensors should be zeroed whenever the electrolyte solution is replaced.

To calibrate the chlorine sensor, access the **Calibration** screen by pressing **ENTER/ MENU** from the main screen. Select S1 or S2 Measurement and press **ENTER/ MENU**. Press **INFO** at any time to learn more about this procedure. A yellow screen will appear with detailed instructions and information.

The following calibration routines are covered:

1. Zero Cal :Zeroing the sensor in solution with zero free chlorine.
2. Grab Cal: Standardizing to a sample of known free chlorine concentration.

S1: 7.00pH 25.2°C		S2: 0.056 μS/cm 52.1°C	
Calibrate what?			
S1 Measurement	Output 1		
S1 Temperature	Output 2		
S2 Measurement	Output 3		
S2 Temperature	Output 4		
BACK			

Procedure

1. To Zero Calibrate the transmitter with the sensor attached, follow the step-by-step procedures displayed on-screen.
2. To perform a Grab Calibration by Standardizing the sensor, follow the step-by-step procedures displayed on-screen.

S1:-53μS/cm 999.9°C		S2:-0.447ppm 999.9°C	
Why is calibration necessary? To find out, press INFO. Otherwise, choose the desired calibration method.			
Zero			
Grab			
BACK			

10.6.2 Total chlorine calibration

Total chlorine is the sum of free and combined chlorine. The continuous determination of total chlorine requires two steps. First, the sample flows into a conditioning system (TCL) where a pump continuously adds acetic acid and potassium iodide to the sample. The acid lowers the pH, which allows total chlorine in the sample to quantitatively oxidize the iodide in the reagent to iodine. In the second step, the treated sample flows to the sensor. The sensor is a membrane-covered amperometric sensor, whose output is proportional to the concentration of iodine.

Because the concentration of iodine is proportional to the concentration of total chlorine, the transmitter can be calibrated to read total chlorine. Because the sensor really measures iodine, calibrating the sensor requires exposing it to a solution containing no iodine (zero standard) and to a solution containing a known amount of iodine (full-scale standard). The Zero calibration is necessary because the sensor, even when no iodine is present, generates a small current called the residual current. The transmitter compensates for the residual current by subtracting it from the measured current before converting the result to a total chlorine value. New sensors require zeroing before being placed in service, and sensors should be zeroed whenever the electrolyte solution is replaced. The best zero standard is deionized water. The purpose of the In Process Calibration is to establish the slope of the calibration curve. Because stable total chlorine

standards do not exist, the sensor must be calibrated against a test run on a grab sample of the process liquid. Several manufacturers offer portable test kits for this purpose.

To calibrate the chlorine sensor, access the **Calibration** screen by pressing **ENTER/ MENU** from the main screen. Select S1 or S2 Measurement and press **ENTER/MENU**. Press **INFO** at any time to learn more about this procedure. A yellow screen will appear with detailed instructions and information.

The following calibration routines are covered:

1. Zero Cal: Zeroing the sensor in solution with zero total chlorine.
2. Grab Cal: Standardizing to a sample of known total chlorine concentration.

S1: 7.00pH 25.2°C S2: 0.056 µS/cm 52.1°C	
Calibrate what?	
S1 Measurement	Output 1
S1 Temperature	Output 2
S2 Measurement	Output 3
S2 Temperature	Output 4
BACK	

Procedure

1. To Zero Calibrate the transmitter with the sensor attached, follow the step-by-step procedures displayed on-screen.
2. To perform a Grab Calibration by Standardizing the sensor, follow the step-by-step procedures displayed on-screen.

S1:-53µS/cm 999.9°C S2:-0.447ppm 999.9°C	
Why is calibration necessary? To find out, press INFO. Otherwise, choose the desired calibration method.	
Zero Grab	
BACK	

10.6.3 Monochloramine calibration

A monochloramine sensor generates a current directly proportional to the concentration of monochloramine in the sample. Calibrating the sensor requires exposing it to a solution containing no monochloramine (zero standard) and to a solution containing a known amount of monochloramine (full-scale standard). The Zero calibration is necessary because monochloramine sensors, even when no monochloramine is in the sample, generate a small current called the residual or zero current. The transmitter compensates for the residual current by subtracting it from the measured current before converting the result

to a monochloramine value. New sensors require zeroing before being placed in service, and sensors should be zeroed whenever the electrolyte solution is replaced. The best zero standard is deionized water.

The purpose of the In Process calibration is to establish the slope of the calibration curve. Because stable monochloramine standards do not exist, the sensor must be calibrated against a test run on a grab sample of the process liquid. Several manufacturers offer portable test kits for this purpose.

To calibrate the chlorine sensor, access the **Calibration** screen by pressing **ENTER/ MENU** from the main screen. Select S1 or S2 Measurement and press **ENTER/ MENU**. Press **INFO** at any time to learn more about this procedure. A yellow screen will appear with detailed instructions and information.

The following calibration routines are covered:

1. Zero Cal: Zeroing the sensor in solution with zero total chlorine.
2. Grab Cal: Standardizing to a sample of known monochloramine concentration.

S1: 7.00pH 25.2°C S2: 0.056 µS/cm 52.1°C	
Calibrate what?	
S1 Measurement	Output 1
S1 Temperature	Output 2
S2 Measurement	Output 3
S2 Temperature	Output 4
BACK	

Procedure

1. To Zero Calibrate the transmitter with the sensor attached, follow the step-by-step procedures displayed on-screen.
2. To perform a Grab Calibration by Standardizing the sensor, follow the step-by-step procedures displayed on-screen.

S1:-53µS/cm 999.9°C S2:-0.447ppm 999.9°C	
Why is calibration necessary? To find out, press INFO. Otherwise, choose the desired calibration method.	
Zero Grab	
BACK	

10.6.4 pH-Independent free chlorine measurement

A free chlorine sensor generates a current directly proportional to the concentration of free chlorine in the sample. Calibrating the sensor requires exposing it to a solution

containing no chlorine (zero standard) and to a solution containing a known amount of chlorine (full-scale standard). The zero calibration is necessary because chlorine sensors, even when no chlorine is in the sample, generate a small current called the residual current. The analyzer compensates for the residual current by subtracting it from the measured current before converting the result to a chlorine value. New sensors require zeroing before being placed in service, and sensors should be zeroed whenever the electrolyte solution is replaced.

To calibrate the chlorine sensor, access the Calibration screen by pressing **ENTER/ MENU** from the main screen, select S1 or S2 Measurement and press **ENTER/MENU**. Press **INFO** at any time to learn more about this procedure. A yellow screen will appear with detailed instructions and information.

The following calibration routines are covered:

1. Zero Cal Zeroing the sensor in solution with zero total chlorine
2. Grab Cal Standardizing to a sample of known chlorine concentration

S1: 7.00pH 25.2°C S2: 0.056 μS/cm 52.1°C	
Calibrate what?	
S1 Measurement	Output 1
S1 Temperature	Output 2
S2 Measurement	Output 3
S2 Temperature	Output 4
BACK	

Procedure

1. To Zero Calibrate the analyzer with the sensor attached, follow the step-by-step procedures displayed on-screen.
2. To perform a Grab Calibration by Standardizing the sensor, follow the step-by-step procedures displayed on-screen.

S1:-53μS/cm 999.9°C S2:-0.447ppm 999.9°C	
Why is calibration necessary? To find out, press INFO. Otherwise, choose the desired calibration method.	
Zero Grab	
BACK	

10.6.5 Oxygen calibration

Oxygen sensors generate a current directly proportional to the concentration of dissolved oxygen in the sample. Calibrating the sensor requires exposing it to a solution containing

no oxygen (zero standard) and to a solution containing a known amount of oxygen (full-scale standard). The Zero Calibration is necessary because oxygen sensors, even when no oxygen is present in the sample, generate a small current called the residual current. The transmitter compensates for the residual current by subtracting it from the measured current before converting the result to a dissolved oxygen value.

New sensors require zeroing before being placed in service, and sensors should be zeroed whenever the electrolyte solution is replaced. The recommended zero standard is 5 percent sodium sulfite in water, although oxygen-free nitrogen can also be used. The Rosemount 499ATrDO sensor, used for the determination of trace (ppb) oxygen levels, has very low residual current and does not normally require zeroing. The residual current in the 499ATrDO sensor is equivalent to less than 0.5 ppb oxygen. The purpose of the In Process Calibration is to establish the slope of the calibration curve. Because the solubility of atmospheric oxygen in water as a function of temperature and barometric pressure is well known, the natural choice for a full-scale standard is air-saturated water.

However, air-saturated water is difficult to prepare and use, so the universal practice is to use air for calibration. From the point of view of the oxygen sensor, air and air-saturated water are identical. The equivalence comes about because the sensor really measures the chemical potential of oxygen. Chemical potential is the force that causes oxygen molecules to diffuse from the sample into the sensor where they can be measured. It is also the force that causes oxygen molecules in air to dissolve in water and to continue to dissolve until the water is saturated with oxygen.

Once the water is saturated, the chemical potential of oxygen in the two phases (air and water) is the same. Oxygen sensors generate a current directly proportional to the rate at which oxygen molecules diffuse through a membrane stretched over the end of the sensor. The diffusion rate depends on the difference in chemical potential between oxygen in the sensor and oxygen in the sample.

An electrochemical reaction, which destroys any oxygen molecules entering the sensor, keeps the concentration (and the chemical potential) of oxygen inside the sensor equal to zero. Therefore, the chemical potential of oxygen in the sample alone determines the diffusion rate and the sensor current. When the sensor is calibrated, the chemical potential of oxygen in the standard determines the sensor current. Whether the sensor is calibrated in air or air-saturated water is immaterial.

The chemical potential of oxygen is the same in either phase. Normally, to make the calculation of solubility in common units (like ppm dissolved oxygen [DO]) simpler, it is convenient to use water-saturated air for calibration. Automatic air calibration is standard. Simply expose the sensor to water-saturated air.

The transmitter monitors the sensor current. When the current is stable, the transmitter stores the current and measures the temperature using a temperature element inside the oxygen sensor. The user must enter the barometric pressure. From the temperature the transmitter calculates the saturation vapor pressure of water.

Next, it calculates the pressure of dry air by subtracting the vapor pressure from the barometric pressure. Using the fact that dry air always contains 20.95 percent oxygen, the transmitter calculates the partial pressure of oxygen. Once the transmitter knows the partial pressure of oxygen, it uses the Bunsen coefficient to calculate the equilibrium solubility of atmospheric oxygen in water at the prevailing temperature. At 25 °C and 760 mmHg, the equilibrium solubility is 8.24 ppm.

Often, it is too difficult or messy to remove the sensor from the process liquid for calibration. In this case, the sensor can be calibrated against a measurement made with a portable laboratory instrument. The laboratory instrument typically uses a membrane-covered amperometric sensor that has been calibrated against water-saturated air.

To calibrate the oxygen sensor, access the **Calibration** screen by pressing **ENTER/ MENU** from the main screen. Select S1 or S2 Measurement and press **ENTER/MENU**. Press **INFO**

at any time to learn more about this procedure. A yellow screen will appear with detailed instructions and information.

The following calibration routines are covered:

1. Zero Cal: Zeroing the sensor in a medium with zero oxygen.
2. Air Cal: Calibrating the sensor in a water-saturated air sample.
3. In Process Cal: Standardizing to a sample of known oxygen concentration.
4. Sen@ 25 °C: 2500 μ A/ppm Entering a known slope value for sensor response.

S1: 7.00pH 25.2°C S2: 0.056 μS/cm 52.1°C	
Calibrate what?	
S1 Measurement	Output 1
S1 Temperature	Output 2
S2 Measurement	Output 3
S2 Temperature	Output 4
BACK	

Procedure

1. Zero Calibrate the transmitter with the sensor attached; follow the step-by-step procedures displayed on-screen.
2. To Air Cal Calibrating the sensor in a water-saturated air sample, follow the step-by-step procedures displayed on-screen.
3. To perform an In-Process Calibration by Standardizing the sensor, follow the step-by-step procedures displayed on-screen.
4. To calibrate the oxygen sensor by manually. Entering a known slope value for sensor response, follow the step-by-step procedures displayed on-screen.

S1: 0.00ppm -41.6°C S2: 0.002ppm 999.9°C	
Why is calibration necessary? To find out, press INFO. Otherwise, choose the desired calibration method.	
Zero	
Air calibrate	
In process	
Sensitivity / zero	
BACK	

10.6.6 Ozone calibration

An ozone sensor generates a current directly proportional to the concentration of ozone in the sample. Calibrating the sensor requires exposing it to a solution containing no ozone (zero standard) and to a solution containing a known amount of ozone (full-scale standard). The Zero Calibration is necessary because ozone sensors, even when no ozone

is in the sample, generate a small current called the residual or zero current. The analyzer compensates for the residual current by subtracting it from the measured current before converting the result to an ozone value.

New sensors require zeroing before being placed in service, and sensors should be zeroed whenever the electrolyte solution is replaced. The best zero standard is deionized water. The purpose of the In Process Calibration is to establish the slope of the calibration curve. Because stable ozone standards do not exist, the sensor must be calibrated against a test run on a grab sample of the process liquid. Several manufacturers offer portable test kits for this purpose.

To calibrate the ozone sensor, access the **Calibration** screen by pressing **ENTER/MENU** from the main screen. Select S1 or S2 Measurement and press **ENTER/MENU**. Press **INFO** at any time to learn more about this procedure. A yellow screen will appear with detailed instructions and information.

The following calibration routines are covered:

1. Zero Cal: Zeroing the sensor in solution with zero total chlorine.
2. Grab Cal: Standardizing to a sample of known ozone concentration.

S1: 7.00pH 25.2°C S2: 0.056 μS/cm 52.1°C	
Calibrate what?	
S1 Measurement	Output 1
S1 Temperature	Output 2
S2 Measurement	Output 3
S2 Temperature	Output 4
BACK	

Procedure

1. To Zero Calibrate the analyzer with the sensor attached, follow the step-by-step procedures displayed on-screen.
2. To perform a Grab Calibration by Standardizing the sensor, follow the step-by-step procedures displayed on-screen.

S1:-53μS/cm 999.9°C S2:-0.447ppm 999.9°C	
Why is calibration necessary? To find out, press INFO. Otherwise, choose the desired calibration method.	
Zero Grab	
BACK	

10.6.7 Calibrating temperature

Most liquid analytical measurements require temperature compensation (except ORP). The Rosemount 56 performs temperature compensation automatically by applying internal temperature correction algorithms. Temperature correction can also be turned off. If temperature correction is off, the transmitter uses the manual temperature entered by the user in all temperature correction calculations.

To calibrate temperature, access the **Calibration** screen by pressing **ENTER/MENU** from the main screen. Select S1 or S2 Temperature and press **ENTER/MENU**. Press **INFO** at any time to learn more about this procedure. A yellow screen will appear with detailed instructions and information.

The following calibration routine is covered:

Procedure

1. Temperature with manual temperature entry:

S1: 7.00pH 25.2°C		S2: 0.056 µS/cm 52.1°C	
Calibrate what?			
S1 Measurement		Output 1	
S1 Temperature		Output 2	
S2 Measurement		Output 3	
S2 Temperature		Output 4	
BACK			

2. To Calibrate Temperature, follow the step-by-step procedures displayed on-screen.

S1: 0.00ppm -41.6°C		S2: 0.002ppm 999.9°C	
Why is calibration necessary? To find out, press INFO. Otherwise, press ENTER.			
BACK			

10.6.8 Turbidity

This section describes how to calibrate the turbidity sensor against a user-prepared standard as a 2-point calibration with deionized water, against a 20 NTU user-prepared standard as a single point calibration, and against a grab sample using a reference turbidimeter.

To calibrate the turbidity sensor, access the **Calibration** screen by pressing **ENTER/MENU** from the main screen. Select S1 or S2 Measurement and press **ENTER/MENU**. Press **INFO**

at any time to learn more about this procedure. A yellow screen will appear with detailed instructions and information.

The following calibration routine is covered:

1. Slope Calibration: Slope cal with pure water and a standard of known turbidity.
2. Standardize Calibration: Standardizing the sensor to a known turbidity.
3. Grab Calibration: Standardizing the sensor to a known turbidity based on a reference turbidimeter.

S1: 7.00pH 25.2°C S2: 0.056 µS/cm 52.1°C	
Calibrate what?	
S1 Measurement	Output 1
S1 Temperature	Output 2
S2 Measurement	Output 3
S2 Temperature	Output 4
BACK	

Procedure

1. To calibrate the turbidity loop using Slope Calibration with pure water and a standard of known turbidity, follow the step-by-step procedures displayed on-screen.
2. To calibrate the turbidity loop using Standardize Calibration by Standardizing the sensor to a known turbidity, follow the step-by-step procedures displayed on-screen.
3. To calibrate the turbidity loop using Grab Calibration by Standardizing the sensor to a known turbidity based on a reference turbidimeter, follow the step-by-step procedures displayed on-screen.

S1: ---NTU	
Why is calibration necessary? To find out, press INFO. Otherwise, choose the desired calibration method.	
Slope	
Standard	
Grab	
BACK	

10.6.9 Pulse flow

A variety of pulse flow sensors can be wired to the Flow signal input board to measure flow volume, total volume, and flow difference (if 2 Flow signal boards are installed). The

Rosemount 56 Flow signal board will support flow sensors that are self-driven (powered by the rotation of the impeller paddle-wheel).

To calibrate the pulse flow sensor, access the **Calibration** screen by pressing **ENTER/MENU** from the main screen. Select S1 or S2 Measurement and press **ENTER/MENU**. Press **INFO** at any time to learn more about this procedure. A yellow screen will appear with detailed instructions and information.

The following calibration routine is covered:

1. K Factor: A constant value representing pulses/Gal of flow.
2. Frequency/Velocity & Pipe Alternate cal method: Requires manual entry of frequency (Hz) per velocity and Pipe diameter used.
3. In process Calibration based on known volume per unit of time
4. Totalizer Control User settings to stop, restart and reset total volume meter

S1: 7.00pH 25.2°C		S2: 0.056 µS/cm 52.1°C	
Calibrate what?			
S1 Measurement	Output 1		
S1 Temperature	Output 2		
S2 Measurement	Output 3		
S2 Temperature	Output 4		
BACK			

Procedure

1. To enter a K Factor constant value representing pulses/Gal of flow, follow the step-by-step procedures displayed on-screen.
2. To calibrate pulse flow Frequency/Velocity & Pipe as an alternate cal method, follow the step-by-step procedures displayed on-screen.
3. To perform In-process Calibration the pulse flow sensor based on known volume per unit of time, follow the step-by-step procedures displayed on-screen.
4. To stop, restart, and reset Totalizer Control total volume meter, follow the step-by-step procedures displayed on-screen.

S1:0.0000GPM
Why is calibration necessary? To find out, press INFO. Otherwise, choose the desired calibration method.
K factor
Frequency/Velocity
In process
BACK

11 HART® communications

11.1 Introduction to HART® communication

The Rosemount 56 can communicate with a HART host using HART Revision 5 or HART Revision 7. The revision of HART used by the Rosemount 56 can be selected using the keypad/display or a HART master such as AMS or the Field Communicator. The default version of HART is Revision 5. Since some HART hosts cannot accommodate HART 7, the choice of HART Revision should be based on the capabilities of the host, and should be chosen as a first step in configuration.

When HART 5 is chosen, the Device Revision of the 56 is Device Revision 1; when HART 7 is chosen, the Device Revision is Revision 2 or higher for later revisions of the 56. The Device Revision of the DD (Device Driver) and install files for AMS and DeltaV used should be the same as the Device Revision of the Rosemount 56.

HART 5 Device Identification (56 Revision 1):

Manufacturer Name:	Rosemount
Model Name:	Rosemount 56
Manufacturer ID:	46 (0x2E)
Device Type Code:	86 (0x0056)
HART Protocol Revision:	5.1
Device Revision:	1
Capabilities:	Supports all signal boards except the turbidity and flow/4-20mA input signal boards.

HART 7 Device Identification (56 Revision 2):

Manufacturer Name:	Rosemount
Model Name:	Rosemount 56
Manufacturer ID:	46 (0x2E)
Device Type Code:	11862 (0x2E56)
HART Protocol Revision:	7.1
Device Revision:	2
Capabilities:	Supports all signal boards.

HART 7 Device Identification (56 Revision 3):

Manufacturer Name:	Rosemount
Model Name:	Rosemount 56
Manufacturer ID:	46 (0x2E)
Device Type Code:	11862 (0x2E56)
HART Protocol Revision:	7.1
Device Revision:	3
Capabilities:	Supports all signal boards and the complete set of parameters for standardized PID with PID transport time feature and TPC control.

11.2 Physical installation and configuration

11.2.1 HART® wiring and output configuration

HART communication is superimposed on Analog Output 1 for all of the measurements and parameters of the Rosemount 56. The 4-20 mA current of Analog Output 1 can be configured by the keypad display to be powered by the 56 (Output 1 power: Internal), or by an external 24 Vdc power supply, or an input/output (I/O) that provides power (Output 1 power: External).

11.2.2 HART® multidrop (Bus) configuration

The HART Polling Address should be left at its default value of 0, unless the Rosemount 56 is used in a Multidrop configuration with up to 14 other transmitters. When the Polling Address is greater than 0, the 4-20 mA output is held at 4 mA or below and does not change in response to changes in the measurement in HART 5.

In HART 7, Loop Current Mode should be set to On to hold the current output to a minimum value. In both HART 5 and HART 7, Output Power should be set to External so that an external 24 Vdc power supply can be used to power the multidrop bus.

11.2.3 HART® configuration

To access the **HART Configuration** screens, press the **HART** button in the **Main Menu**. The following controls are available:

Figure 11-1: HART Configuration Screen 1: Basic Definitions

- Host HART mode – Toggles between HART version 5 and HART version 7. If the HART host being used can accommodate HART 7, choose HART 7 due to its larger feature set. If the host can only use HART 5, then choose HART 5.

Note

If the Rosemount 56 is connected to a HART host and the HART version is changed, the host will likely detect the transmitter as a new transmitter with a different device revision number.

- Tag – The traditional 8 character HART tag number
- Long tag – HART tag number of up to 32 characters (HART 7 only).
- Polling address – Choose **0** unless Multidrop is being used. If Multidrop is being used, each transmitter should have its own polling address of from 1 to 15.
- Loop current mode – Set Output 1 current to a minimum value for multidrop applications (HART 7 only).
- Output 1 Power – Select **Internal** to power Output 1 with the 56. Select **External** to power the current loop with an external power supply, such as a host I/O that provides power (source) to the transmitter (sink).

HART Configuration Screen 2 Basic Definitions

- Burst command:
 - Cmd 1 – Bursts the Primary Value
 - Cmd 2 – Bursts Loop Current + % of range of the Primary Value
 - Cmd 3 – Bursts Dynamic Variables (Primary Variable, Secondary Variable, Tertiary Variable, and Quaternary Variable) + Loop Current
 - Cmd 9 – Bursts up to 8 Device Variables with time stamp and status (HART 7 only)
 - Cmd 33 – Bursts 4 Device Variables
 - Cmd 48 – Bursts Additional Transmitter Status Bits (HART 7 only)
 - Cmd 93 – Bursts Trend Data (HART 7 only)

- Find device cmd – Setting Find Device to **On**, enables the 56 to be identified by the host. The transmitter returns identity information including device type, revision level, and device ID.
- Response preambles – Preambles synchronize the receiver to the incoming data. Response preambles are the number of bytes of preambles (2 to 20) sent by the 56 at the start of a response packet.

11.3 Measurements available via HART®

A number of live measurements are made available by HART in addition to the main measurements, such as pH or Conductivity. All of these measurements are called Device Variables, which can be mapped to the Dynamic Variables PV, SV, TV, and QV for regular reading by the typical HART host.

The Rosemount 56 assigns the Dynamic Variables Primary Variable, Secondary Variable, Tertiary Variable, and Quaternary Variable (PV, SV, TV, and QV) to Analog Outputs 1, 2, 3, and 4 respectively. Conversely, measurements assigned to Outputs 1 through 4, will automatically be assigned to PV through QV.

Each measurement board will have its own set of Device Variables, based on the secondary measurements used in making the main measurement. [HART® and Device Variables](#) shows the Device Variable for the each sensor boards

11.4 Diagnostics available via HART®

11.4.1 Status information – Device status bits

Bit 0	Primary Variable out of Limits: This bit is set when PV is out of its limits.
Bit 1	Non-primary Variable out of Limits: This bit is set when non PV is out of its limits.
Bit 2	Loop Current Saturated: This bit is set when the Analog Output 1 current is less than 1.0 mA or greater than 22.0 mA and the Device Status Bytes bit 3 is not set.
Bit 3	Loop Current Fixed: This bit is set when Analog Output 1 does not follow the process. This bit is cleared when Analog Output 1 follows the process.
Bit 4	More Status Available: The “more status available” bit will be set when the device status condition occurs (i.e. bit goes from 0 to 1) on at least one of the Additional Transmitter Status bits are set.
Bit 5	Cold Start: This bit is set when a Master Reset is performed either by Command 42, or a power cycle. This bit is cleared after the first response or burst. In the case of a burst, the first burst always goes to the primary master. Configuration Changed:

This bit is set when the last bytes of an EEPROM writing sequence is completed. Since EEPROM writes are delayed until after the response, the immediate acknowledgement will not have the bit set, however, after the EEPROM write completes, the bit will be set. This bit applies to all EEPROM writes whether or not they apply directly to the configuration of the instrument or not. This bit is cleared when Command 38 is executed.

Field Device Malfunction:

This bit is set when any of the following conditions is true, and cleared when all of the following conditions are false:

1. There is at least one main board fault.
2. There is at least one Sensor 1 fault.
3. There is at least one Sensor 2 fault.

11.4.2 Status information – Extended device status bits (HART® 7 only)

Bit 0	Maintenance Required: Any calibration error will set this bit. Any calibration for either Sensor 1 or Sensor 2 that fails will set this bit. This bit gets cleared if all device variables are calibrated successfully. This bit is set to indicate that, while the device has not malfunctioned, the Field Device requires maintenance.
Bit 1	Device Variable Alert: This bit will get set when at least one of device status byte of all the valid Device Variables does not equal to "good and not limited" (i.e. the higher 4 bits not equal to 0x1100). This bit is set if any Device Variable is in an Alarm or Warning State. The host should identify the Device Variable(s) causing this to be set using the Device Variable Status indicators.
Bit 3	Critical Power Failures: This bit will always be cleared on the Rosemount 56.

11.4.3 Additional transmitter status (Command 48)

Additional Transmitter Status provides diagnostic status bits specific to the condition of sensors, sensor boards, and the main board of the Rosemount 56. Calibration errors and notification of events, such as calibration in progress and relay activation are also indicated by status bits. [HART® Status Bits](#) shows these bits organized according to the main board or applicable sensor board.

11.5 HART® hosts

A HART host can access live measurements, as well as diagnostic messages and provide a tool for configuring the measurement and calibrating the Rosemount 56. The AMS

Intelligent Device Manager and the Field Communicator are two examples further explained in the next two sections.

11.5.1 AMS Intelligent Device Manager

The AMS Device Intelligent Device Manager is member of the AMS Suite of asset management applications, which provides tools for configuration, calibration, diagnosing, and documenting transmitters and valves. The following AMS windows are examples of these functions:

Figure 11-2: Main Measurement and Overall Status: Overview Screen

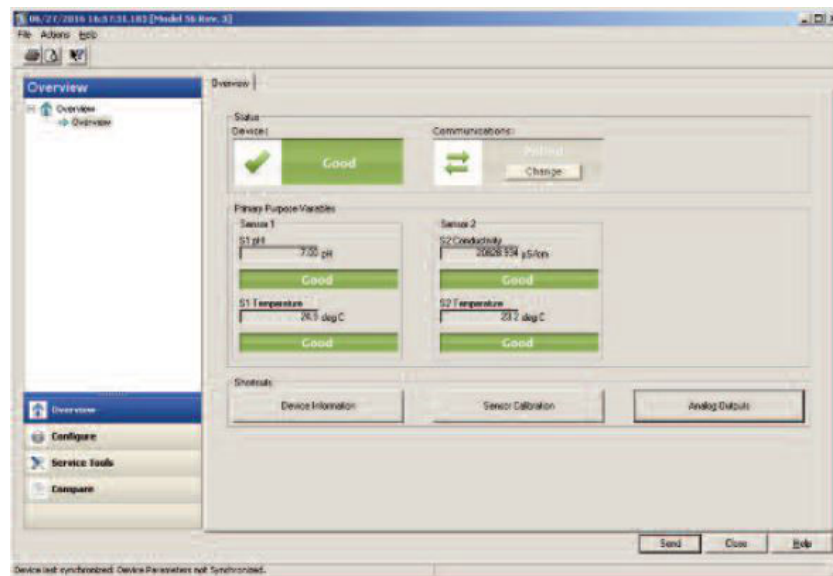


Figure 11-3: Device Variables and Dynamic Variables

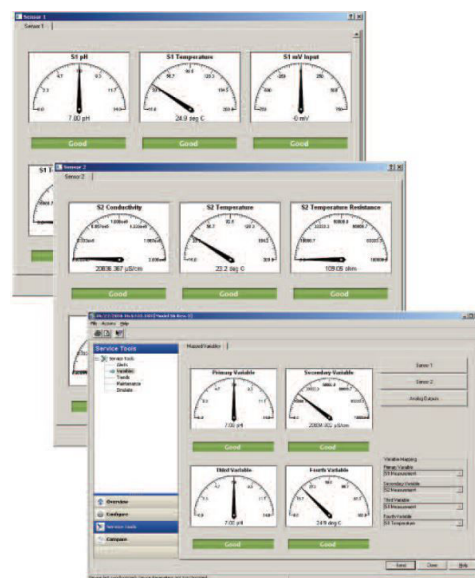


Figure 11-4: Diagnostic Messages (Additional Transmitter Status)

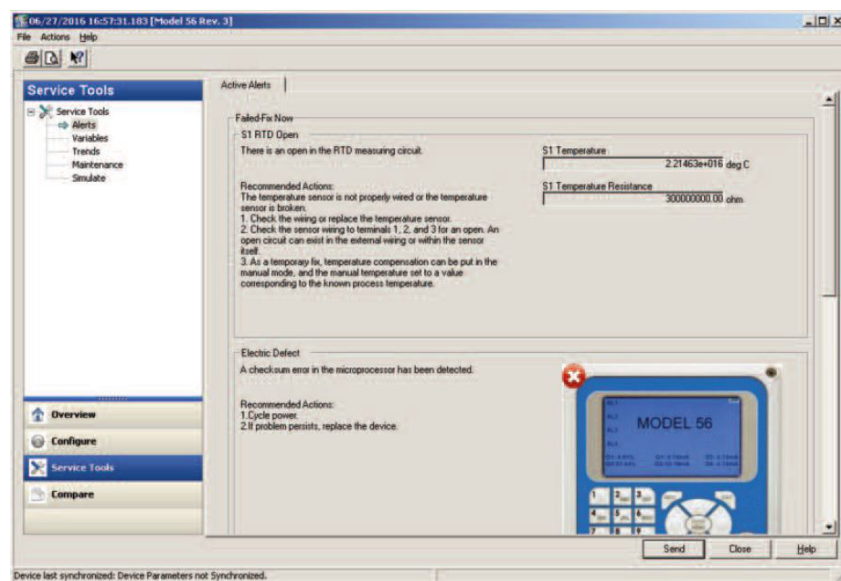


Figure 11-5: Configure Screen

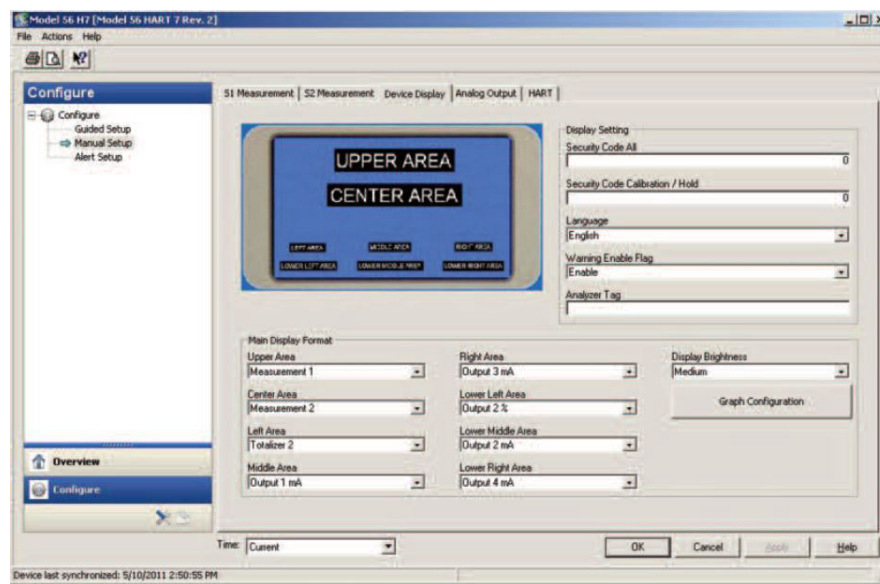
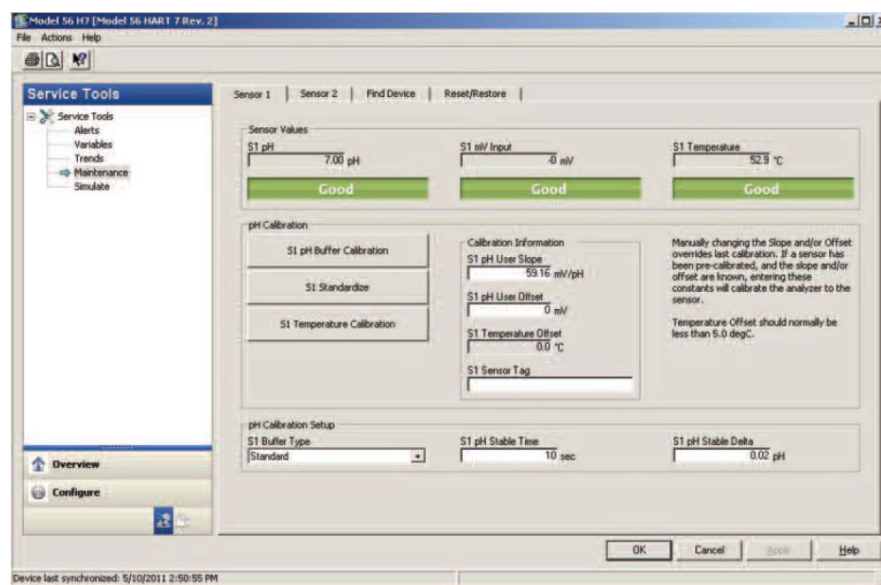


Figure 11-6: Maintenance



11.5.2 Field Communicator

HART® (and Fieldbus) devices can be access in the field using the Field Communicator, which provides the same basic functionality as the AMS Intelligent Device Manager. Asset management information can be uploaded into the AMS database from the Field Communicator for a common database for asset management data. The Field Communicator uses a color menu driven display.

11.6 Wireless communication

The Rosemount 56 can communicate by *WirelessHART*® using the Smart Wireless THUM Adapter™ and the Emerson Wireless 1410 Gateway. All the information available with the wired device can be accessed wirelessly, making it possible to have the measurements and benefits of HART® communication in locations where running cable would be difficult or prohibitively expensive.

Although HART 5 or HART 7 can burst the Dynamic Variables Primary Variable, Secondary Variable, Tertiary Variable, and Quaternary Variable (PV, SV, TV, and QV), HART 7 should be used with the THUM because up to 8 Device Variables can be continually burst using Command 9.

11.7 Field Device Specification (FDS)

For more details on the implementation of HART® in the Rosemount 56 and its command structure, the Field Device Specification for the relevant Device Revision should be consulted. They can be downloaded from Emerson.com/global.

12 PROFIBUS® communications

12.1 General

The 56 can communicate using PROFIBUS® DP-V1 if you purchase a 56 with a PROFIBUS communication board installed (model code 56-PC-02-DP), or by adding a PROFIBUS communications board to the standard 56 with HART® communications.

The standard HART 56 Transmitter can be converted to PROFIBUS DP by adding a PROFIBUS board. There are two different PROFIBUS boards for the 56, which must be chosen to be compatible with the main board software version of the 56.

- If the 56 software version begins with a 2 (2.XX), PROFIBUS board PN 24285-02 should be chosen.
- If the 56 software version begins with a 1 (1.XX), PROFIBUS board PN 24285-01 should be chosen.

A 56 with PROFIBUS communications retains all the analog and discrete functionality of the standard HART 56 transmitter. The four 4 to 20 mA analog outputs can be configured as analog outputs or PID control outputs.

The four discrete relay outputs can be configured for concentration control (high/ low alarms with or without a delay timer), event based activation, timer based activation, or TPC (Duty Cycle/ Pulse Width Modulation) control.

12.2 PROFIBUS® features

As outlined in the Device Description Data Field (GSD), the 56 has the following PROFIBUS DP-V1 identification and capabilities:

Identification:

GSD Revision: 5

Vendor Name: Rosemount

Model Name: MODEL 56 PROFIBUS

DP Revision: V1.00

Identification Number: 0x10AA

Hardware Release: V1.00

Software Release: V1.00

Implementation Type: VPC3+C

Device: DP-V1 Slave

Baud Rates Supported:

All PROFIBUS DP baud rates are supported, from 9.6 kbps to 12 Mbps.

Additional Capabilities:

- The 56 PROFIBUS board supports the automatic transmission rate recognition. It automatically sets its baud rate to the transmission rate of the PROFIBUS network, specified by the master.

- The DP device supports the function Set_Slave_Add for setting the slave address via the PROFIBUS. The slave address for the 56 can be set automatically or manually by the PROFIBUS master. The DP device supports DP-V0 cyclic services and Identification and Maintenance (I & M) function: - I&M 0
- The Minimum Slave Interval is 100 sec minimum interval between two poll cycles.

56 Modules

The 56 is a multiparameter device, which supports a number of combinations of two analytical measurements, and four relays which can be configured for a number of discrete functions. As a result, the 56 is defined as a modular station, to allow it to cover these measurements, relay status, and associated information. The 56 has 36 modules available, and 33 can be inserted into the device. They include:

- The two main measurements, their units, and the measurement
 - The temperature measurements from each board and their units
 - Dual conductivity measurements: conductivity ration, percent passage, and percent rejection
 - Dual flow board measurements: flow recovery, flow difference, and flow unit
 - Alarm relays (four possible): their type, state, logic assignment and simulate status
- Details of the module are in [PROFIBUS® communications](#).

56 Device Diagnostics

A number of diagnostic bits are provided via PROFIBUS, which cover the fault and warning messages for the 56 main board, signal boards, and measurements. They are organized as follows:

Table 12-1: Device Diagnostic Bits

Diagnostic bits ⁽¹⁾	Bit description
16	Change in diagnostic data
24-27	Main board faults
33-38	Main board warnings
40-57	Signal board 1 and measurement faults
72-89	Signal board 2 and measurement faults
104-121	Signal board 1 and measurement warnings
136-153	Signal board 2 and measurement warnings

(1) Bit position after the header byte.

12.3 PROFIBUS® communications

12.3.1 Configuring the 56 for PROFIBUS® communications

Baud Rates

The 56 supports all the baud rates of PROFIBUS DP as shown in [Table 12-2](#). Since the 56 supports transmission rate recognition, it will recognize the baud rate used on the network, and set its own baud rate to match the network's rate.

Table 12-2: Baud Rates Supported

Baud rate	Maximum Response Time for Responders (unit is bit time)
9.6 kbps	60
19.2 kbps	60
45.45 kbps	60
93.75 kbps	60
187.5 kbps	60
500 kbps	100
1.5 Mbps	150
3 Mbps	250
6 Mbps	450
12 Mbps	800

Slave address

The 56 supports the set slave address function, which makes it possible for the PROFIBUS master to set the slave address of the 56. Some PROFIBUS masters cannot set slave addresses, and the slave addresses have to be set in each slave device. If this is case, the slave address can be set in the 56 by pressing the **ENTER/MENU** key and selecting **DP: PROFIBUS**. This will launch the PROFIBUS configuration window:

Live display

Address

Profi cable diagnostics

BACK

Fault/warning banner

- The PROFIBUS address is writeable up to a value of 126.
- At the same time the slave address is being set, PROFIBUS cable diagnostics should be enabled. These diagnostics provide a useful tool for troubleshooting cable connection problems.

12.3.2 PROFIBUS® faults and warnings

Faults

The 56 displays the following hardware faults associated with problems related to the PROFIBUS board and its connection to the main board:

Recommended actions

1. PROFIBUS board mismatch - The revision of the installed PROFIBUS board is not compatible with the main board of the transmitter. Note the revisions of the PROFIBUS board and the main board of the transmitter and contact the factory.

2. Self-test failed - At power up, the PROFIBUS board conducts several internal self tests. At least one of them failed.
 - a. Try to reset the transmitter by cycling the power.
 - b. Replace the PROFIBUS board.
3. Internal communication failed - The main board detects the PROFIBUS board, but the PROFIBUS board is not communicating with the main board.
 - a. Try to reset the transmitter by cycling the power.
 - b. Check the interconnecting cable between the PROFIBUS and main board.
 - c. Replace the PROFIBUS board.

Warnings

Cause

Warnings related to cable problems and software compatibility are also displayed, if PROFIBUS cable diagnostics are enabled:

Recommended actions

1. Cable shorted or open - No PROFIBUS cable is connected, or the A and B leads of the cable are shorted.
 2. Check PROFIBUS Cable - The A and B leads in the PROFIBUS cable may be reversed. If standard PROFIBUS cable is used, the green lead should be wired to Position A and the red lead to Position B. The bus may not have a terminator, or it may not be turned on. Check to see that a terminator is present and turned on.
 3. PROFIBUS function limited - The PROFIBUS board has new features that the main board software does not support. If one or more new features are not supported, the minor revision number of the PROFIBUS board will be greater than the minor revision number of the main board. Replace the main board.
- Details on these faults and warnings are accessed like any other fault or warning in the 56: Press the **INFO** key and then select **Faults – fix now** or **Warnings – fix soon**.

LED diagnostics

Cause

The PROFIBUS board itself displays diagnostic information via an LED, which is located on the upper right side of an installed board:

Recommended actions

1. Slow blink – No cable is present or the connection is shorted
2. Slow, even blinking – Reversed A and B cable connection
3. Quick flashing – PROFIBUS message detected
4. 1 second blinking – Self-test failure
5. Off – No power or a defective or missing ribbon cable

Diagnostic information

Cause

The 56 provides diagnostic information on PROFIBUS communications. To access the **Live Display** window:

Recommended actions

1. Press the **INFO** key.
2. Select **PROFIBUS information**.

The screenshot shows a window titled "Live display". Inside, there are several labeled input fields with their current values: "Address" with "3", "Baud rate" with "9600", "Master detected" with "yes", "POST" with "0", "Lpf output" with "60", and "Rx char count" with "8". At the bottom right of the main content area are two buttons: "NEXT" and "BACK". Below the main content area is a footer bar labeled "Fault/warning banner".

- Address – Displays the address being used by the 56 on the network
- Baud rate – The baud rate of the 56 and the network
- Master detected – If the master is not detected, the host and transmitter are not communicating. Check wiring connections, make sure the addresses match, and try changing the baud rate.
- POST, Lpf output, Rx character count – POST is the power-on self test. POST and the remaining parameters on this window are used as factory diagnostics only.

Pressing the **NEXT** button brings up the final diagnostic parameter, the software version used by the PROFIBUS board:

The screenshot shows a window titled "Live display". Inside, there is a single labeled input field: "Profibus bd SW ver" with the value "1.26". At the bottom right of the main content area is a button labeled "BACK". Below the main content area is a footer bar labeled "Fault/warning banner".

12.4 Data transmission

General

The 56 uses RS-485 communication technology for transmission. When messages are transmitted on PROFIBUS networks, for word transfer (more than one byte), the high byte is transferred first, followed by the low byte (Big-Endian/Motorola format).

56 modules

The details of measurement modules and relay modules are shown in [Table 12-3](#).

12.4.1 Measurement modules

Table 12-3: Measurement Modules

Module	Module name	Data type	Size bytes	Identifiers
	Signal Input Board 1			
1	PV1 value	float	4	0x41,0x83,0x01
2	PV1 Unit	uint	2	0x41,0x81,0x02
3	PV1 Type	uchar	1	0x41,0x80,0x03
4	Temperature1	float	4	0x41,0x83,0x04
5	Temperature1 Unit	uint	2	0x41,0x81,0x05
	Signal Input Board 2			
6	PV2 Value	float	4	0x41,0x83,0x06
7	PV2 Unit	uint	2	0x41,0x81,0x07
8	PV2 Type	uchar	1	0x41,0x80,0x08
9	Temperature 2	float	4	0x41,0x83,0x09
10	Temperature 2 Unit	uint	2	0x41,0x81,0x0A
	Dual Conductivity Input Boards			
11	Conductivity Ratio	float	4	0x41,0x83,0x0B
12	% Passage	float	4	0x41,0x83,0x0C
13	% Rejection	float	4	0x41,0x83,0x0D
	Dual Flow Input Boards			
14	Flow Recovery	float	4	0x41,0x83,0x0E
15	Flow Difference	float	4	0x41,0x83,0x0F
16	Flow Unit	uint	2	0x41,0x81,0x10

Table 12-4: Measurement Unit Codes and Units

Unit code	Unit	Unit code	Unit	Unit code	Unit
1001	°C	1212	μA	1364	GPH
1002	°F	1213	nA	1423	ppm
1034	m3	1243	mV	1424	ppb

Table 12-4: Measurement Unit Codes and Units (continued)

Unit code	Unit	Unit code	Unit	Unit code	Unit
1038	L	1274	pH	1425	ppth
1043	ft3	1281	Ohm	1521	ppb-ppm
1048	Gallon	1282	Gohm	1522	ug//L-mg/L
1059	h	1283	Mohm	1523	None
1060	d	1284	Kohm	1524	% Oxygen in Gas
1061	m.sec	1289	mS	1525	ppm Oxygen in Gas
1067	ft/sec	1290	μS	1526	NTU
1105	g/L	1295	Ohm-cm	1527	FTU
1133	kPa	1302	mS/cm	1528	FNU
1137	bar	1342	%	1551	S/cm
1138	mbar	1349	m3/hour	1552	μS/cm
1140	atm	1352	L/min	1555	M Ohm-cm
1155	in Hg	1353	L/hour	1556	k Ohm-cm
1157	mm Hg	1357	cu ft./min	1558	mg/L
1190	kwatt	1358	cu ft./hour	1559	μg/L
1211	mA	1363	GPM	1560	% Saturation

Table 12-5: Measurement (Primary Variable [PV] 1 and PV 2) Types

Types	Measurement	Types	Measurement
0	Unknown	14	Custom concentration
1	pH	15	Total dissolve solids
2	ORP	16	Salinity
3	Redox	17	Oxygen
4	Ammonia	18	Ozone
5	Fluoride	19	Free chlorine
6	Custom ISE	20	pH independent free
7	Conductivity	21	Chlorine total chlorine
8	Resistivity	22	Chloramine
9	NaOH	23	Flow
10	HCl	24	mA input
11	Low Range H ₂ SO ₄	25	Turbidity
12	High Range H ₂ SO ₄	26	Total suspended solids
13	NaCl	-	-

Measurement modules provide the PV value for each signal board, the PV unit ([Table 12-3](#)), and the PV type ([Table 12-4](#)).

12.4.2 Relay modules

Table 12-6: Measurement Modules

Module	Module name	Data type	Size bytes	Identifiers
	Relay 1		1	
17	Alarm1 Type	uchar	1	0x41,0x80,0x11
18	Alarm1 State	uchar	1	0x41,0x80,0x12
19	Alarm1 Logic	uchar	1	0x41,0x80,0x13
20	Alarm1 Assignment	uchar	1	0x41,0x80,0x14
21	Alarm1 Simulate Status	uchar	1	0x41,0x80,0x15
	Relay 2			
22	Alarm2 Type	uchar	1	0x41,0x80,0x16
23	Alarm2 State	uchar	1	0x41,0x80,0x17
24	Alarm2 Logic	uchar	1	0x41,0x80,0x18
25	Alarm2 Assignment	uchar	1	0x41,0x80,0x19
26	Alarm2 Simulate Status	uchar	1	0x41,0x80,0x1A
	Relay 3			
27	Alarm3 Type	uchar	1	0x41,0x80,0x1B
28	Alarm3 State	uchar	1	0x41,0x80,0x1C
29	Alarm3 Logic	uchar	1	0x41,0x80,0x1D
30	Alarm3 Assignment	uchar	1	0x41,0x80,0x1E
31	Alarm3 Simulate Status	uchar	1	0x41,0x80,0x1F
	Relay 4			
32	Alarm4 Type	uchar	1	0x41,0x80,0x20
33	Alarm4 State	uchar	1	0x41,0x80,0x21
34	Alarm4 Logic	uchar	1	0x41,0x80,0x22
35	Alarm4 Assignment	uchar	1	0x41,0x80,0x23
36	Alarm4 Simulate Status	uchar	1	0x41,0x80,0x24

Table 12-7: Alarm Types

Alarm type code	Alarm type
0	Set Point Alarm
1	Interval Timer
2	TPC (Duty Cycle)
3	Bleed Alarm
4	Feed Alarm
5	Setpoint Alarm + Delay Timer
6	Date and Time Timer
7	Totalizer Timer

Table 12-7: Alarm Types (continued)

Alarm type code	Alarm type
8	Fault Alarm
9	No Alarm Assigned to Relay

Table 12-8: Alarm States

0	Off
1	On

Table 12-9: Alarm Logic

Code	Logic
0	High Alarm
1	Low Alarm
2	USP Alarm (Contacting Conductivity only)

Table 12-10: Alarm Simulation

Code	State
0	Off
1	De-Energize
2	Energize

Table 12-11: Alarm Assignment Codes

Sensor 1	Sensor 2	Variable assigned
1	41	Process variable
2	42	Temperature
4	44	Amperometric sensor current
7	47	Millivolt input
9	49	Glass electrode impedance
11	51	Reference electrode impedance
14	54	Raw conductivity
15	55	Raw resistivity
16	56	Turbidity
18	58	Flow velocity
19	59	Totalized flow
33	73	Free ions

Dual Sensor and Main Board Assignments	
0	Main board temperature
201	Conductivity ratio

Dual Sensor and Main Board Assignments	
202	% Rejection (Conductivity)
203	% Passage (Conductivity)
204	Calculated pH (Conductivity)
205	Flow ratio
206	Percent flow ratio
207	Flow recovery
208	Flow difference
209	Totalized flow difference

Relay Modules provide the alarm type, state, logic, assignment, and simulation status as shown in [Table 12-3](#) to [Table 12-10](#).

12.4.3 Transmitter diagnostic bits

The Rosemount 56 transmits diagnostic bits associated with main board and signal board faults and warnings, as well as faults and warning specific to the sensors used to make the various measurements. These bits are shown organized by main board, signal board, and measurement with an explanation of the fault or warning in [Alarm Assignment Codes](#) to [Signal board diagnostic bits](#).

Main board faults 16

Alert

Change in diagnostic data

Cause

A diagnostic bit has changed state.

24

Alert

Main Board CPU Error

Cause

The main board software is corrupted.

Recommended actions

1. Try to reset the transmitter by turning the power off then on again.
2. Call the factory. The main board must be replaced.

25

Alert

Main Board User Data Error

Cause

The main board user EEPROM data is corrupted.

Recommended actions

1. Try to reset the transmitter by turning the power off then on again.
2. Reset the transmitter to factory default settings. Go to main menu and select Reset. Re-enter user settings and repeat calibration.

26

Alert

Main Board Factory Data Error

Cause

The main board factory EEPROM data is corrupted.

Recommended actions

1. Try to reset the transmitter by turning the power off then on again.
2. Call the factory. The main board must be replaced (at the factory).

27

Alert

Main Board Wrong Power Supply

Cause

The existing power supply is incorrect for the turbidity sensor.

Recommended actions

Replace power supply.

Main board warnings

33

Alert

Unknown power supply

Cause

The main board software cannot identify the power supply.

Recommended actions

1. Check the ribbon cable connections between the power supply board and main board.
2. Check the ribbon cable for damage.
3. Consult the factory.

34

Alert

Line frequency unknown

Cause

The transmitter has detected an AC power source, but the frequency is not 50 Hz or 60 Hz.

Recommended actions

1. Check the ribbon cable connections between the power supply board and main board.
2. Check the main frequency.

35

Alert

Main board factory call

Cause

The transmitter was not calibrated at the factory.

Recommended actions

1. Try to reset the transmitter by turning the power off then on again.
2. Call the factory.

36

Alert

Keypad error

Cause

The transmitter has detected shorted contacts in at least one key.

Recommended actions

Call the factory.

37

Alert

Overheating LCD warning

Cause

High ambient temperature and high temperature inside the transmitter is causing the LCD to overheat, reducing the operating life of the display. At 131 °F (55 °C), transmitter automatically begins reducing display brightness. At 172 °F (78 °C) transmitter turns off the display and stops storing data in the flash drive (if one is installed). At 185 °F (85 °C) transmitter turns off the analog current outputs. At 194 °F (90 °C) transmitter turns off the relays.

As the temperature cools, the functions are restored.

Recommended actions

To prevent shutdown of the display and loss of other transmitter functions, move the transmitter to a cooler place.

38

Alert

Excess output current

Cause

One or more analog outputs are drawing too much current, and all outputs have been shut down. The transmitter will check the current every 30 seconds and will return the outputs to normal operation once the current drops below the shutdown limit.

Recommended actions

Check analog output wiring. A short from the positive terminal to ground will cause excessive current to flow.

Even if only one output is shorted, all four outputs will be shut down. If no wiring problems are found, the main board has been damaged and must be replaced.

Signal board diagnostic bits 40/72

Alert

SN 1/2 Board Unknown (Fault)

Cause

The transmitter automatically recognizes the sensor board on power up. Sensor board unknown implies the sensor board is new and not supported or there is a bad connection between the sensor board and the main board.

Recommended actions

1. Check ribbon cable connections at the main board and sensor board.
2. Inspect ribbon cable for damage and replace if necessary.
3. Replace sensor board.

41/73

Alert

SN 1/2 HW SW Mismatch error (Fault)

Cause

The main board software does not match the sensor board software.

Recommended actions

1. Check ribbon cable connections at the main board and sensor board.
2. Inspect ribbon cable for damage and replace if necessary.
3. Replace sensor board.

42/74

Alert

SN ½ Incompatible Error (Fault)

Cause

The sensor board software is not supported by the main board. Either the sensor board software is too old, or the main board software is too old.

Recommended actions

1. Replace the main board with one compatible with the sensor board.
2. Call the factory for assistance. The main board must be replaced at the factory.

43/75

Alert

SN 1/2 Not Detected

Cause

The sensor board is no longer being detected.

Recommended actions

1. Check ribbon cable connections at the main board and sensor board.
2. Inspect the ribbon cable for damage and replace if necessary.
3. Replace the sensor board.

44/76

Alert

SN 1/2 Not Communicating (Fault)

Cause

The transmitter automatically recognizes the sensor board on power up. Sensor not communicating implies there is a bad connection between the sensor board and the main board or there is a bad component on the sensor board.

Recommended actions

1. Check ribbon cable connections at the main board and sensor board.
2. Inspect the ribbon cable for damage and replace if necessary.
3. Replace the sensor board.

45/77

Alert

SN 1/2 CPU error (Fault)

Cause

The sensor board software is corrupted.

Recommended actions

1. Try to reset the transmitter by turning the power off then on again.
2. If cycling the power does not help, replace the sensor board.

46/78

Alert

SN 1/2 Factory Data Error (Fault)

Cause

The factory-entered EEPROM data on the sensor board is corrupted.

Recommended actions

1. Try to reset the transmitter by turning the power off then on again.
2. Replace the sensor board.

47/79

Alert

SN 1/2 ADC Error (Fault)

Cause

There is a bad hardware component on the sensor board.

Recommended actions

Replace the sensor board.

50/82

Alert

SN 1/2 Hardware Error (Fault)

Cause

Hardware error means there is a missing or bad hardware component on the sensor board.

Recommended actions

Replace the sensor board.

54/86

Alert

SN 1/2 User Data Error (Fault)

Cause

The user-entered EEPROM data on the sensor board is corrupted.

Recommended actions

1. Try to reset the transmitter by turning the power off then on again.
2. Replace the sensor board.

55/87

Alert

SN 1/2 EEPROM Write Error (Fault)

Cause

There is a bad CPU on the sensor board.

Recommended actions

1. Try to reset the transmitter by turning the power off then on again.
2. Replace the sensor board.

104/136

Alert

SN 1/2 Need Factory Cal (Warning)

Cause

The sensor board was not calibrated at the factory.

Recommended actions

Call the factory.

48/80

Alert

SN 1/2 RTD Open (Fault)

Cause

The temperature measuring circuit is open. The RTD is improperly wired or the RTD IN or RTD RTN are broken.

Recommended actions

1. Check RTD wiring connections.
2. Check RTD for open or short circuits.

49/81

Alert

SN 1/2 RTD Out Of Range (Fault)

Cause

The resistance of the temperature sensing element (RTD) is too large or too small. The sensor is wired improperly, or the temperature sensor is not recognized by the sensor board.

Recommended actions

1. Check sensor wiring.
2. Check that the temperature sensing element is compatible with the transmitter.
3. It must be a PT100 or PT1000 RTD or a 22k NTC thermistor.

105/137 pH and Amperometric Measurements

Alert

SN 1/2 Temperature High (Warning)

Cause

The measured temperature is greater than 311 °F (155 °C).

Recommended actions

1. Check wiring.
2. Disconnect the sensor and check the resistance between the RTD in and RTD return wires. It should be about 110 ohm at room temperature.
3. Replace the sensor if the RTD has failed.

105/137 Contacting Conductivity Measurements

Alert

SN 1/2 Temperature High (Warning)

Cause

The measured temperature is greater than 572 °F (300 °C).

Recommended actions

1. Check wiring.
2. Disconnect sensor and check resistance between RTD in and RTD return wires. It should be about 1100 ohm at room temperature.
3. Replace sensor if RTD has failed.

105/137 Toroidal Conductivity Measurements

Alert

SN 1/2 Temperature High (Warning)

Cause

The measured temperature is greater than 392 °F (200 °C).

Recommended actions

1. Check wiring.
2. Disconnect sensor and check resistance between RTD in and RTD return wires. It should be about 110 ohm at room temperature.
3. Replace sensor if RTD has failed.

106/138 pH and Amperometric Measurements

Alert

SN 1/2 Temperature Low (Warning)

Cause

The measured temperature is less than -4 °F (-20 °C).

Recommended actions

1. Check wiring.
2. Disconnect the sensor and check the resistance between the RTD in and RTD return wires. It should be about 110 ohm at room temperature.
3. Replace the sensor if the RTD has failed.

106/138 Contacting and Toroidal Conductivity Measurements

Alert

SN 1/2 Temperature Low (Warning)

Cause

The measured temperature is less than -40 °F (-40 °C).

Recommended actions

1. Check wiring.
2. Disconnect the sensor and check the resistance between the RTD in and RTD return wires. It should be about 110 ohm at room temperature.
3. Replace the sensor if the RTD has failed.

107/139

Alert

SN 1/2 RTD Sense Line Open (Warning)

Cause

The transmitter uses the sense line to correct for the resistance of the RTD leads and for changes in the lead wire resistance caused by variations in ambient temperature.

Recommended actions

1. Check wiring.
2. Disconnect the sensor and check for continuity between the RTD return and RTD sense leads at the sensor.
3. If sensor has failed, use a wire jumper to connect the RTD sense and return terminals.
4. Replace the sensor.

51/83

Alert

SN 1/2 Ref Z Too High (Fault)

Cause

The impedance of the reference junction is too high.

Recommended actions

1. Confirm that the sensor is fully immersed in the process liquid.
2. High reference impedance implies the reference junction is fouled or depleted. Replace the sensor.
3. Some sensors are designed to have high reference impedance. If this is the case, change the reference impedance setting (in the measurement menu) to high.

52/84

Alert

SN 1/2 Glass Z Too High (Fault)

Cause

The sensing element in a pH sensor is a thin glass membrane. Normally, the impedance of the membrane is 80 – 100 megohm. As the glass ages, impedance increases. A large increase in impedance implies the sensor is near the end of its useful life.

Certain ion selective electrodes (fluoride, ammonia, and ammonium) also have high impedance sensing elements.

Recommended actions

1. Confirm that the sensor is fully immersed in the process liquid.
2. If sensor performance in buffers and the process is acceptable, increase the impedance limit.
3. Replace the sensor.

53/85

Alert

SN 1/2 Broken Glass Fault (Fault)

Cause

The sensing element in a pH sensor is a thin glass membrane. In a good sensor, the glass impedance is very high. If the glass bulb breaks or cracks, the impedance drops to a very low value, and the broken glass fault appears. Certain ion selective electrodes (fluoride, ammonia, and ammonium) also have high impedance sensing elements.

Recommended actions

1. Inspect the sensor for obvious damage.
2. Check the sensor in buffers. If the sensor does not respond to pH changes, the glass is broken.
3. Replace the sensor.

108/140

Alert

SN 1/2 Out Of Range pH Brd (Warning)

Cause

The pH input is outside the range -750 mV to +750 mV or the ORP or ISE input is outside the range -1500 mV to +1500 mV.

Recommended actions

1. Check sensor wiring.
2. Replace sensor.

111/143

Alert

SN 1/2 No Solution Gnd (Warning)

Cause

The sensor is not properly wired.

Recommended actions

Check wiring.

115/147

Alert

SN 1/2 Broken Glass Disabled (Warning)

Cause

The impedance of the sensing glass in a pH sensor is a strong function of temperature. For the impedance to be a useful indicator that the sensing glass is cracked or broken, it must be corrected for temperature.

If the process temperature exceeds the correction cut-off temperature, the broken glass fault is automatically disabled. The transmitter recalculates the cut-off temperature every time the sensor is calibrated. The cutoff temperature is about 239 °F (115 °C).

109/141 Contacting Conductivity Measurements

Alert

SN 1/2 Out Of Range Cont/Tor Brd

Cause

The raw conductance is greater than 1 S.

Recommended actions

1. Check sensor wiring.
2. Check sensor cleanliness.
3. Check the sensor electrodes for shorts.

109/141 Toroidal Conductivity Measurements

Alert

SN 1/2 Out Of Range Cont/Tor Brd

Cause

The raw conductance is greater than 2 S.

Recommended actions

1. Check sensor wiring.
2. Check sensor electrodes for shorts.

112/144 Contacting Conductivity Measurements

Alert

SN 1/2 -ve Rdng Cont/Tor Brd (Warning) (Negative conductivity reading)

Cause

Negative Reading: During zero calibration, the transmitter makes a correction for the conductance equivalent of the cable capacitance. If the difference between the measured conductance and the zero correction is less than -2 uS, the negative reading warning appears.

Recommended actions

1. Repeat zero calibration. Be sure the sensor is completely dry.
2. Confirm that the sensor is completely submerged in the process liquid.

112/144 Toroidal Conductivity Measurements

Alert

SN 1/2 -ve Rdng Cont/Tor Brd (Warning) (Negative conductivity reading)

Cause

Negative Reading:

During zero calibration, the transmitter makes a correction for small offsets in the signal that exist even when the conductance is zero. If the difference between the measured conductance and the zero correction is less than -50 uS, the negative reading warning appears.

Recommended actions

1. Repeat zero calibration. Be sure the sensor is completely dry.
2. Confirm that the sensor is completely submerged in the process liquid.

113/145

Alert

SN 1/2 Out Of Range (Warning)

Cause

The calculated concentration or temperature is out of range.

Recommended actions

1. NaOH: 0 – 12.00%, 0 - 100 °C.
2. HCl: 0 – 15.00%, 0 - 65 °C.
3. H₂SO₄ (low): 0 – 25.00%, -1 - 99 °C.
4. H₂SO₄ (high): 96.0 – 99.7%, 4 - 110 °C.
5. NaCl: 0 – 20.00%, 0 - 100 °C.
6. Salinity: 2 – 42 part per thousand, -2 - 35 °C.

110/142

Alert

SN 1/2 -ve Rdng Amp/Oxy Brd (Warning) (Negative amperometric reading)

Cause

The transmitter subtracts the zero current (the current generated by the sensor when no analyte is present) from the measured current before converting the result into a concentration value. A negative reading implies the zero step was done before the sensor reached a stable zero current.

Recommended actions

Repeat the zero calibration. It may require several hours or as long as overnight for the zero current to stabilize.

114/145

Alert

SN 1/2 Pressure Sensor Broken (Warning)

Cause

The pressure sensor on the oxygen sensor board has failed, or it is not installed, or it is installed backwards.

Recommended actions

Replace the sensor board.

117/149

Alert

SN 1/2 No Flow Detected (Warning)

Cause

The transmitter has sensed no flow for at least ten seconds.

Recommended actions

1. Check that the flow exceeds the minimum flow recommended for the sensor.

2. Check wiring.
3. Check the sensor.

118/150**Alert**

SN 1/2 -ve Current (Warning) (Negative 4-20 mA input current)

Cause

The input current from the device is less than -0.1 mA.

Recommended actions

1. The polarity is wrong. Reverse wiring.
2. Check the current source.

119/151**Alert**

SN 1/2 Excessive Current (Warning)

Cause

The input current from the device is greater than 22.00 mA.

Recommended actions

1. Check wiring.
2. Check the current source.

120/152**Alert**

SN 1/2 Low Current (Warning)

Cause

The input current range has been set to 4-20 mA, and the input current is less than 3.6 mA.

Recommended actions

1. Check the input current range configuration.
2. Check configuration of current source.

27**Alert**

Main Board Wrong Power Supply (Fault)

Cause

The existing power supply is incorrect at the turbidity sensor.

Recommended actions

Replace power supply.

56/88**Alert**

SN 1/2 Lamp Led Fail (Fault)

Cause

The lamp or LED has failed.

Recommended actions

1. Try to reset the transmitter by turning the power off then on again.
2. Replace the sensor.

57/89

Alert

SN ½ Disconnected (Fault)

Cause

The turbidity sensor cable is disconnected at either the sensor or the sensor board.

Recommended actions

1. Confirm that the cable is tightly connected to the sensor receptacle.
 - a) If necessary, completely disconnect the cable and reconnect it.
 - b) Check connectors for cleanliness.
2. Confirm that the cable is tightly connected to the board receptacle.
 - a) If necessary, completely disconnect the cable and reconnect it.
 - b) Check connectors for cleanliness.
3. If needed, clean the connectors.

116/148

Alert

SN 1/2 Weak Lamp (Warning)

Cause

The lamp intensity has decreased below the lower limit. The lamp is aging.

Recommended actions

Replace the lamp.

121/153

Alert

SN 1/2 Needs calibration (Warning)

Cause

The analyzer continuously measures the intensity of the lamp and uses the measured intensity to correct for the effect of lamp drift on measured turbidity. As the lamp ages and its intensity drops, the target intensity is adjusted. Readjusting the target intensity introduces a significant error. To remove the error, the sensor must be recalibrated.

Recommended actions

1. Recalibrate the sensor in 20 NTU standard.
2. Order replacement sensor.

12.5 Installation and wiring

12.5.1 Wire PROFIBUS® cable to PROFIBUS card

This section shows the recommended method of wiring the PROFIBUS cable to the PROFIBUS card of the 56.

Procedure

1. Feed the PROFIBUS cable through a cable gland fitting. Install the cable gland fitting into the enclosure opening on the leftmost side of the enclosure nearest the front of the door hinge.

Note

The power cable should be installed in the leftmost side of the enclosure farthest from the front of the door hinge, as shown in [Figure 12-1](#).

Figure 12-1: Proper Enclosure Opening Locations for Cable Installation

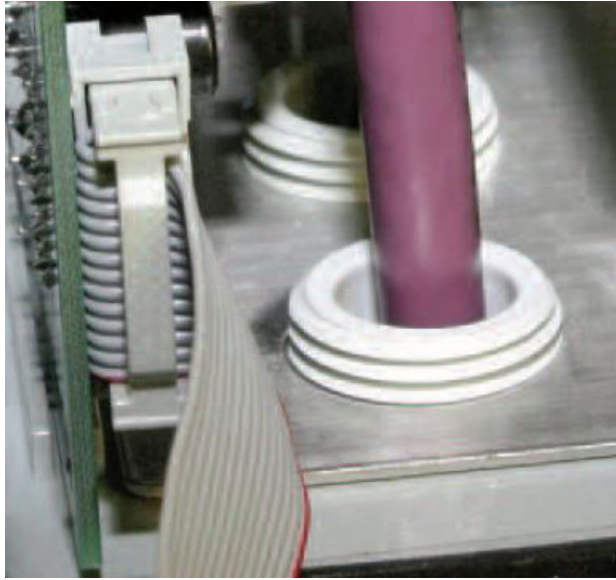


2. Secure the PROFIBUS cable with a cable gland fittings and nut from the outside of the enclosure to ensure a proper seal.

Note

The cable gland fittings (PN 23554-00 - Cable Gland Kit, Quantity 5) do not require the securing nut inside the enclosure to properly install the fitting. Simply thread the fitting into the grounding plate inside the enclosure and tighten.

Figure 12-2: Cable Gland Fittings Secured on Internal Grounding Plate



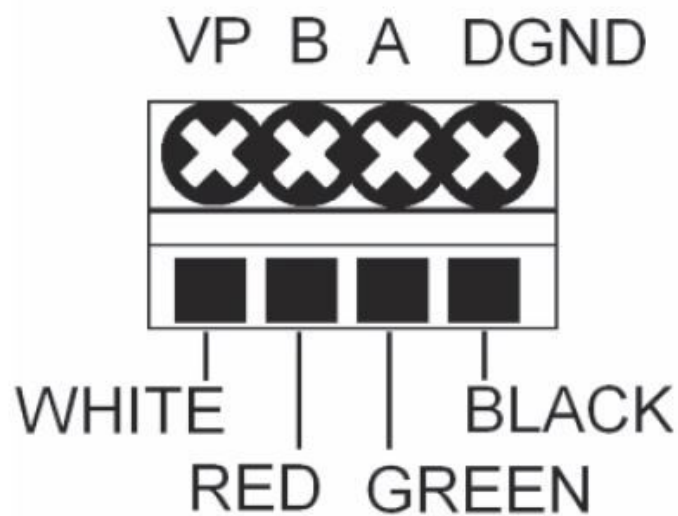
Once the gland fitting is tightly screwed into the enclosure and internal grounding plate, only the external nut needs to be tightened to properly seal the PROFIBUS cable.

3. Remove the 4-lead terminal block which is installed on the PROFIBUS slide-in board. [Figure 12-3](#) shows the 4-lead terminal block installed onto the board.

Figure 12-3: PROFIBUS Board Showing Removable 4-Lead Terminal Block



Figure 12-4: 4-Lead Terminal Block



4. **NOTICE**

Verify the PROFIBUS cable is properly prepared. Unshielded wire leads can lead to poor signal integrity from the PROFIBUS device to the Master.

Wire the two leads of the PROFIBUS cable (red and green) to the A and B positions of the lead removable terminal block.

A #0 Philips head screw driver is required to open and close the terminal posts on the terminal block. The lead positions are labeled on the PROFIBUS card (A and B) to assist in wiring.

For successful communication using standard PROFIBUS cable: The green color lead must be wired to lead position A (RxD/TxD-N). The red color lead must be wired to lead position B (RxD/TxD-P). The VP and DGND (digital ground) positions are used to a power bus terminator if required.

5. After wiring the PROFIBUS cable to the terminal block, slide the wired 4-lead terminal block onto the four pins protruding from PROFIBUS board on the left side.

[Figure 12-5](#) shows the 4-lead terminal block properly wired to the PROFIBUS board and installed onto the board.

Note

The PROFIBUS cable must be directed downwards. The PROFIBUS board can be partially or fully removed to allow easy insertion of the 4-lead terminal block onto the PROFIBUS board.

Figure 12-5: Complete PROFIBUS Board Installation with Ribbon Cable Attached



6. Ensure that the 10-lead ribbon cable is properly connected from the PROFIBUS board to the left-most connector of the 3 10-pin shrouded connectors on the right side of the main circuit board.
Once power is wired to the unit (See [Figure 12-5](#)), the PROFIBUS-configured 56 is ready for power up and communication on a PROFIBUS network.

13 Maintenance

13.1 Maintenance

This section gives general procedures for routine maintenance of the Rosemount 56 transmitter. The transmitter needs almost no routine maintenance. Sensors require periodic inspection and cleaning. The calibration of the transmitter-sensor combination should be checked regularly and the loop recalibrated if necessary.

⚠ WARNING

Risk of Electrical Shock

Electrical installation must be in accordance with the National Electrical Code (ANSI/NFPA-70) and/or any other applicable national or local codes.

⚠ WARNING

Always power off the transmitter or disconnect the transmitter from the main power supply before opening the enclosure in a hazardous area.

13.2 Transmitter maintenance

Periodically clean the transmitter window and housing as needed with a cloth dampened with water. Do not use abrasives or cleaning solutions.

13.3 USB port

The USB communications port is protected by a NEMA®-rated seal and cover.

⚠ WARNING

Do not remove the cover during cleaning.

Never remove the USB port cover when the instrument is operated in a hazardous rated area.

A HART® and Device Variables

Table A-1: pH device variables

Device variable name	Assignable to dynamic variables	Variable range
Sensor 1 / 2 Measurement Type		
pH (1)	PV, SV, TV or QV	0 to 14 pH
ORP (2), Redox (3)	PV, SV, TV or QV	-1500 to 1500 mV
Ammonia (4), Fluoride (5), Custom ISE (6)	PV, SV, TV or QV	0 to 1000 ppm
		0 to 1000 ppb
		0 to 1000 mg/L
		0 to 1000 µg/L
		0 to 100 %
Measurement Parameters		
Sensor 1 / 2 Temperature	PV, SV, TV or QV	-15 to 200 °C
		5 to 360 °F
Sensor 1 / 2 Temperature resistance	TV or QV	0 to 100000 ohm
Sensor 1 / 2 mV input	PV, SV, TV or QV	-750 to 750 mV
Sensor 1 / 2 Glass impedance	PV, SV, TV or QV	0 to 2000 M
Sensor 1 / 2 Sensor impedance	PV, SV, TV or QV	0 to 2000 M
Sensor 1 / 2 Reference impedance	PV, SV, TV or QV	0 to 10000 k

Table A-2: Contacting and Toroidal Conductivity Device Variables

Device Variable Name	Assignable to Dynamic Variables	Variable Range
Sensor 1 / 2 Measurement Type		
Conductivity (7)	PV, SV, TV or QV	0 to 2000000 µS/cm
Resistivity (8)	PV, SV, TV or QV	0 to 50000000 ohm-cm
Concentration		
NaOH (9)	PV, SV, TV or QV	0 to 12%
HCl (10)	PV, SV, TV or QV	0 to 15%
Low H ₂ SO ₄ (11)	PV, SV, TV or QV	0 to 25%
High H ₂ SO ₄ (12)	PV, SV, TV or QV	96 to 99.7%
NaCl (13)	PV, SV, TV or QV	0 to 25%
Custom Concentration (14)	PV, SV, TV or QV	0 to 1000 ppm
		0 to 1000 mg/L
		0 to 100 g/L

Table A-2: Contacting and Toroidal Conductivity Device Variables (continued)

Device Variable Name	Assignable to Dynamic Variables	Variable Range
Sensor 1 / 2 Measurement Type		
		0 to 100%
		0 to 1000 None
TDS (15)	PV, SV, TV or QV	0 to 10000 ppm
Measurement Parameters		
Sensor 1 / 2 Temperature	PV, SV, TV or QV	-15 to 200 °C
		5 to 360 °F
Sensor 1 / 2 Temperature resistance	TV or QV	0 to 100000 ohm
Sensor 1 / 2 Conductance	TV or QV	0 to 2000000 µS
Sensor 1 / 2 Input resistance	TV or QV	0 to 500 k
Sensor 1 / 2 Raw Conductivity	PV, SV, TV or QV	0 to 2000000 µS/cm
Sensor 1 / 2 Raw Resistivity	PV, SV, TV or QV	0 to 50000000 ohm-cm
Dual Conductivity Measurements		
Conductivity Ratio	PV, SV, TV or QV	0 to 10000
% Rejection	PV, SV, TV or QV	0 to 100%
% Passage	PV, SV, TV or QV	0 to 100%
Calculated pH (Contacting only)	PV, SV, TV or QV	0 to 14 pH

Table A-3: Turbidity Device Variables

Device Variable Name	Assignable to Dynamic Variables	Variable Range
Sensor 1 / 2 Measurement Type		
Turbidity (25)	PV, SV, TV or QV	0 to 200 FNU
		0 to 200 FTU
		0 to 200 NTU
TSS (26)	PV, SV, TV or QV	0 to 1000 ppm
		0 to 1000 mg/L
		0 to 1000 None
Measurement Parameters		
Sensor 1 / 2 Lamp Voltage	TV or QV	0 to 2000 mV

Table A-4: Amperometric Device Variables

Device Variable Name	Assignable to Dynamic Variables	Variable Range
Sensor 1 / 2 Measurement Type		
Salinity (16)	PV, SV, TV or QV	0 to 36 ppt

Table A-4: Amperometric Device Variables (continued)

Device Variable Name	Assignable to Dynamic Variables	Variable Range
Oxygen (17)	PV, SV, TV or QV	0 to 100 ppm
		0 to 1000 ppb
		0 to 100 mg/L
		0 to 1000 µg/L
		0 to 300% Saturation
		0 to 760 mmHg
		0 to 30 inHg
		0 to 1 bar
		0 to 1000 mbar
		0 to 100 kPa
		0 to 1 atm
• Ozone (18) • Free Chlorine (19) • pH Independent Free Chlorine (20) • Total Chlorine (21) • Chloramine (22)	PV, SV, TV or QV	0 to 20 ppm
		0 to 1000 ppb
		0 to 20 mg/L
		0 to 1000 µg/L
Measurement Parameters		
Sensor 1 / 2 Temperature	PV, SV, TV or QV	-15 to 200 °C
		5 to 360 °F
Sensor 1 / 2 Temperature resistance	TV or QV	0 to 100000
Sensor 1 / 2 Sensor input current	PV, SV, TV or QV	0 to 100000 nA
Sensor 1 / 2 Polarizing voltage	TV or QV	-1000 to 1000 mV
Sensor 1 / 2 Pressure	TV or QV	0 to 5000 mmHg
		0 to 200 inHg
		0 to 7 bar
		0 to 7000 mbar
		0 to 700 kPa
		0 to 7 atm

Table A-5: Flow / mA Input Device Variables

Device Variable Name	Assignable to Dynamic Variables	Variable Range
Sensor 1 / 2 Measurement Type		
Flow Rate (23)	PV, SV, TV or QV	0 to 100000 gal/min

Table A-5: Flow / mA Input Device Variables (continued)

Device Variable Name	Assignable to Dynamic Variables	Variable Range
		0 to 100000 gal/hr
		0 to 100000 cu.ft/min
		0 to 100000 cu.ft/hr
		0 to 100000 liter/min
		0 to 100000 liter/hr
		0 to 100000 m3/hr
Scaled mA Input (24)	PV, SV, TV or QV	As per Configuration
	Input Type:	Units:
	Temperature	°C, °F
	Pressure	• mmHg • inHg • bar • mbar • kPa • atm
	Flow	• gal/min • gal/hr • cu.ft./hr • cu.ft./min • liter/hr • m3/hr
	Other	• ft./sec • m/sec • None
	pH/ORP	• pH • mV
	Conductivity	• μS/cm • mS/cm
	Resistivity	• M -cm • K -cm
	Concentration	• % • parts per thousand • ppm • ppb

Table A-5: Flow / mA Input Device Variables (continued)

Device Variable Name	Assignable to Dynamic Variables	Variable Range
	Weight per Volume	• mg/L • µg/L • g/L
	Turbidity	• FNU • FTU • NTU
Measurement Parameters		
Sensor 1 / 2 Frequency	TV or QV	0 to 1000 Hz
Sensor 1 / 2 Velocity	PV, SV, TV or QV	0 to 10 ft/sec
		0 to 10 m/sec
Sensor 1 / 2 Totalizer	PV, SV, TV or QV	0 to 1000000 gal
		0 to 1000000 liter
		0 to 1000000 m3
		0 to 1000000 cu.ft
Sensor 1 / 2 mA input	TV or QV	3.6 to 22 mA
Dual Flow Measurements		
Flow ratio	PV, SV, TV or QV	0 to 1000 NA
% Flow ratio	PV, SV, TV or QV	0 to 100%
% Recovery	PV, SV, TV or QV	0 to 100% Recovery
Flow difference	PV, SV, TV or QV	-10000 to 10000 gal/min
		-10000 to 10000 gal/hr
		-10000 to 10000 cu.ft/min
		-10000 to 10000 cu.ft/hr
		-10000 to 10000 liter/min
		-10000 to 10000 liter/hr
		-10000 to 10000 m3/hr
Flow total difference	PV, SV, TV or QV	-100000 to 100000 gal
		-100000 to 100000 liter
		-100000 to 100000 m3
		-100000 to 100000 cu.ft

B HART® Status Bits

Table B-1: Common Transmitter Status Bits

Byte	Bit	Message	Severity	Device Status Bits Set
2	2	Sensor 1 Hardware Error	Error	Device Status: bit 7, 3
2	6	Sensor 1 User Data Error	Error	Device Status: bit 7, 3
2	7	Sensor 1 EEPROM Write Error	Error	Device Status: bit 7, 3
3	0	Sensor 1 Sensor Board Unknown	Error	Device Status: bit 7, 3
3	1	Sensor 1 Hardware/Software Mismatch	Error	Device Status: bit 7, 3
3	2	Sensor 1 Sensor Incompatible	Error	Device Status: bit 7, 3
3	3	Sensor 1 Sensor Not Detected	Error	Device Status: bit 7, 3
3	4	Sensor 1 Sensor not communicating	Error	Device Status: bit 7, 3
3	5	Sensor 1 CPU Error	Error	Device Status: bit 7, 3
3	6	Sensor 1 Factory Data Error	Error	Device Status: bit 7, 3
3	7	Sensor 1 ADC Error	Error	Device Status: bit 7, 3
5	2	Sensor 2 Hardware Error	Error	Device Status: bit 7, 3
5	6	Sensor 2 User Data Error	Error	Device Status: bit 7, 3

Table B-1: Common Transmitter Status Bits (continued)

Byte	Bit	Message	Severity	Device Status Bits Set
5	7	Sensor 2 EEPROM Write Error	Error	Device Status: bit 7, 3
6	0	Sensor 2 Sensor Board Unknown	Error	Device Status: bit 7, 3
6	1	Sensor 2 Hardware/Software Mismatch	Error	Device Status: bit 7, 3
6	2	Sensor 2 Sensor Incompatible	Error	Device Status: bit 7, 3
6	3	Sensor 2 Sensor Not Detected	Error	Device Status: bit 7, 3
6	4	Sensor 2 Sensor not communicating	Error	Device Status: bit 7, 3
6	5	Sensor 2 CPU Error	Error	Device Status: bit 7, 3
6	6	Sensor 2 Factory Data Error	Error	Device Status: bit 7, 3
6	7	Sensor 2 ADC Error	Error	Device Status: bit 7, 3
7	0	Maintenance required	Warning	Extended Device bit 0
7	1	Device variable alert	Warning	Extended Device bit 1
9	0	Simulation active	Mode	N/A
9	1	Non-volatile memory defect	Error	N/A
9	2	Volatile memory defect	Error	N/A

Table B-1: Common Transmitter Status Bits (continued)

Byte	Bit	Message	Severity	Device Status Bits Set
9	3	Watchdog reset executed	N/A	N/A
9	4	Voltage condition out of range	N/A	N/A
9	5	Environmental condition out of range	N/A	N/A
9	6	Electric defect	Error	N/A
11	0	Analog channel-2 saturated	Warning	N/A
11	1	Analog channel-3 saturated	Warning	N/A
11	2	Analog channel-4 saturated	Warning	N/A
14	0	Analog channel-2 fixed	Mode	N/A
14	1	Analog channel-3 fixed	Mode	
14	2	Analog channel-4 fixed	Mode	
21	0	Main board CPU Error	Error	Device Status: bit 7, 3
21	1	User Data Error	Error	Device Status: bit 7, 3
21	2	Factory Data Error	Error	Device Status: bit 7, 3
22	1	Unknown power supply	Warning	Device Status: bit 4
22	2	Unknown line frequency	Warning	Device Status: bit 4

Table B-1: Common Transmitter Status Bits *(continued)*

Byte	Bit	Message	Severity	Device Status Bits Set
22	3	Factory calibration error	Warning	Device Status: bit 4
22	4	Keypad error	Warning	Device Status: bit 4
22	5	Overheating LCD	Warning	Device Status: bit 4
22	6	Excess output current	Warning	Device Status: bit 4
23	0	Relay-1 Energized	Mode	N/A
23	1	Relay-2 Energized	Mode	
23	2	Relay-3 Energized	Mode	
23	3	Relay-4 Energized	Mode	
24	0	Sensor 1 Zeroing in Progress	Mode	Device Status: bit 4
24	1	Sensor 1 Calibration in Progress	Mode	Device Status: bit 4
24	2	Sensor 1 Standardization in Progress	Mode	Device Status: bit 4
24	3	Sensor 1 Stabilization in Progress	Mode	Device Status: bit 4
25	0	Sensor 2 Zeroing in Progress	Mode	Device Status: bit 4
25	1	Sensor 2 Calibration in Progress	Mode	Device Status: bit 4
25	2	Sensor 2 Standardization in Progress	Mode	Device Status: bit 4

Table B-1: Common Transmitter Status Bits (continued)

Byte	Bit	Message	Severity	Device Status Bits Set
25	3	Sensor 2 Stabilization in Progress	Mode	Device Status: bit 4

Table B-2: Temperature Status Bits

Byte	Bit	Message	Severity	Device Status Bits Set
2	0	Sensor 1 RTD Open	Error	Device Status: bit 7, 3
2	1	Sensor 1 RTD Out Of Range	Error	Device Status: bit 7, 3
5	0	Sensor 2 RTD Open	Error	Device Status: bit 7, 3
5	1	Sensor 2 RTD Out Of Range	Error	Device Status: bit 7, 3
17	1	Sensor 1 Temperature High	Warning	Device Status: bit 4
17	2	Sensor 1 Temperature Low	Warning	Device Status: bit 4
17	3	Sensor 1 RTD Sense Line Open	Warning	Device Status: bit 4
20	1	Sensor 2 Temperature High	Warning	Device Status: bit 4
20	2	Sensor 2 Temperature Low	Warning	Device Status: bit 4
20	3	Sensor 2 RTD Sense Line Open	Warning	Device Status: bit 4

Table B-3: pH Board Status Bits

Byte	Bit	Message	Severity	Device Status Bits Set
2	3	Sensor 1 Reference Impedance Too High	Error	Device Status: bit 7, 3

Table B-3: pH Board Status Bits (continued)

Byte	Bit	Message	Severity	Device Status Bits Set
2	4	Sensor 1 Glass Impedance Too High	Error	Device Status: bit 7, 3
2	5	Sensor 1 Broken Glass	Error	Device Status: bit 7, 3
5	3	Sensor 2 Reference Impedance Too High	Error	Device Status: bit 7, 3
5	4	Sensor 2 Glass Impedance Too High	Error	Device Status: bit 7, 3
5	5	Sensor 2 Broken Glass	Error	Device Status: bit 7, 3
16	3	Sensor 1 Broken Glass Disabled	Warning	Device Status: bit 4
17	7	Sensor 1 No Solution Ground	Warning	Device Status: bit 4
19	3	Sensor 2 Broken Glass Disabled	Warning	Device Status: bit 4
20	7	Sensor 2 No Solution Ground	Warning	Device Status: bit 4
24	6	Sensor 1 Offset Error	Mode	Device Status: bit 4
24	N/A	N/A		Extended Device Status: bit 0
24	7	Sensor 1 Slope Error	Mode	Device Status: bit 4
25	6	Sensor 2 Offset Error	Mode	Device Status: bit 4 Extended Device Status: bit 0
25	7	Sensor 2 Slope Error	Mode	Device Status: bit 4 Extended Device Status: bit 0

Table B-4: Contacting and Toroidal Conductivity Status Bits

Byte	Bit	Message	Severity	Device Status Bits Set
16	0	Sensor 1 Conductivity Negative Reading	Warning	Device Status: bit 4
	1	Sensor 1 Percent Out Of range	Warning	Device Status: bit 4
17	5	Sensor 1 Conductivity Board Out Of Range	Warning	Device Status: bit 4
19	0	Sensor 2 Conductivity Negative Reading	Warning	Device Status: bit 4
	1	Sensor 2 Percent Out Of range	Warning	Device Status: bit 4
20	5	Sensor 2 Conductivity Board Out Of Range	Warning	Device Status: bit 4
24	5	Sensor 1 Zero Error	Mode	Device Status: bit 4 Extended Device Status: bit 0
25	5	Sensor 2 Zero Error	Mode	Device Status: bit 4 Extended Device Status: bit 0

Table B-5: Amperometric Status Bits

Byte	Bit	Message	Severity	Device Status Bits Set
16	2	Sensor 1 Pressure Broken	Warning	Device Status: bit 4
17	6	Sensor 1 Amperometric Board Negative Reading	Warning	Device Status: bit 4
19	2	Sensor 2 Pressure Broken	Warning	Device Status: bit 4

Table B-5: Amperometric Status Bits (continued)

Byte	Bit	Message	Severity	Device Status Bits Set
20	6	Sensor 2 Amperometric Board Negative Reading	Warning	Device Status: bit 4

Table B-6: Flow / mA Input Status Bits

Byte	Bit	Message	Severity	Device Status Bits Set
15	0	Sensor 1 Low Current	Warning	Device Status: bit 4
16	5	Sensor 1 No Flow Detected	Warning	Device Status: bit 4
16	6	Sensor 1 Negative Current	Warning	Device Status: bit 4
16	7	Sensor 1 Excessive Current	Warning	Device Status: bit 4
18	0	Sensor 2 Low Current	Warning	Device Status: bit 4
19	5	Sensor 2 No Flow Detected	Warning	Device Status: bit 4
19	6	Sensor 2 Negative Current	Warning	Device Status: bit 4
19	7	Sensor 2 Excessive Current	Warning	Device Status: bit 4

Table B-7: Turbidity Input Status Bits

Byte	Bit	Message	Severity	Device Status Bits Set
1	0	Sensor 1 Lamp/LED Failed	Error	Device Status: bit 7, 3
1	1	Sensor 1 Disconnected	Error	Device Status: bit 7, 3

Table B-7: Turbidity Input Status Bits *(continued)*

Byte	Bit	Message	Severity	Device Status Bits Set
4	0	Sensor 2 Lamp/LED Failed	Error	Device Status: bit 7, 3
4	1	Sensor 2 Disconnected	Error	Device Status: bit 7, 3
15	1	Sensor 1 Need Calibration	Warning	Device Status: bit 4
18	1	Sensor 2 Need Calibration	Warning	Device Status: bit 4
21	3	Wrong Power Supply	Error	Device Status: bit 7, 3

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