

HAMILTON

Hamilton Transmitter H210X

pH/ORP, COND, DO

Operating Instructions



Hamilton Warranty

Please refer to the General Terms of Sales (GTS).

Important Note

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1 Safety Precautions and Hazards

This chapter provides safety information and electrical safety precautions and hazards about the Hamilton Transmitter H210X.



WARNING! Electrical safety precautions:

- Personnel can be exposed to dangerous voltages during installation and maintenance of the Hamilton Transmitter H210X
- Electrical installation must be in accordance with the National Electrical Code (ANSI/National Fire Protection Agency-70) and/or any other national or local codes.
- Installation shall be in accordance with IEC 60079-14 and applicable national regulations.
- The transmitter is protected throughout by double insulation
- Do not open the transmitter while the circuit is live. Disconnect the main power, wired to separate power source before you service the transmitter.
- Do not open while energized in hazardous locations.
- Make sure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified personnel.
- Keep power supply/signal wiring at least 2 m (6 ft) away from heavy electrical equipment.
- Keep the sensor and output signal wiring separate from loop power wiring.
- Non-metallic cable strain reliefs do not provide grounding between the conduit connections. Use grounding type bushings and jumper wires.
- Make sure that the transmitter is connected and properly grounded through a three-wire power source.
- Install transmitter as specified in the Quick Start Guide and as per the applicable local and national standards. Connect all associated products to the correct electrical and pressure sources.
- The operator is responsible for the configuration and correct use of the transmitter.
- Install all protective equipment covers and safety ground leads after installation.
- Operate the transmitter only when the front panel is in place and fastened.
- Disconnect and lock out the transmitter power before you connect the power supply.



WARNING! Electrostatic discharge hazard:

- The plastic enclosure, except the front panel, can create an electrostatic ignition hazard. The surface resistivity of the non-metallic enclosure materials is greater than $1 \text{ G}\Omega$.
- To prevent electrostatic charge build-up, you must adhere to the following cleaning requirements:
 - > Approved cleaning: Clean the enclosure only with a damp cloth.
 - > Prohibited actions: Do not rub the transmitter surfaces.
 - > Prohibited materials: Do not clean the transmitter with solvents or a dry cloth.

Electrostatic ignition hazard



WARNING! Physical access:

- Unauthorized personnel can potentially cause significant damage to and/or incorrectly configure the transmitter. This could be intentional or unintentional and must be prevented.
- Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access by unauthorized personnel to protect the end users' assets. This applies to all systems used within the facility.



Caution! Only use original spare parts or accessories:

Only use original spare parts or accessories when a replacement or repair is necessary. Tampering or unauthorized substitution of parts can affect the performance of the transmitter and safe operation of your process. Substitution of components may impair explosion protection.



WARNING!

The equipment shall only be installed in locations consistent with the equipment marking.

Enclosure and sealing specifications



Notice: Protection rating limitations:

When you install the device, note the following limitations for the panel-mount gasket:

- Enclosure rating: The enclosure is rated to IP66 and protection classes II and III.
- Gasket limitation: The panel-mount gasket is not tested for IP66.
- Installation requirement: Make sure that the installation environment considers this limitation.

2 Description and Specifications

2.1 Features and Applications

The Hamilton H210X Transmitter is a loop-powered, multi-parameter device which serves industrial, commercial, and municipal applications with the widest range of liquid measurements available for a two-wire liquid transmitter. The transmitter supports continuous measurement of one liquid analytical input. The design supports easy internal access and wiring connections.

Feature	Value
Analytical inputs	• pH/ORP • Resistivity/conductivity • Dissolved oxygen
Large display	The high-contrast LCD display provides live measurement readouts in large digits and shows up to four additional variables or diagnostic parameters.
Digital communication	HART®
Menus	Menu screens for calibrating and programming are simple and intuitive. Plain language prompts and Help screens guide you through the procedures. All menu screens are available in eight languages. The transmitter displays live process values during programming and calibration.
Quick start programming	Popular Quick Start screens appear the first time you turn on the transmitter. The transmitter prompts you to configure the sensor loop in a few quick steps for immediate commissioning.
Help screens	Fault and warning messages include Help screens which provide useful troubleshooting tips. These on-screen instructions are intuitive and easy to use.
Diagnostics	The transmitter continuously monitors itself and the sensor for problems. A display banner on the screen alerts technicians to fault and/or warning conditions.
Languages	• English • French • German • Italian • Spanish • Portuguese • Chinese • Russian
Current outputs	Two 4-20 mA electrically isolated current outputs, giving the ability to transmit the live measurement value and the process temperature reported from the sensor.
Input damping	Automatically enabled to suppress noisy process readings.
Smart-enabled pH	Smart pH capability eliminates field calibration of pH probes through automatic upload of calibration data and history.
Automatic temperature compensation	Most measurements require temperature compensation. The transmitter automatically recognizes Pt100, Pt1000, or 22k NTC resistance temperature detectors (RTDs) built into the sensor.

Technical specifications available on hamiltoncompany.com.

 **Notice:** Electromagnetic interference/radio frequency interference (EMI/RFI) effect Meets all requirements of EN61326. The measured values remain unchanged when using an analog 4–20 mA signal or a digital HART signal with shielded twisted-pair cabling.

 **Notice:** During EMI disturbance, maximum deviation is < 0.006 ppm (6 ppb) for models that measure, dissolved oxygen.

 **Notice:** During EMI disturbance, maximum deviation is < 18% of reading for COND transmitter.

 **Notice:** During EMI disturbance, maximum deviation is < 2.5 pH for pH/ORP transmitter.

Specification	Value
Current output accuracy	±0.05 mA at 25 °C (77 °F)
Terminal connections rating	• Power connector (2 leads): 24–12 AWG wire size • Signal board terminal blocks: 26–16 AWG wire size • Current output connectors (two leads): 24–16 AWG wire size
Weight/shipping weight	0.9 kg (2 lb) / 1.4 kg (3 lb)

2.2 Approvals and Certifications

This chapter provides information about the approvals and certifications issued for the Hamilton Transmitter H210X.

2.2.1 European Directive Information

The latest copy of the EU Declaration of Conformity for the Hamilton Transmitter H210X can be found on the Hamilton Process Analytics website (www.hamiltoncompany.com/process-analytics-sensors).

2.2.2 Europe

Europe: ATEX intrinsically safe

Overview of ATEX intrinsically safe certificates, standards, and markings (Europe)

Europe: ATEX intrinsically safe certificates, standards, and markings	
ATEX Certificate:	SGS25ATEX0097X
Standards:	EN IEC 60079-0:2018 EN 60079-11:2012
Markings:	II 1 G Ex ia IIC T4 Ga (–20°C ≤ Ta ≤ +65°C)

Special Conditions for Safe Use (X)

The plastic enclosure, excluding the front panel, may constitute a potential electrostatic ignition risk and must only be cleaned with a damp cloth.

2.2.3 International**International: IECEx intrinsically safe**

Overview of IECEx intrinsically safe certificates, standards, and markings (International)

International: Intrinsically safe certificates, standards, and markings

Certificate:	IECEX SGS 25.0046X
Standards:	IEC 60079-0:2017 IEC 60079-11:2011
Markings:	Ex ia IIC T4 Ga (-20°C ≤ Ta ≤ +65°C)

Special Conditions for Safe Use (X)

The plastic enclosure, excluding the front panel, may constitute a potential electrostatic ignition risk and must only be cleaned with a damp cloth.

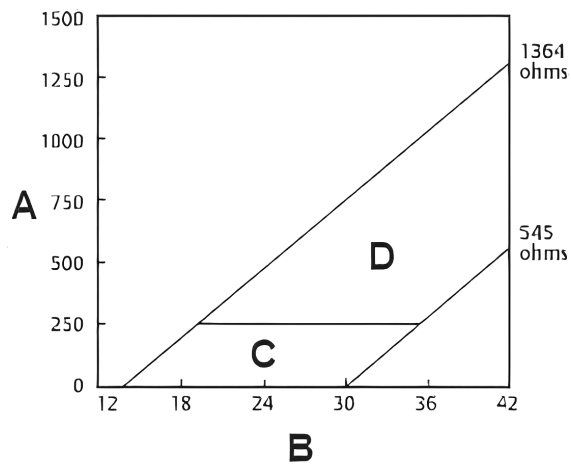
Ex protection and compliance

To maintain safety and certification of the system in hazardous environments, you must adhere to the following requirements:

- Certification and compatibility
 - Regulatory adherence: All conditions described in Certificates SGS25ATEX0097X and IECEx SGS 25.0046X must be adhered to at all times.
 - Operator responsibility: The operator is responsible for making sure that all system components are certified for the applicable hazardous area and are compatible with each other.
- Operational constraints
 - Intrinsically safe circuits: If a sensor or transmitter is connected, even temporarily, to a non-intrinsically safe electrical circuit, the sensor loses its ATEX and IECEx certification.
 - Environmental impact: Do not expose the connection system to direct and intense vapor or dust. Such exposure can cause damage or create safety risks.

Power and load requirements

Supply voltage at the transmitter terminals should be at least 12.7 Vdc. Power supply voltage should cover the voltage drop on the cable plus the external load resistor required for HART® communications (250 Ω minimum). Minimum power supply voltage is 12.7 Vdc. Maximum power supply voltage is 42.4 Vdc (30 Vdc for intrinsically safe operation).



- A Load, ohms
- B Power supply voltage, Vdc, HART option
- C With HART communication
- D Without HART communication

Figure 1: The graph shows the supply voltage required.

Analog outputs

Two-wire loop powered (Output 1 only). Two 4-20 mA electrically isolated current outputs (Output 2 must be externally powered). Superimposed HART digital signal on Output 1. Fully scalable over the operating range of the sensor.

3 Installation

3.1 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 contact Hamilton Technical Support via email (contact.pa.ch@hamilton.ch) or phone (+41-58-610-10-10).

Scope of Delivery

The H210X transmitter is supplied with the components listed below. Check the package contents for completeness and visible damage before installation.

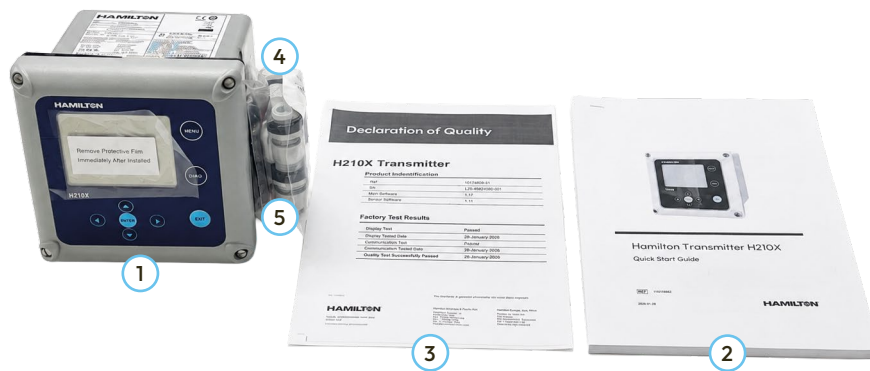


Figure 2: Scope of delivery overview

Position	Description	REF
1	Hamilton H210X Transmitter fitted with Gasket	10174809-xx
2	H210X Quick Start Guide	111011882
3	Declaration of Quality	—
4	Cable glands	—
5	4x Blind plugs, 2x Jumper wires, 4x O-rings and Panel mount kit	—

The position numbers correspond to the items shown in the package-content illustration.

If any component is missing or damaged, retain the original packaging and contact your Hamilton representative or supplier before installing the transmitter.

3.2 General Installation Information



Notice: Mounting options: The transmitter supports panel, pipe, and surface mounting. Refer to the applicable mounting instructions and hardware requirements.

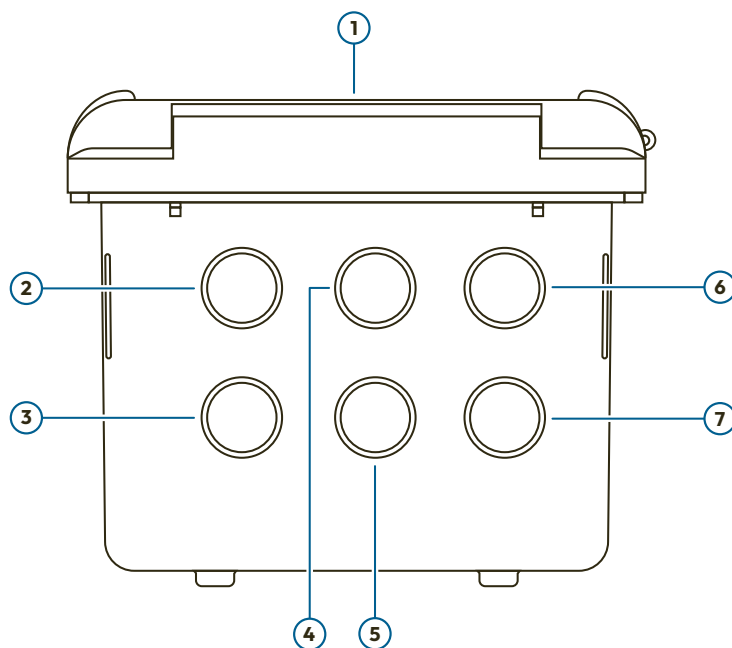
1. Install the transmitter with a sun shield or out of direct sunlight and areas with extreme temperatures.
2. Install the system in an area where vibrations and electromagnetic and radio frequency interference are minimized or absent.
3. Keep the transmitter and sensor wiring at least 0.30 m (1 ft) from high voltage conductors. Ensure there is easy access to the transmitter and sample conditioning system.
4. The transmitter case has six 12.7 mm (½ in.) conduit openings. Use separate conduit openings for the power/output cable, the sensor cable, and the other sensor cable as needed.
5. Use weathertight cable glands to keep moisture out of the transmitter. If using a conduit, plug and seal the connections at the transmitter housing to prevent moisture from getting inside the instrument.
6. Install cable gland fittings and plugs as needed to properly seal the transmitter on all six enclosure openings.

3.3 Preparing Conduit Openings

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



Notice: Hamilton fits four of the openings with plugs upon shipment.



- 1 Front panel/keypad
- 2 Spare opening
- 3 Spare opening
- 4 Sensor 1 cable
- 5 4-20 mA/HART®
- 6 Spare opening
- 7 Spare opening

Figure 3: Conduit openings



Notice: Always use proper cable gland fittings and plugs for wire and cable installations.

Conduit openings accept 13 mm (½ in.) conduit fittings or PG13.5 cable glands. To keep the case watertight, block unused openings with Type 4X or IP66 conduit plugs.

To maintain ingress protection for outdoor use, seal unused conduit holes with suitable 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.

3.4 Mounting

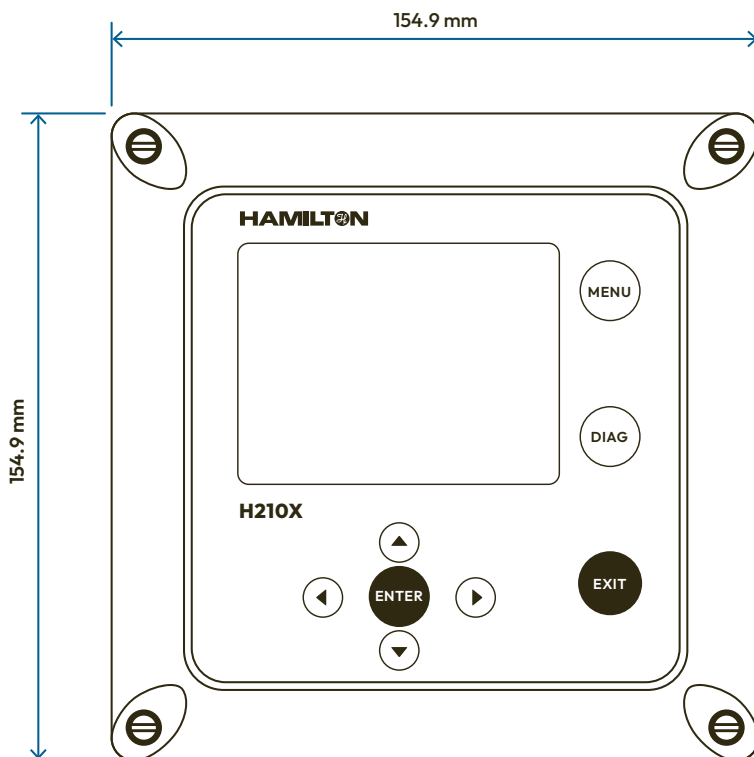
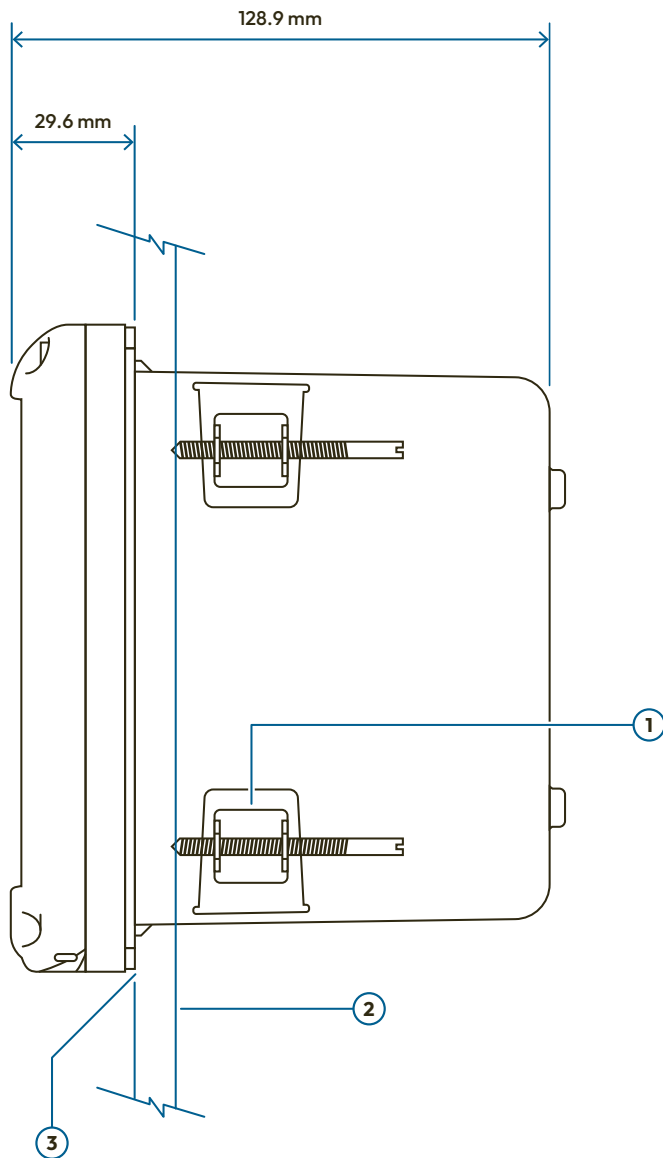
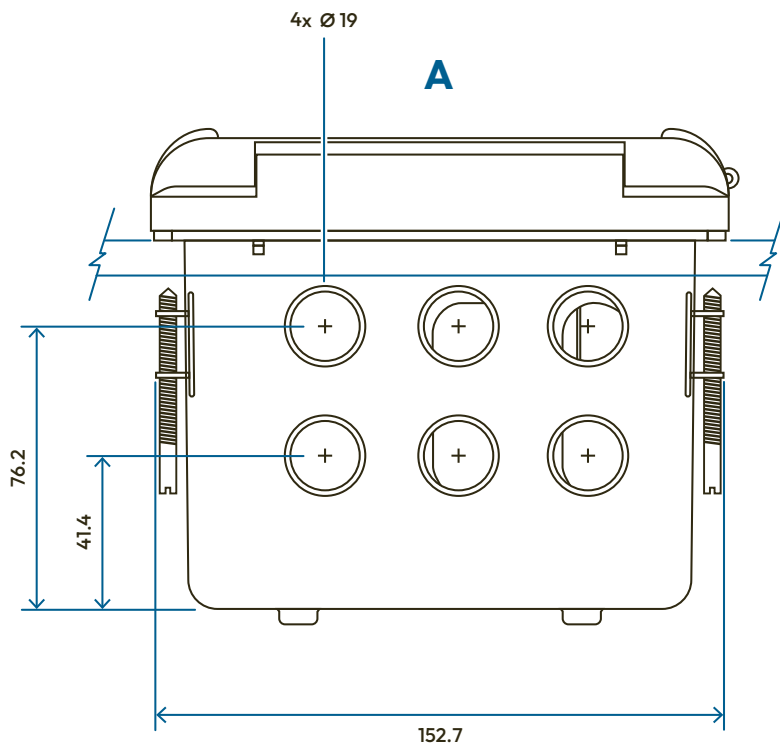


Figure 4: Panel mount front



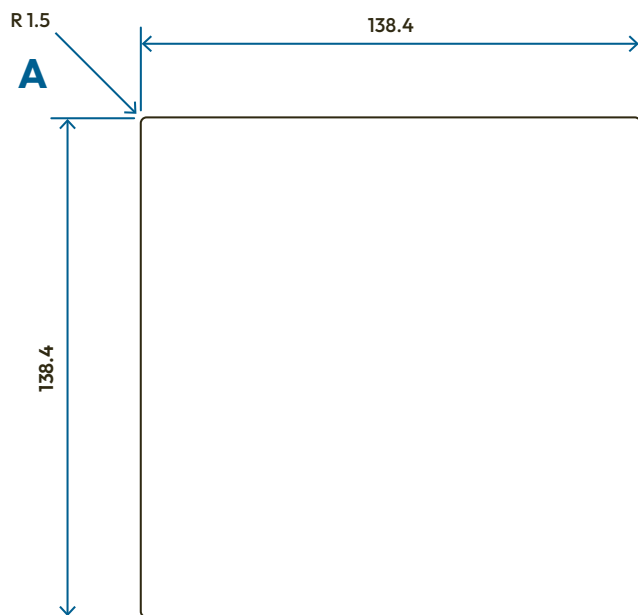
- 1 Four mounting brackets and screws provided with instrument
- 2 Panel supplied by others. Maximum thickness: 9.52 mm (0.375-in.)
- 3 Panel mount gasket

Figure 5: Panel mount side



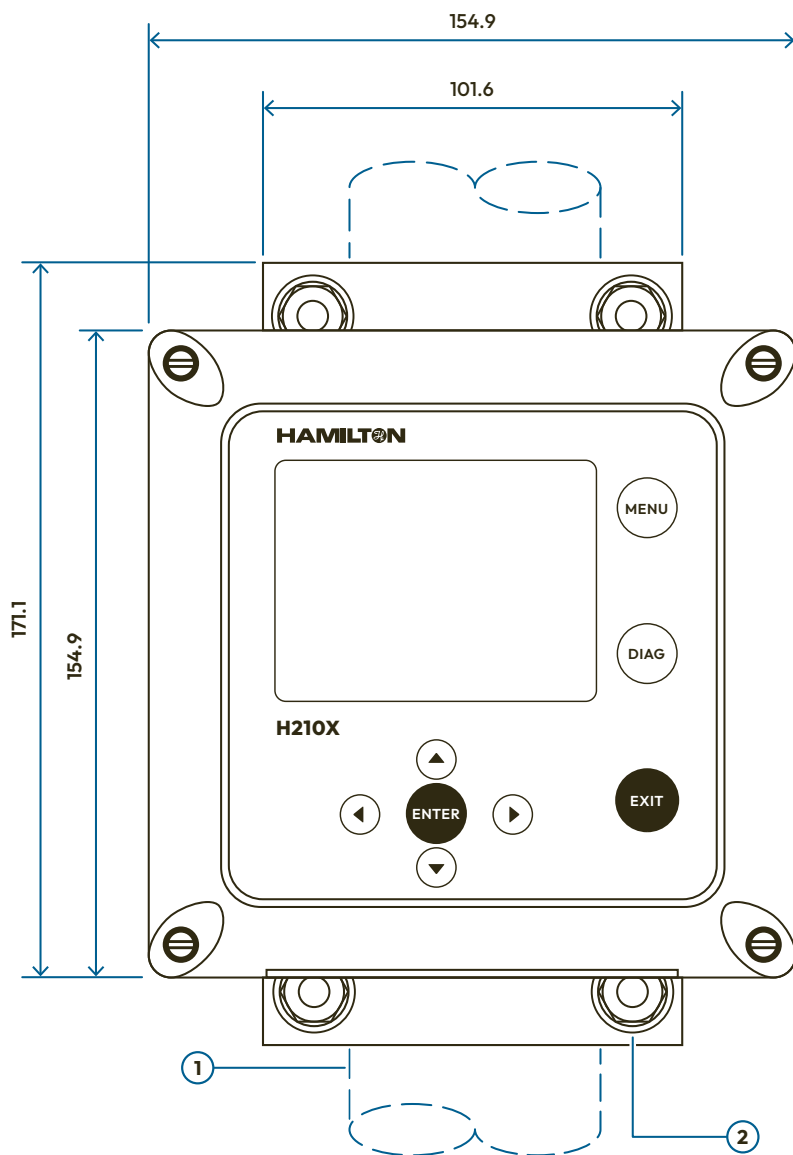
A Conduit openings

Figure 6: Panel mount bottom



A Maximum

Figure 7: Panel cut-out



- A 50.8 mm (2 in.) pipe supplied by customer
B Four cover screws

Figure 8: Wall mount front

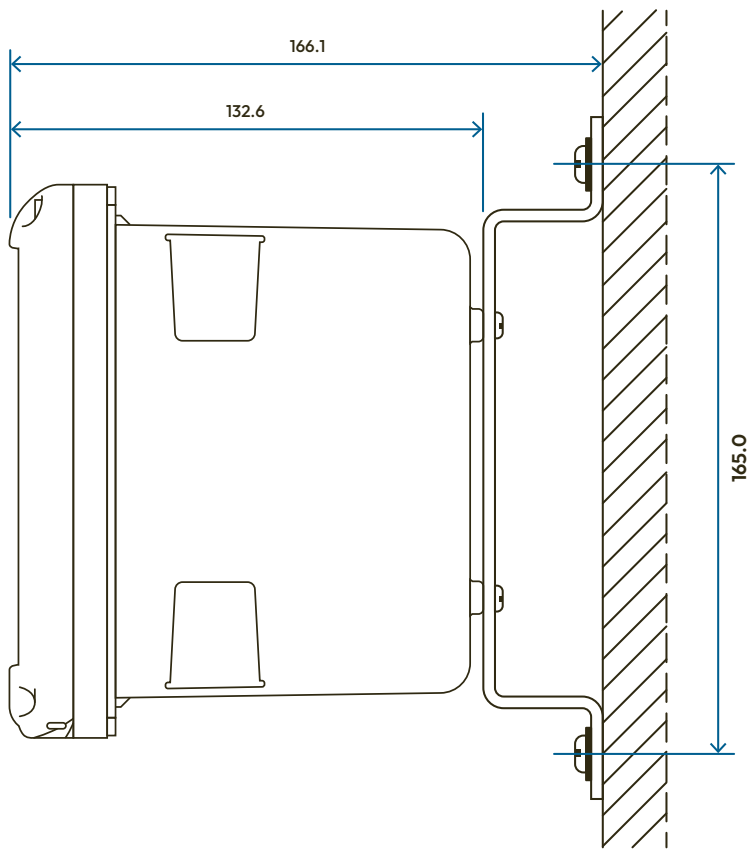
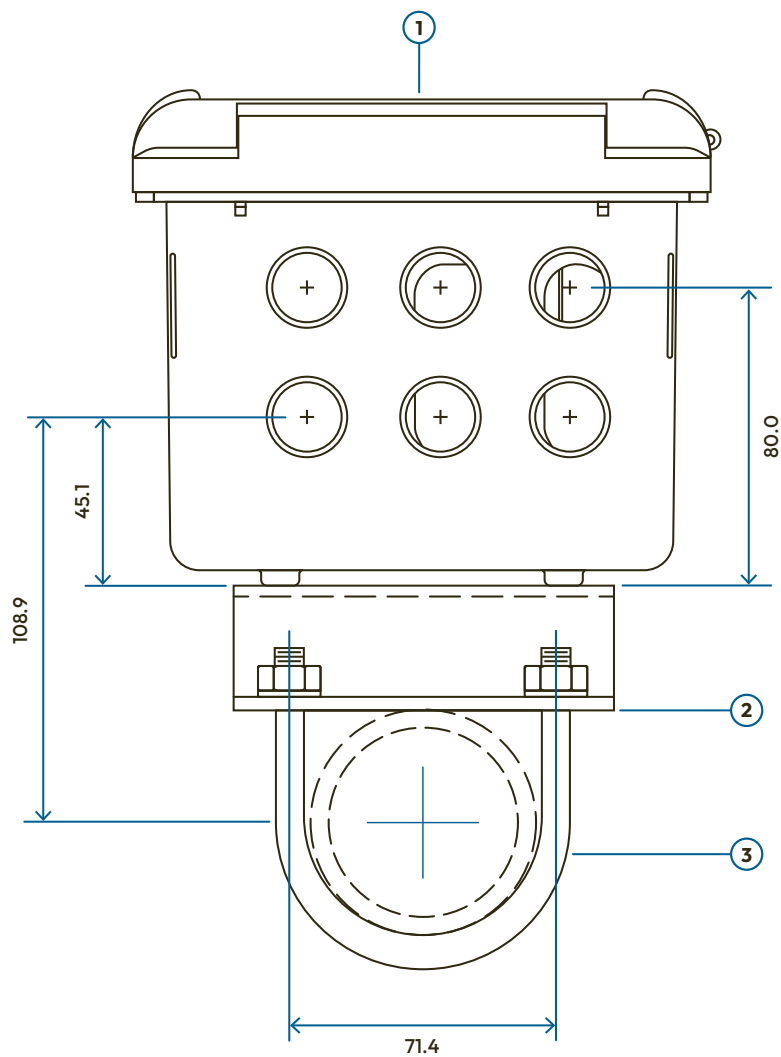


Figure 9: Wall mount side



- 1 Front panel
- 2 50.8 mm (2 in.) pipe mount bracket
- 3 Two sets of U-bolts for 50.8 mm (2 in.) pipe in kit REF 10174806 or 10210860

Figure 10: Pipe mount bottom

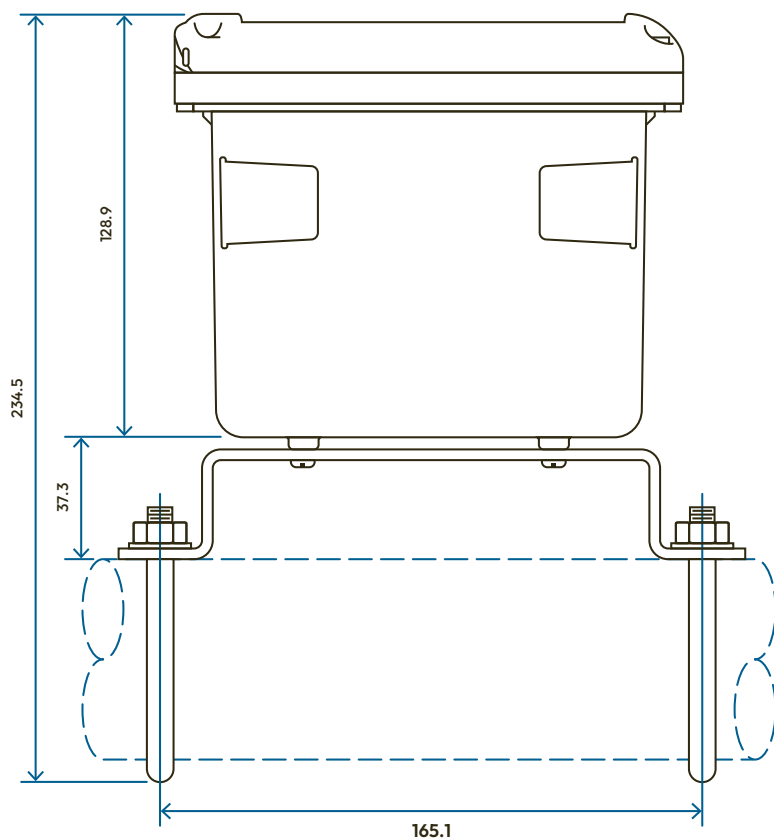


Figure 11: Pipe mount side

4 Wiring

4.1 General Wiring Information

All wiring connections are located on the main circuit board. The front panel is hinged at the bottom. The panel swings down for easy access to the wiring locations.

4.2 Digital Communication

The H210X supports Bell 202 digital communications over analog 4–20 mA current output 1.

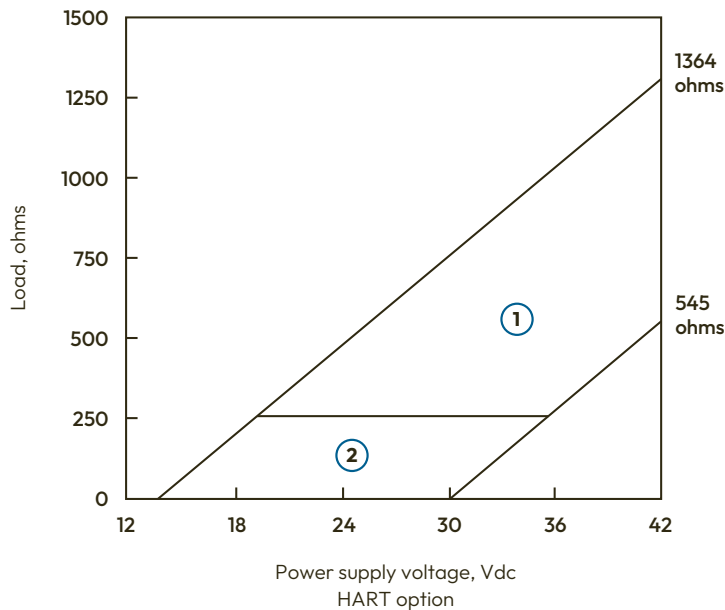
4.3 Wiring Power Supply Using HART®

4.3.1 HART® Power Supply and Load Requirements

Refer to Figure 12. The supply voltage must be at least 12.7 Vdc at the transmitter terminals. The power supply must be able to cover the voltage drop on the cable as well as the load resistor (250 Ω minimum) required for HART communication. The maximum power supply voltage is 42.4 Vdc. For intrinsically safe installations, the maximum power supply voltage is 30.0 Vdc.

Figure 12 shows load and power supply requirements. The upper line is the power supply voltage needed to provide 12.7 Vdc at the transmitter terminals for a 22 mA current. The power supply must provide a surge current during the first 80 milliseconds of startup. The maximum current is about 24 mA.

For digital communication, the load must be at least 250 ohms. To supply the 12.7 Vdc lift off voltage at the transmitter, the power supply voltage must be at least 17.5 Vdc.



- 1 With HART communication
- 2 Without HART communication

Figure 12: Load/Power Supply Requirements

4.3.2 HART® Power Supply - Current Loop Wiring

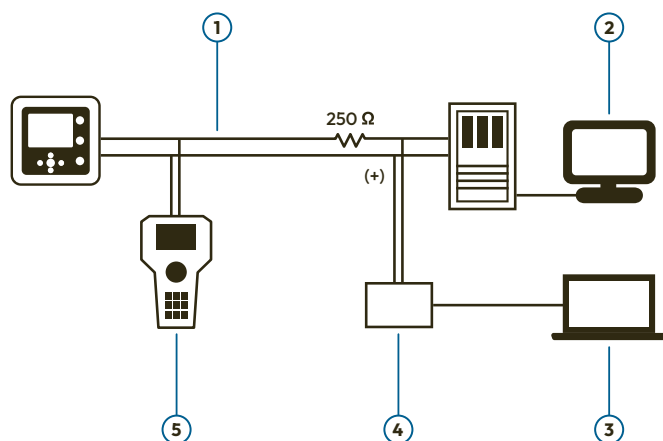
Refer to Figure 13.

Run the power/signal wiring through the opening nearest TB-2.

For optimum EMI/RFI protection:

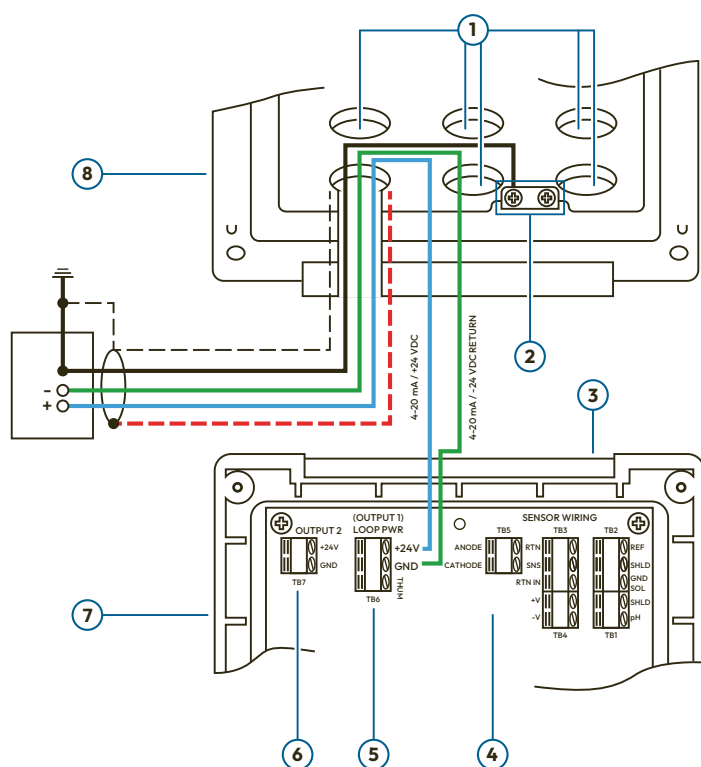
Caution! Do not run power supply/signal wiring in the same conduit or cable tray with loop power lines. Keep power supply/signal wiring at least 2 m (6 ft.) away from heavy electrical equipment.

1. Use shielded power/signal cable and ground the shield at the power supply.
2. Use a metal cable gland and be sure the shield makes good electrical contact with the gland.
3. Use the metal backing plate when attaching the gland to the transmitter enclosure. The power/signal cable can also be enclosed in an earth-grounded metal conduit.



- 1 4-20 mA and HART signal
- 2 Control system
- 3 Computer
- 4 Bridge
- 5 Field Communicator

Figure 13: Hamilton H210X System Block Diagram



- 1 Install plugs in all other openings as needed
- 2 Ground lugs
- 3 Hinge side of front panel
- 4 Hamilton H210X HART circuit board (pH/amperometric)
- 5 Output 1 loop power
- 6 TB7/output 2 requires external DC power
- 7 Hinged panel
- 8 Inner enclosure

Figure 14: Hamilton H210X HART loop power wiring

4.4 Wire the Sensor to the Transmitter

To wire the sensor to the transmitter, follow these steps:



Caution! Sensor and power wiring precautions:

Keep sensor and output signal wiring separate from loop power wiring. Do not feed the sensor and power wiring in the same conduit or close together in a cable tray.

1. Wire the sensor cables to the main board according to the cable locations marked on the board.
2. For Hamilton Sensors, use the compatible Hamilton sensor cable for safe connection.
3. Follow the wiring diagrams in the sensor manual to complete the wiring.
4. Carefully route and secure excess sensor cable through the cable gland.

4.4.1 Wire a pH/ORP Sensor to the Transmitter

To wire a pH/ORP Sensor to the transmitter, follow these steps:



Caution! Solution ground requirements:

To ensure the correct reference potential for accurate measurement, the connection to the Solution Ground terminal depends on your sensor's configuration:

- If the sensor does not have a solution ground: You must install a jumper (bridge) between the Reference (REF) terminal and the Solution Ground terminal.
- If the sensor includes a solution ground (GND SOL): The jumper is not required. In this case, the Solution Ground terminal must be connected to the process solution ground to maintain correct electrical continuity.

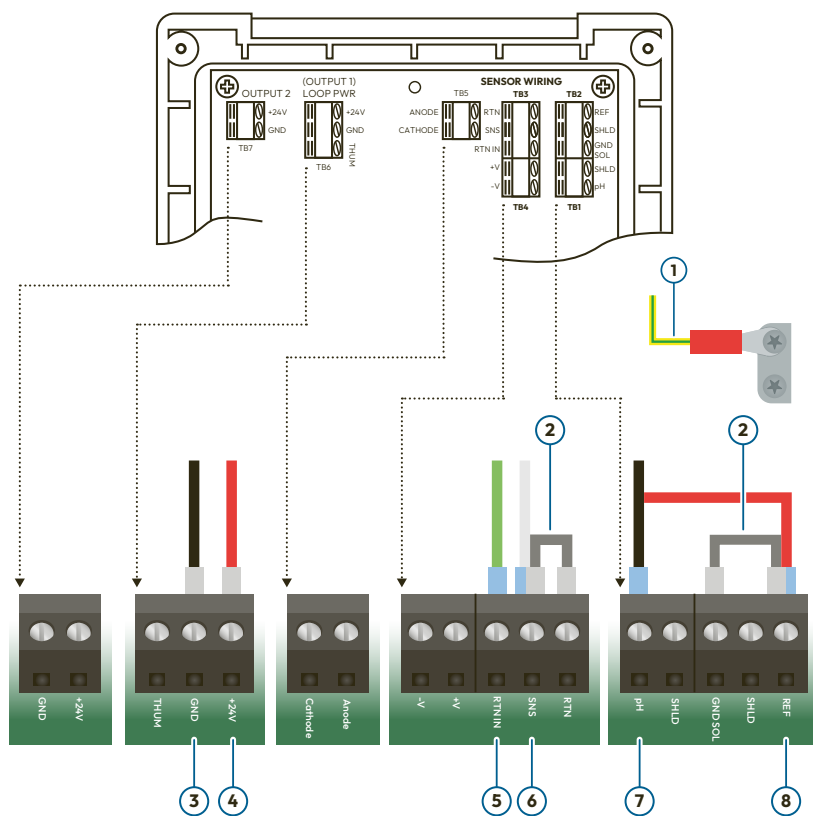
Refer to Figure 15 for the wiring overview of the pH/ORP Sensor.



Notice: Sensor wiring precautions and applicable terminals:

- If ground lead is present, terminate it to green ground screw inside the rear housing.
- TB5, TB6, and TB7 are not used for pH/ORP sensor wiring.

1. Wire GND to the Ground terminal.
2. Wire +24 V to the Power Supply terminal.
3. Wire TB3/RTD to the Return, Sense, and RTD Input terminals.
4. Wire TB2/Reference and Solution Ground to the Reference Input, Reference Shield, and Solution Ground terminals.
5. Wire TB1/pH Input to the pH Shield and pH Input terminals.



- 1 Ground/earth cable shield connected to the transmitter housing
- 2 Jumper connection
- 3 Ground terminal
- 4 Power supply voltage: +24 V
- 5 Return input (RTN IN) for a power/signal terminal
- 6 Sense (SNS) terminal
- 7 pH sensor terminal
- 8 Reference (REF) terminal

Figure 15: Wiring a pH Sensor to the Hamilton Transmitter H210X terminal board.
Cable used in graphic is the Hamilton VP6 cable detailed in 4.5.1.

Figure 15 shows the terminal locations of wiring a pH Sensor to the Hamilton H210X Transmitter. Refer to Table 1 for the corresponding terminal functions and cable-wire assignments for VP6, VP8 double coax, K8, and S7 pH sensor cables.

pH	1. Ground/shield	2. Jumper	3. GND	4. +24V	5. RTN IN	6. SNS	7. pH	8. REF
VP6		Jumper GND SOL to REF*	Loop Power 0 VDC	Loop Power 24 VDC	Green	White	Black coax inner	Red
VP8 Double Coax		Jumper GND SOL to REF*	Loop Power 0 VDC	Loop Power 24 VDC	Green	White	Black coax inner	Coax shield black
K8	Green / Yellow	Jumper GND SOL to REF*	Loop Power 0 VDC	Loop Power 24 VDC	NA	NA	Coax Inner Cable	Coax Shield
S7	Green / Yellow	Jumper GND SOL to REF*	Loop Power 0 VDC	Loop Power 24 VDC	NA	NA	Coax Inner Cable	Coax Shield

Table 1: pH Sensor wiring connections for the Hamilton H210X terminal board

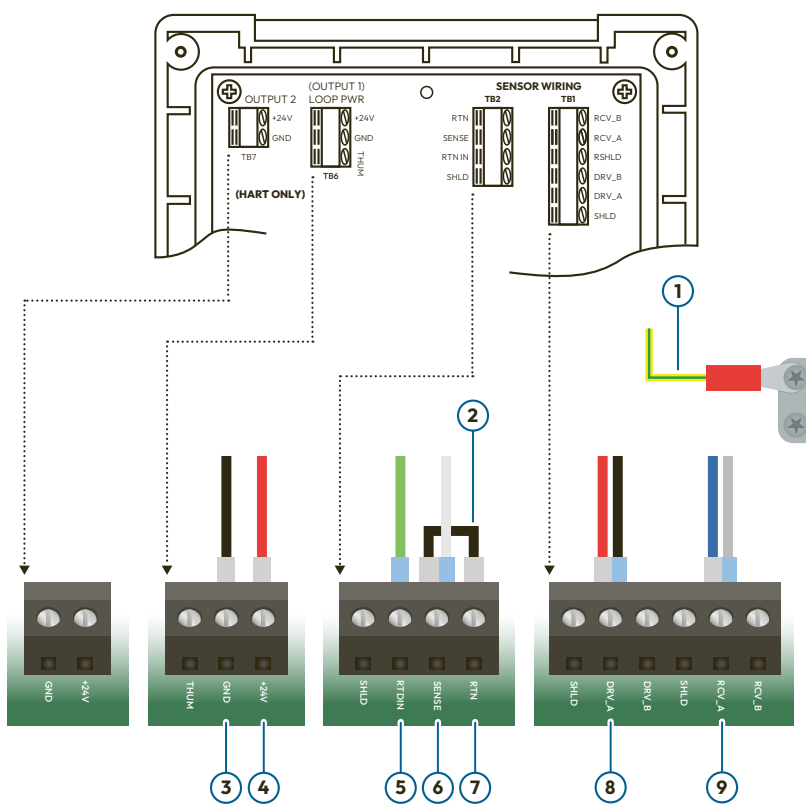
*& jumper SNS to RTN

4.4.2 Wire a Conductivity Sensor to the Transmitter

To wire a Conductivity Sensor with 2-Pole Electrodes to the transmitter, follow these steps:

Refer to Figure 16 for the wiring overview of the Conductivity Sensor with 2-Pole Electrodes.

1. Wire GND to the Ground terminal.
2. Wire +24 V to the Power Supply terminal.
3. Wire TB2/RTD to the Return, Sense, RTD IN, Shield to the terminals.
4. Wire TB1/Conductivity to the Drive A (DRV_A) and Receive A (RCV_A) terminals.



- 1 Ground/earth cable shield connected to the transmitter housing
- 2 Jumper connection
- 3 Ground terminal
- 4 Power supply voltage: +24 V
- 5 Return input (RTN IN) for a power/signal terminal
- 6 Sense (SNS) terminal
- 7 Return (RTN) power/signal connection
- 8 Drive A (DRV_A) terminal
- 9 Receive A (RCV_A) terminal

Figure 16: Wiring a Conductivity Sensor with 2-Pole Electrodes to the Hamilton Transmitter H210X terminal board

Figure 16 shows the terminal locations for wiring a 2-Pole Conductivity Sensor to the Hamilton H210X. Refer to Table 2 for the corresponding terminal functions and cable-wire assignments for recommended Hamilton cables.

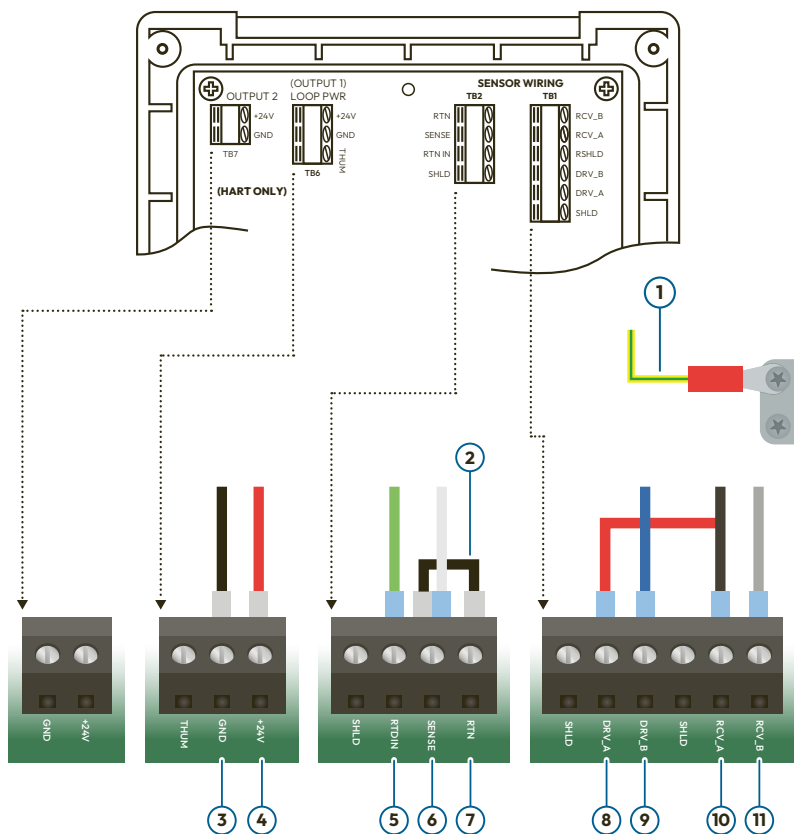
COND 2 pole	1. Ground/shield	2. Jumper	3. GND	4. +24V	5. RTDIN	6. SENSE	7. RTN	8. DRV_A	9. RCV_A
VP6	Green / Yellow	Jumper SENSE to RTN	Loop Power 0 VDC	Loop Power 24 VDC	Green	White	Jumper to 6.	Black Coax Inner + Red	Grey + Blue
VP8 Double Coax	Green / Yellow	Jumper SENSE to RTN	Loop Power 0 VDC	Loop Power 24 VDC	Green	White	Jumper to 6.	Coax inner Black + Coax shield Black	Coax inner Red + Coax Shield Red
Conducell 2DC	Green / Yellow	Jumper SENSE to RTN	Loop Power 0 VDC	Loop Power 24 VDC	Grey / Green	Brown / Pink	Jumper to 6.	Shield	White

Table 2: Conductivity Sensor (2-Pole) cable wiring connections for the Hamilton H210X terminal board

To wire a Conductivity Sensor with 4-Pole Electrodes to the transmitter, follow these steps:

Refer to Figure 17 for the wiring overview of the Conductivity Sensor with 4-Pole Electrodes.

1. Wire GND to the Ground terminal.
2. Wire +24 V to the Power Supply terminal.
3. Wire TB2/RTD to the Return, Sense, RTD IN, Shield to the terminals.
4. Wire TB1/Conductivity to the Drive A (DRV_A) and Receive A (RCV_A) terminals.
5. Wire TB1/Conductivity to the Drive B (DRV_B) and Receive B (RCV_B) terminals.



- | | |
|--|--|
| 1 Ground/earth cable shield connected to the transmitter housing | 7 Return (RTN) power/signal connection |
| 2 Jumper connection | 8 Drive A (DRV_A) terminal |
| 3 Ground terminal | 9 Drive B (DRV_B) terminal |
| 4 Power supply voltage: +24 V | 10 Receive A (RCV_A) terminal |
| 5 Return input (RTN IN) for a power/signal terminal | 11 Receive B (RCV_B) terminal |
| 6 Sense (SNS) terminal | |

Figure 17: Wiring a Conductivity Sensor with 4-Pole Electrodes to the Hamilton Transmitter H210X terminal board

Figure 17 shows the terminal locations for wiring a 4-Pole Conductivity Sensor to the Hamilton H210X. Refer to Table 3 for the corresponding terminal functions and cable-wire assignments for VP6, VP8 Double Coax, and 4US conductivity sensor cables.

COND 4 pole	1. Ground / shield	2. Jumper			5. RTDIN	6. SENSE	7. RTN	8. DRV_A	9. DRV_B	10. RCV_A	11. RCV_B
VP6	Green / Yellow	Jumper SENSE to RTN	Loop Power OVDC	Loop Power 24 VDC	Green	White	Jumper to 6.	Red	Blue	Black coax inner	Grey
VP8 Double Coax	Green / Yellow	Jumper SENSE to RTN	Loop Power OVDC	Loop Power 24 VDC	Green	White	Jumper to 6.	Coax shield black	Coax Shield Red	Coax middle black	Coax Inner Red
4US Sensor	Green / Yellow	Jumper SENSE to RTN	Loop Power OVDC	Loop Power 24 VDC	Blue	Grey / White	Jumper to 6.	Pink	Yellow	Green	Brown

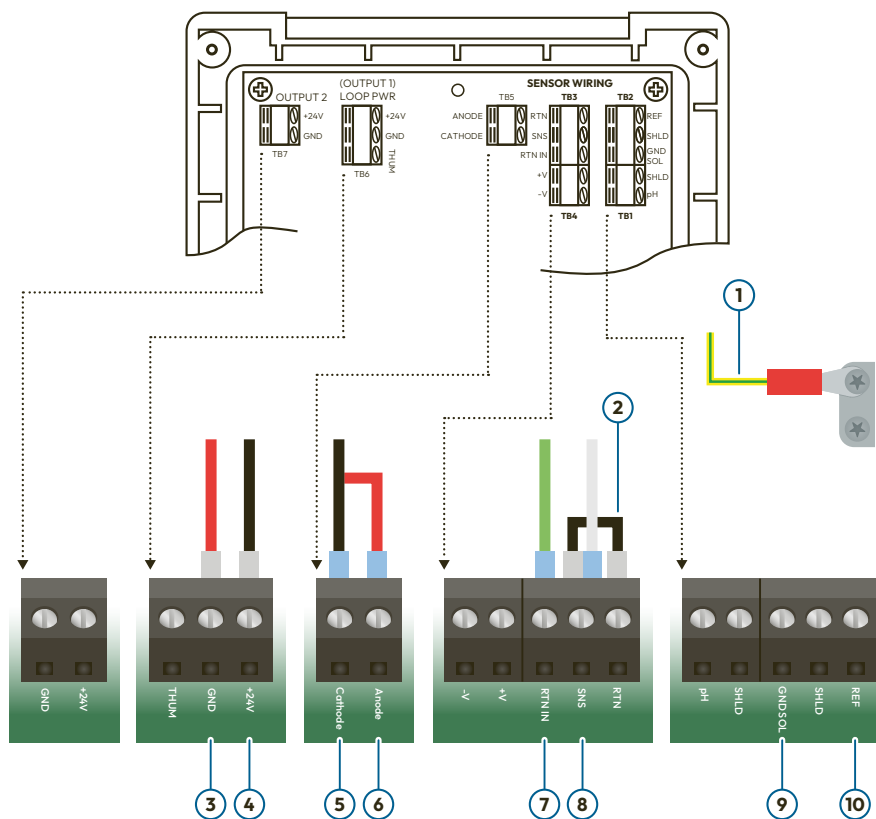
Table 3: Conductivity Sensor (4-Pole) cable wiring connections for the Hamilton H210X terminal board

4.4.3 Wire an Oxygen Sensor to the Transmitter

To wire a compatible Oxygen Sensor to the transmitter, follow these steps:

Refer to Figure 18 for the wiring overview of the Oxygen Sensor.

1. Wire GND to the Ground terminal.
2. Wire +24 V to the Power Supply terminal.
3. Wire TB5/Anode and Cathode to the Anode and Cathode terminals.
4. Wire TB3/RTD to the Return, Sense, and RTD IN terminals.
5. Wire TB2/Ground Solution to the Ground Solution and REF terminals.



- 1 Ground/earth cable shield connected to the transmitter housing
- 2 Jumper connection
- 3 Ground terminal
- 4 Power supply voltage: +24 V
- 5 Cathode terminal
- 6 Anode terminal
- 7 RTD (Resistance Temperature Detector) terminal: Measures the change in electrical resistance in relation to temperature
- 8 Sense (SNS) terminal
- 9 Ground solution (GND SOL) terminal
- 10 Reference (REF) terminal

Figure 18: Wiring a Sensor to the Hamilton Transmitter H210X terminal board

Figure 18 shows the terminal locations for wiring a Dissolved Oxygen (DO) Sensor to the Hamilton H210X. Refer to Table 4 for the corresponding terminal functions and cable-wire assignments for VP6, VP8 Double Coax, T82-D4, and Oxsens sensor cables.

DO	1. Ground/shield	2. Jumper	3. GND	4. +24V	5. Cathode	6. Anode	7. RTDIN	8. SNS
VP6	Green / Yellow	Jumper SENSE to RTN	Loop Power 0VDC	Loop Power 24 VDC	Black coax inner	Red	Green	White
VP8 Double Coax	Green / Yellow	Jumper SENSE to RTN	Loop Power 0VDC	Loop Power 24 VDC	Coax middle Black	Coax shield Black	Green	White
T82-D4	Green / Yellow	Jumper SENSE to RTN	Loop Power 0VDC	Loop Power 24 VDC	colorless / center	Brown	Yellow	Blue
Oxsens	Green / Yellow	Jumper SENSE to RTN	Loop Power 0VDC	Loop Power 24 VDC	colorless / center	Brown	Yellow	Blue

Table 4: Dissolved Oxygen Sensor cable wiring connections for the Hamilton H210X terminal board. Note: terminals 9 and 10 are not used.

4.5 Sensor Cables

Always use Hamilton recommended sensor cables for safe connection and system operation. The sensor cables are available in different lengths to order.

4.5.1 Recommended Cable: VP6 Open-End Cable

These cables are recommended for use with traditional (non-Arc) products like pH/ORP, polarographic DO, and 2/4 pole Conducell conductivity sensors. These products use analog (mV, nA) output signals, with the measurement signal transmitted through a single coaxial cable. VP6 cables feature a slightly thicker outer insulation jacket, making them suitable for use in rugged environments.

Sensors with VP6 connector head will have six gold contact pins as shown in Figure 19. The measurement pins are always labeled as A and B, located on either side of the keyed notch. Table 5 provides an overview of the VP6 cable Pin description and assignment with the corresponding sensor.

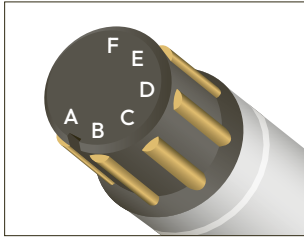


Figure 19: VP6 connector head

Wire color & description	VP Pin	pH / Redox	OxyFerm VP / OxyGold	Conducell UPW	Conducell 4UxF
Blacktrans-parent coax core	A	pH/Redox	Cathode	Inner Electrode	High Potential
Red wire	B	Reference	Anode	Inner Electrode	High Current
Grey wire	C	–	–	Outer Electrode	Low Potential
Blue wire	D	Liquid Earth	Ground	Outer Electrode	Low Current
White wire	E	Pt 100 / Pt 1000	NTC 22 k Ohm	Pt 1000	Pt 1000
Green wire	F	Pt 100 / Pt 1000	NTC 22 k Ohm	Pt 1000	Pt 1000
Green/yellow wire	Housing	Shield	Shield	Shield	Shield

Table 5: Overview of the VP6 cable Pin assignment with the corresponding sensor

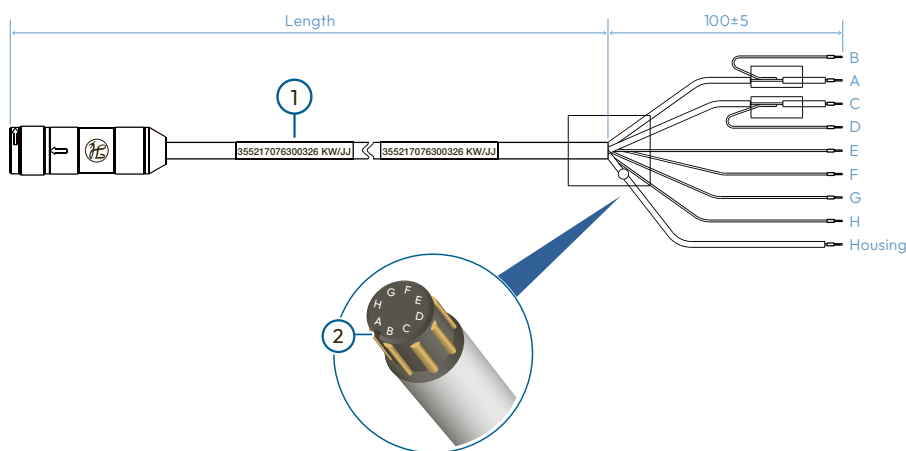
A detailed overview of the various sensor cables with the corresponding part numbers (REFs) that you can use for your order can be found in the Hamilton H210X Transmitter Quick Start Guide (REF 111011882).

4.5.2 VP8 Double Coaxial / Open-End Cable



Notice: Cable requirement for VisiFerm-RS485 ECS:

The VP8 double coaxial / open-end cable is necessary for the VisiFerm-RS485 ECS connection. This cable provide the extra power required to operate the optical sensor.



- 1 VP8 double coaxial / open-end cable
- 2 Notch on the VP8 head serves

NOTICE! The notch indicates the position of the pin and prevents incorrect connection with the sensor cable connector.

Figure 20: Overview of the VP8 double coaxial / open-end cable

Wire color & description	VP Pin	VisiFerm ECS (ECSmode)	OxyFerm VP /OxyGold	pH / Redox
Black transparent coax core	A	Cathode (ECSMode)	Cathode	pH / Redox
Black coax shield	B	Anode (ECS Mode)	Anode	Reference
Red transparentcoax core	C	Power: +24 VDC	Guard	-
Red coax shield	D	Power: Ground	Ground	Liquid earth
White	E	NTC 22 k Ohm	NTC 22 k Ohm	Pt 100 / Pt 1000
Green	F	NTC 22 k Ohm	NTC 22 k Ohm	Pt 100 / Pt 1000
Yellow	G	RS-485 (A)	-	-
Brown	H	RS-485 (B)	-	-
Yellow/green	Housing	Shaft	Shield	Shield

Table 6: Overview of the VP8 cable Pin description and assignment with the corresponding sensor

 **Notice:** Conductivity Sensor cable recommendation:
Do not use the VP8 double coaxial / open-end cable with Conductivity Sensors. This cable type is not recommended because its shielding or capacitance characteristic can interfere with the high-precision AC conductivity measurement signal and result in inaccurate readings.

Cables ordering information

A detailed overview of the various sensor cables with the corresponding part numbers (REFs) that you can use for your order can be found in the Hamilton H210X Transmitter Quick Start Guide (REF 111011882).

4.5.3 K8 Cable

K8 connector characteristics

K8 connectors are typically used with conventional pH/ORP Sensors that do not feature temperature compensation. These connectors have a two-pin design consisting of a center core and an outer metal threaded connection. The K8 connector employs a two-pole design:

- Pole 1: The center core.
- Pole 2: The outer metallic threaded connection.

This design allows the K8 cable to transmit the electrical signal measured by the pH/ORP Sensors but does not accommodate the separate temperature element signal required for automatic temperature compensation. For ordering information, refer to the Hamilton H210X Transmitter Quick Start Guide (REF 111011882).



Figure 21: Overview of the K8 cable

4.5.4 S7 Cable

S7 connector characteristics

The S7 connector is a specialized, traditional connector primarily used on pH and ORP Sensors. Sensors with S7 connector lack temperature compensation. This means the reading from the sensor must be manually adjusted for changes in process temperature. The S7 connector does not have mounting threads. For ordering information, refer to the Hamilton H210X Transmitter Quick Start Guide (REF 111011882).

⚠ Caution! S7 connector recess precaution: Moisture risk
S7 connectors have a recessed design. Due to this, care must be taken to avoid moisture getting trapped in the recess, as this could lead to a short circuit.

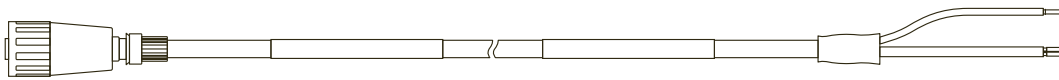


Figure 22: Overview of the S7 cable with open-end wiring

5 Startup the Transmitter

To start up the Hamilton Transmitter H210X, follow these steps:



Warning! Installation and operation:

Safety precautions and hazards Observe and adhere to all safety precautions and Hazards during installation and operation of the Hamilton Transmitter H210X (see Chapter 1).

1. Wire sensor(s) to the signal boards (see Chapter 4).
2. Connect the current output.
3. Once all the connections are secured and verified, apply DC power to the transmitter.



Notice: First power up of the transmitter:

- When the transmitter is powered up for the first time, a Quick Start screen will appear.
- Follow the Quick Start workflow in Figure 23 to complete the setup of the transmitter.

5.1 Navigating the Display: User Interface

The transmitter has a large display which shows the measurement readout and temperature in large digits and up to four additional process variables or diagnostic parameters at the same time (see Figure 24). You can customize the displayed variables to meet your requirements. This is called **Display Format**.

The intuitive menu system allows access to Calibration, Hold (of current outputs), Programming, and Display functions. In addition, a dedicated DIAG button is available to provide access to useful operational information on the installed sensor(s) and problematic conditions that might occur. When a fault condition appears, the display flashes **Fault** and/or **Warning**. Help screens (context sensitive) are displayed for most Faults and Warnings conditions to guide you through troubleshooting.

During calibration and programming, key presses cause different displays to appear. The displays are self-explanatory and guide you step-by-step through the procedure.

A Quick Start screen will appear after the first power up. The following Quick Start operating tips are useful for navigation through the Hamilton Transmitter H210X menu (see Figure 25):

Quick Start operating tips

- A highlighted field shows the position of the cursor.
- To move the cursor Left or Right, use the keys to the left or right of the ENTER key.
- To scroll UP or DOWN or to increase or decrease the value of a digit, use the keys above and below the ENTER key. Use the Left or Right keys to move the decimal point.
- Press ENTER to store a setting. Press EXIT to leave without storing the changes. Press EXIT during Quick Start to return the display to the initial startup screen, then select the required Language and press the ENTER key.
- Select a measurement parameter, then press ENTER.

Quick start workflow

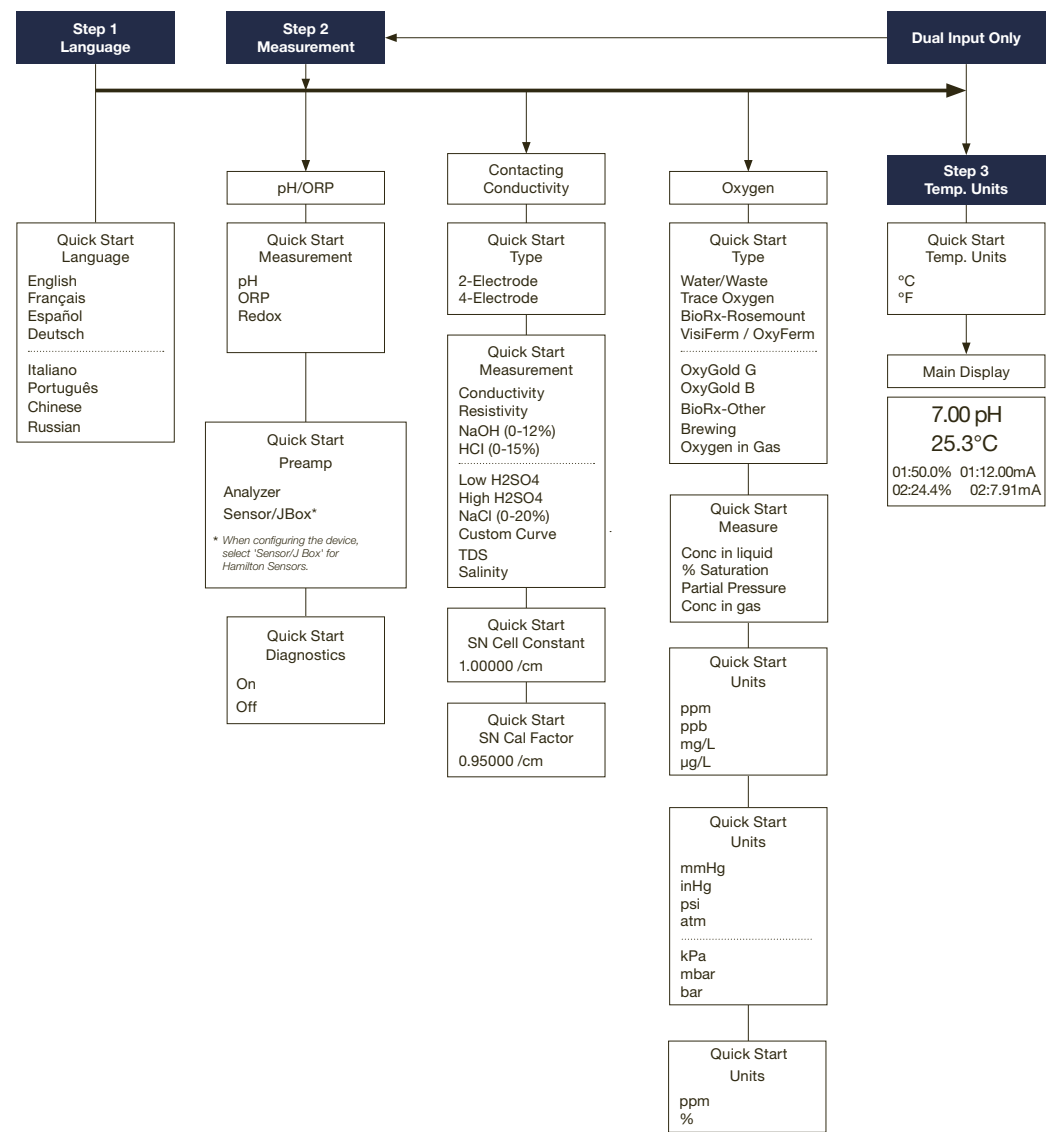


Figure 23: Quick start flow diagram for the Hamilton Transmitter H210X setup

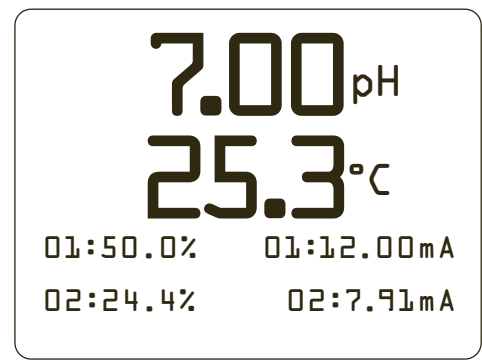


Figure 24: Overview of the Hamilton Transmitter H210X user interface

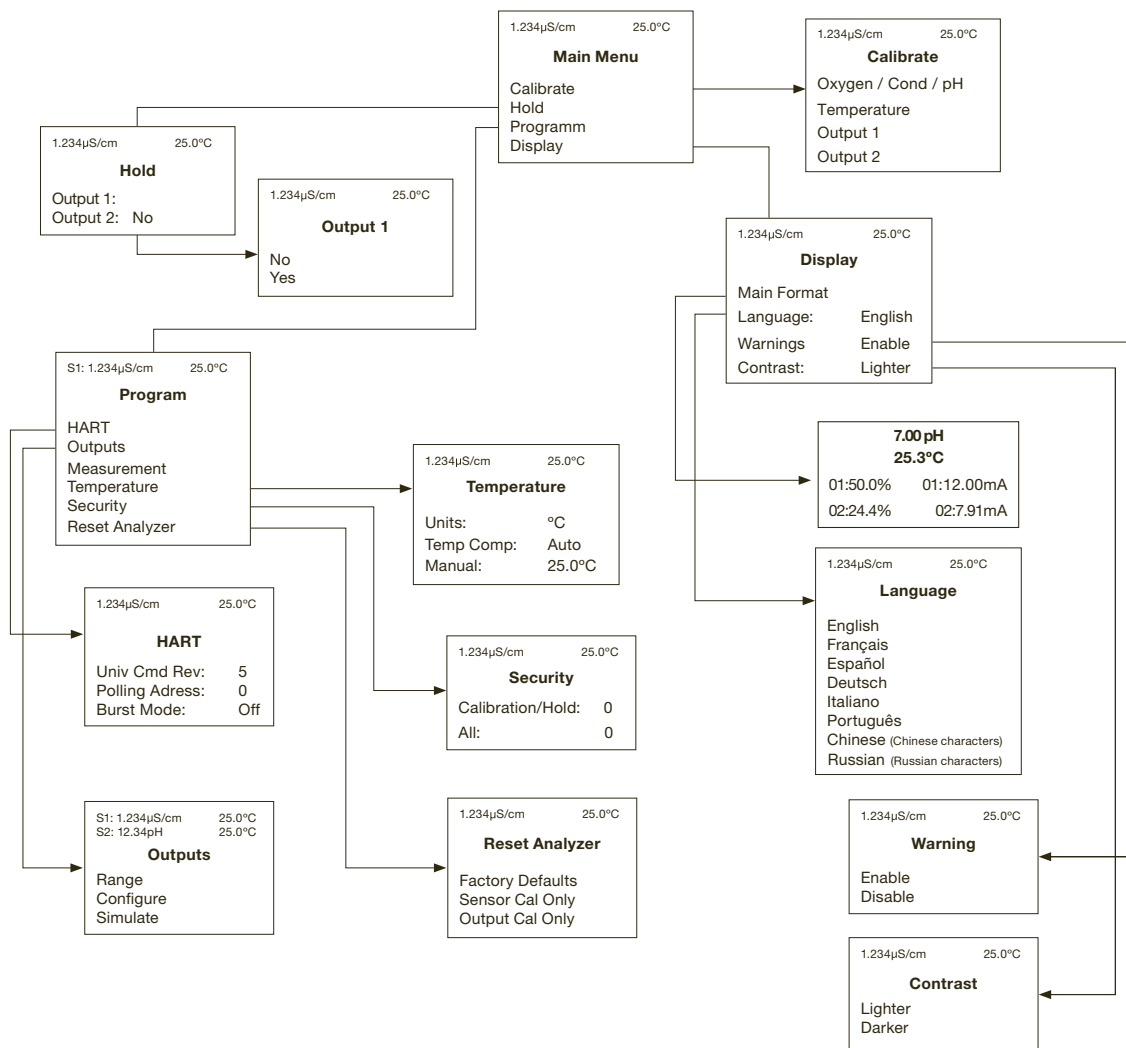


Figure 25: Hamilton Transmitter H210X menu overview

5.2 Transmitter Keypad

There are four function keys and four selection keys on the Hamilton Transmitter H210X keypad.

Function keys

Four top-level menu items appear when you press MENU key:

- **Calibrate**: Calibrate the attached sensor(s) and analog output(s).
- **Hold**: Suspend analog output(s).
- **Program**: Program outputs, measurements, temperature, and security. You can also use the Hold key to reset the transmitter.
- **Display**: Use to select/set Program Display Format, Language, Warnings, and Contrast.

Press **MENU** key to display the Main Menu screen. Press MENU followed by EXIT to display the main display

Press the **DIAG** key to display active faults and warnings and detailed information about the transmitter and sensor diagnostics, including:

- Faults

- Warnings
- Sensor information
- Out 1 and Out 2
- Current values
- Model configuration string
- Instrument software version.

Press **DIAG** on Sensor 1 to display useful diagnostics and information (if applicable):

- Measurement
- Sensor type
- Raw signal value
- Cell constant
- Zero offset
- Temperature
- Temperature offset
- Selected measurement range
- Cable resistance
- Temperature sensor resistance
- Software version.

Press **ENTER** key to store numbers and settings, and change the display to the next screen.

Press **EXIT** to return to the previous screen without storing changes.

Selection keys

The selection keys (Up, Down, Left, and Right) are located around the ENTER key. Use the selection keys to move the cursor to all areas while navigating through the menu.

The selection keys are used to...

- Select items on the menu screen.
- Scroll up and down the menu lists.
- Enter or edit numeric values.
- Move the cursor to the right or left.
- Select measurement units during operation.

5.3 Main Display

The transmitter displays the following information including icons:

- Primary reading
- Temperature
- Up to four secondary readings
- An error and warning banner
- Digital communication icon.

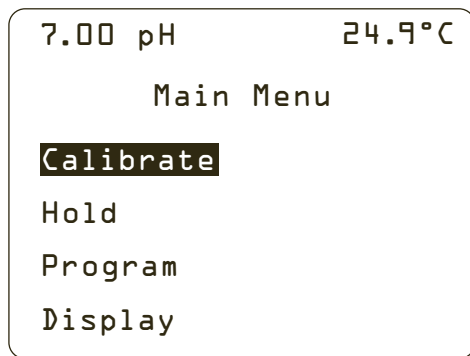


Figure 26: Overview of the Hamilton Transmitter H210X main display

Process measurement

One process variable and process temperature are displayed by default. For all configurations, the upper display area shows the live process variable, and the center display area shows the temperature (default screen settings).

Secondary values

Up to four secondary values are displayed in quadrants in the lower half of the screen. You can program all four secondary value positions to any parameter available to be displayed.

Fault and Warning banner

If the transmitter detects a problem with itself or the sensor, an Error or Warning message appears at the bottom of the display. The **error** requires immediate attention. A **warning** indicates a problematic condition or impending failure. For troubleshooting assistance, press **DIAG** key.

Formatting the main display

You can program the main display screen to display primary process variables, secondary process variables, and diagnostic data.

To format the main display, follow these steps:

1. Press **MENU** key.
2. Scroll down to **Display** > press **ENTER** key to highlight Main Format, then press the **ENTER** key again to confirm the selection.
3. The process value of **Sensor 1** is highlighted in inverse video. Use the selection keys to navigate to the screen areas you want to program > press **Enter** key.
4. Choose the required display parameter or diagnostic for each of the four display sections in the lower half of the screen.
5. Continue to navigate and program all required screen selections. Press **MENU** key> **EXIT** key to finish. The screen will return to the main display.

5.4 Menu System

The transmitter uses a scroll and select menu system. Pressing the **MENU** key at any time opens the top-level menu including **Calibrate**, **Hold**, **Program**, and **Display functions**.

To find a menu item, scroll with the **Up** and **Down** keys until the item is highlighted. Continue to scroll and select menu items until the required function is selected.

To select the item, press the **ENTER** key. To return to a previous menu level or to enable the main live display, press the **EXIT** key repeatedly. To return immediately to the main display from any menu level, press **MENU**, then **EXIT**.

The selection keys have the following functions:

- The **Up** key (above the **ENTER** key) increments numerical values, moves the decimal point one place to the right, or selects units of measurement
- The **Down** key (below the **ENTER** key) decrements numerical values, moves the decimal place one place to the left, or selects units of measurement.
- The **Left** key (left of the **ENTER** key) moves the cursor to the left.
- The **Right** key (right of the **ENTER** key) moves the cursor to the right.

During all menu displays (except main display format and Quick Start), the live process measurement and temperature value are displayed in the top two lines of the upper display area. This conveniently allows display of the live values during important calibration and programming operations. Menu screens will time out after two minutes of inactivity and return to the main live display.

Example: Setting up the pH Sensor measurement

1. For pH measurement, select preamplifier location.
Select **Sensor/J-Box** for Hamilton pH sensors.
2. Select the unit of measurement if applicable.
3. Select the required temperature unit: °C or °F. The main display appears and the outputs are assigned to default values.
4. To change the output settings, scale the 4-20 mA current outputs, change measurement-related settings from the default values, and enable pH diagnostics, press **MENU**, select **Program** and follow the on-screen instructions to the appropriate menu.
5. To reset the transmitter to factory defaults, select **Program** from the **Main Menu**, then scroll to **Reset**.

6 Programming the Transmitter

6.1 General Programming Information

Typical programming steps include the following procedures:

- Change 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.
- Access menu functions using a security code.
- Enable and disable Hold mode for current outputs.
- Reset all factory defaults, calibration data only, or current output settings only.

6.2 Changing Startup Settings

To change the measurement type, measurement units, or temperature units you initially entered in Quick Start, select Reset or access the Program menus for the sensor.

Table 7 displays the choices for the measurement types and measurement units available for each sensor.

Signal board	Available measurements	Measurement units
pH/oxidation reduction potential (ORP)	• pH • ORP • Redox	• pH • mV (ORP, redox)
Contacting conductivity	• Conductivity • Resistivity • Total dissolved solids (TDS) • Salinity • NaOH (0-12%) • HCl (0-15%) • Low H₂SO₄ • High H₂SO₄ • NaCl (0-20%)	• µS/cm • mS/cm • S/cm • % (concentration)
Oxygen	• Oxygen (ppm) • Trace oxygen (ppb) • Percent oxygen in gas	• ppm • mg/L • ppb • µg/L • % saturation • Partial pressure • % oxygen in gas • ppm oxygen in gas

Table 7: Measurements and Measurement Units

To reconfigure the transmitter to display new measurements or measurement units, refer to Reset factory default settings. To change the specific measurement or measurement units, refer to Programming the transmitter.

6.3 Choose Temperature Units and Automatic/Manual Temperature Compensation

Most liquid measurements (except Oxidation Reduction Potential (ORP) and redox) require temperature compensation.

The Hamilton H210X performs temperature compensation automatically by applying internal temperature correction algorithms. You can also turn off temperature correction. If the temperature correction is off, the transmitter uses the temperature you enter in all temperature correction calculations.

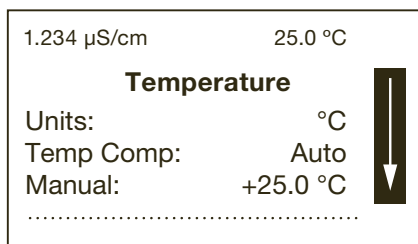


Figure 27: Temperature Screen

6.4 Configuring and Ranging the Current Outputs

6.4.1 Purpose of Configuring and Ranging the Current Outputs

The Hamilton H210X has two analog current outputs.

Ranging the outputs means assigning values to the low (4 mA) and high (20 mA) outputs.



Notice: Always configure the outputs before ranging them.

6.4.2 Definitions of Outputs

Current outputs

The transmitter provides a continuous output current (4-20 mA) directly proportional to the process variable or temperature. You can set the low or high current outputs to any value.

Assigning outputs

Assign a measurement or temperature to Output 1 or Output 2.

Dampen

Output dampening smooths out noisy readings. It also increases the response time of the output. Output dampening does not affect the response time of the display.

Mode

You can make the current output directly proportional to the displayed value (linear mode) or directly proportional to the common logarithm of the displayed value (log mode).

6.4.3 Configure Outputs

Under the Program/Outputs menu, Figure 28 appears to allow configuration of the outputs.

1.234 μ S/cm	25.0 °C
OutputM Configure	
Assign:	Meas
Scale:	Linear
Dampening:	0sec
.....	
Fault Mode: Fixed	
Fault Value: 21.00 mA	

Figure 28: Configure Output Screen

Follow the menu screens in Figure 29 to configure the outputs.

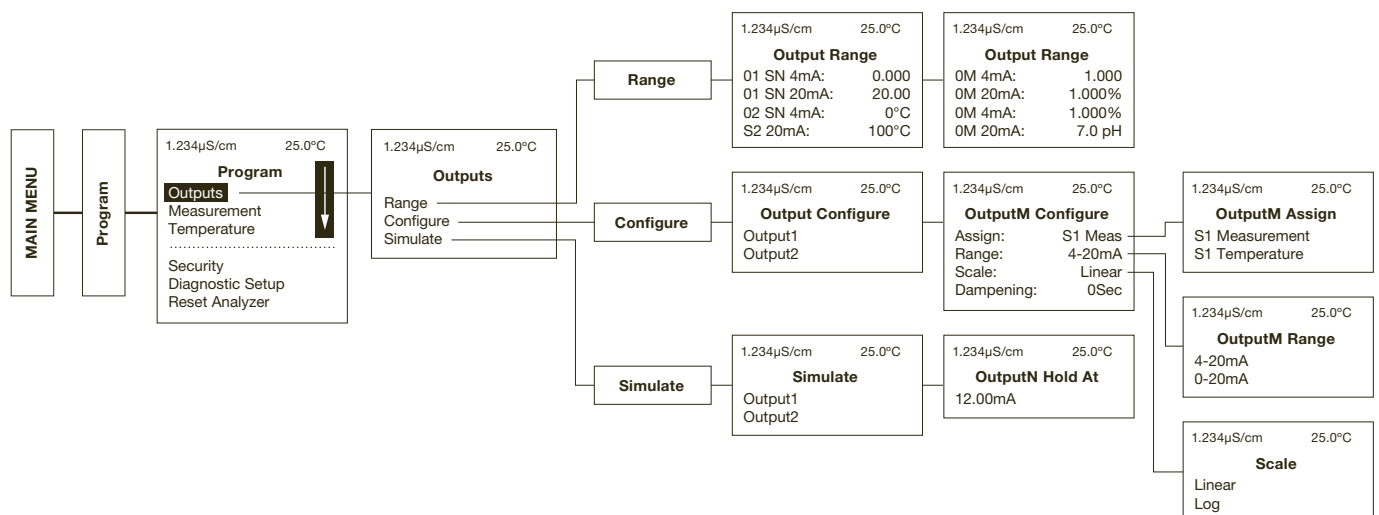


Figure 29: Configure and Range the Current Outputs

6.4.4 Range Current Outputs

Go to **Program → Output → Range**.

1.234 μ S/cm	25.0 °C
Output Range	
O1 SN 4mA:	0.000 μ S/cm
O1 SN 20mA:	20.00 μ S/cm
O2 SN 4mA:	0 °C
O2 SN 20mA:	100 °C

Figure 30: Output Range Screen

Enter a value for 4 mA and 20 mA (or 0 mA and 20 mA) for each output.
Follow the menu screens in Figure 30 to assign values to the outputs.

6.5 Set Security Code

The Hamilton H210X has two levels of security codes to control access and use of the transmitter. 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

1. Press **MENU**.
The **Main menu** screen appears.
2. Select **Program**.
3. Select **Security**.
The **Security** screen appears.
4. Enter a three digit security code for each of the desired security levels.
The security code takes effect two minutes after the last key stroke.
5. Record the security codes for future access and communication to operators or technicians as needed.

The display returns to the **Security** menu screen. Figure 31 displays the security code screens.

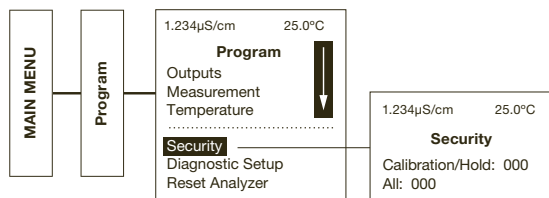


Figure 31: Setting a Security Code

Postrequisites

Press **EXIT** to return to the previous screen. To return to the main display, press **MENU** and then **EXIT**.

6.6 Security Access

6.6.1 How the Security Code Works

To access the Calibration and Hold menus, enter the correct access code for the **Calibration/Hold** security level. This allows operators or technicians to perform routine maintenance. This does not allow access to the **Program** or **Display** menus.

To access all menu functions, including programming, calibration, hold, and display, enter the correct access code for the All security level.

6.6.2 Use a Security Code

If someone has programmed a security code, selecting the Calibrate, Hold, Program, or Display top menu items causes the **Security Code** screen to appear.

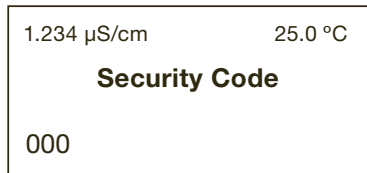


Figure 32: Security Code Screen

Procedure

Enter the three-digit security code for the appropriate security level.

If the entry is correct, the appropriate menu screen appears. If the entry is incorrect, the **Invalid Code** screen appears. The **Security Code** screen reappears after two seconds.

6.7 Using Hold

6.7.1 Purpose of Hold

The transmitter output is always proportional to measured value. To prevent improper operation of systems or pumps that are controlled directly by the current output, place the transmitter on hold before removing the sensor for calibration and maintenance.

Be sure to remove the transmitter from hold once you have finished calibrating the sensor. During hold, both outputs remain at the last value.



Notice: Once on hold, all current outputs remain on hold indefinitely.

6.7.2 Put Outputs on Hold

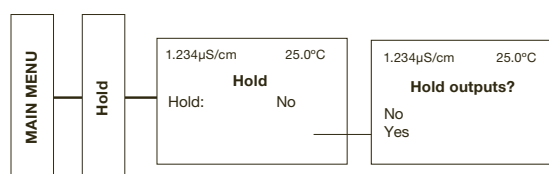


Figure 33: Hold Menu Tree

Procedure

1. Press **MENU**.
The **Main Menu** screen appears.
2. Select Hold.
The **Hold Outputs?** screen appears.
3. Select Yes to place the transmitter on hold. Select No to take the transmitter out of hold.

The **Hold** screen appears.



Notice: Hold will remain on indefinitely until someone disables it.

6.8 Resetting Factory Default Settings

6.8.1 Purpose of Resetting Factory Default Settings

Resetting factory default settings also clears all fault messages and returns the display to the first **Quick Start** screen.

The Hamilton H210X offers three options for resetting factory defaults:

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



WARNING! PROCESS CONTROL AND DATA LOSS!

A reset may change the transmitter output and affect the connected control loop. It may also permanently erase calibration data or configuration settings.

Before performing a reset: Place the control loop in manual or bypass and ensure that the process is in a safe condition. Record or back up all calibration data and configuration settings. Confirm that the output is held at a predefined safe value. Check the description of the selected reset option to determine which data and settings will be erased or restored.

After the reset, verify the transmitter configuration, calibration, output response and alarm settings.

Complete the required commissioning checks before returning the control loop to automatic operation.

6.8.2 Reset Factory Default Settings

Procedure

To reset factory defaults, reset calibration data only, or reset analog outputs only, follow Figure 34.

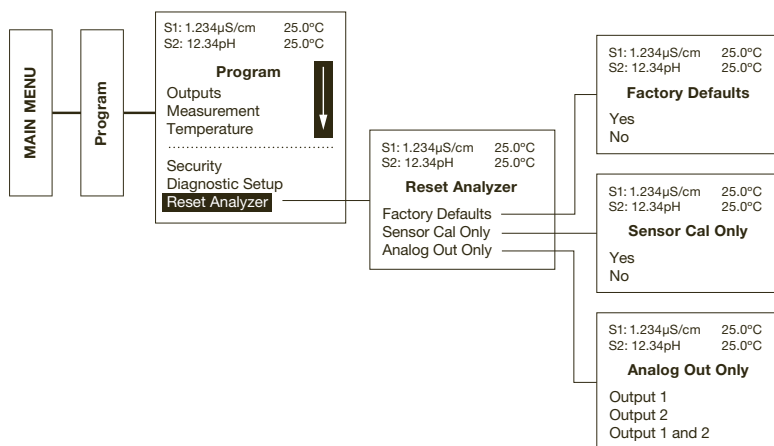


Figure 34: Resetting Factory Default Settings Menu Tree

7 Programming Measurements

7.1 Introduction to Programming Measurements

The Hamilton H210X automatically recognizes the measurement input upon first power-up and each time the transmitter is turned on.

Completing **Quick Start** screens upon first power-up enables measurements, but you may have to take additional steps to program the transmitter for the desired measurement application. This section covers the following programming and configuration functions:

7.2 Program pH Measurement

Figure 35 is a detailed flow diagram for pH programming to guide you through all basic programming and configuration functions.

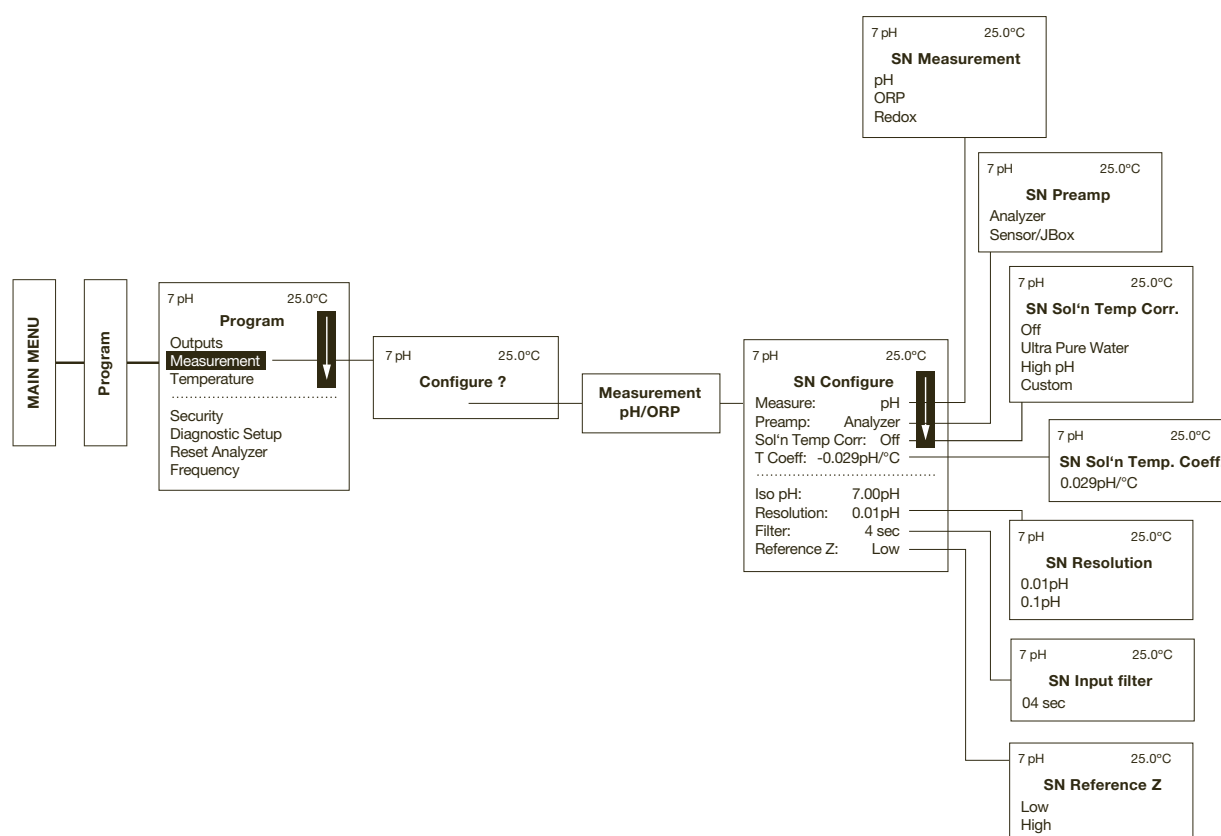


Figure 35: Flow Diagram for pH and ORP Programming

To configure the pH measurement board:

1. Press **MENU**.
2. Go to **Program** → **Measurement**.

Figure 36 appears; factory default settings are shown.

7 pH	25.0 °C
SN Configure	
Measure:	pH
Preamp:	Analyzer
Sol'n Temp Corr:	Off
.....	
Resolution:	0.01pH
Filter:	4 sec
Reference Z:	Low

Figure 36: Configure pH Screen

To change any setting, scroll to the desired item and press **ENTER**.

7.2.1 Select Measurement Type

Figure 37 displays the screen where you can choose the measurement type.

7 pH	25.0 °C
SN Measurement	
pH	
ORP	
Redox	

Figure 37: Measurement Screen

The default value (pH) is displayed in bold type. Refer to Figure 35 to select a measurement type.

7.2.2 Select pH Preamplifier Location

Figure 38 shows the screen from which you can select the preamp location.

7 pH	25.0 °C
SN Preamp	
Analyzer	
Sensor/JBox	

Figure 38: Preamp Screen

The default location (Analyzer) is in bold.
For Hamilton sensors, select Sensor/JBox.

Procedure

Refer to Figure 35 to select a preamplifier location.

7.2.3 Select Solution Temperature Correction

Figure 39 displays the screen on which you can enter a custom solution temperature coefficient.

7 pH	25.0 °C
SN Sol'n Temp Corr.	
Off	
Ultra Pure Water	
High pH	
Custom	

Figure 39: Solution Temperature Correction Screen

The default value (Off) is displayed in bold.

Procedure

Refer to Figure 35 to select a solution temperature correction algorithm.

7.2.4 Enter Custom Solution Temperature Coefficient

Figure 40 displays the screen on which you can enter a custom solution temperature coefficient.

7 pH	25.0 °C
SN Sol'n Temp Coeff.	
-0.032pH/°C	

Figure 40: Solution Temperature Coefficient Screen

The default value (-0.032 pH/°C) is displayed in bold.

Procedure

Refer to Figure 35 to enter a custom solution coefficient.

7.2.5 Select pH Display Resolution

Figure 41 displays the screen from which you can select a display resolution.

7 pH	25.0 °C
SN Resolution	
0.01pH	
0.1pH	

Figure 41: Resolution Screen

The default value (0.01pH) is displayed in bold.

Procedure

Refer to Figure 35 to select a resolution.

7.2.6 Enter Input Filter Value

Figure 42 displays the screen on which you can enter the input filter value in seconds.



Figure 42: Input Filter Value Screen

The default value (04 sec) is displayed in bold.

Procedure

Refer to Figure 35 to enter the input filter value.

7.2.7 Select Reference Impedance

Figure 43 displays the screen from which you can select the reference impedance.

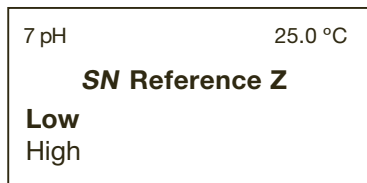


Figure 43: Reference Impedance Screen

The default value (Low) is displayed in bold.

Procedure

Refer to Figure 35 to select the reference impedance.

7.3 Program Oxidation Reduction Potential (ORP) Measurement

Figure 35 is a detailed flow diagram for ORP programming to guide you through all basic programming and configuration functions.

To configure the ORP board:

1. Press **MENU**.
2. Go to **Program** → **Measurement**.
3. Select Sensor 1 corresponding to ORP, then press **Enter**.

Figure 44 appears; factory default settings are shown.

12 mV	25.0 °C
SN Configure	
Measure:	ORP
Preamp:	Analyzer
Filter:	4 sec
Reference Z:	Low

Figure 44: Configure ORP Screen

To change any setting, scroll to the desired item and press **ENTER**.

7.3.1 Select Measurement Type

Figure 45 displays the screen where you can choose the measurement type.

12 mV	25.0 °C
SN Measurement	
pH	
ORP	
Redox	

Figure 45: Measurement Screen

The default value (ORP) is displayed in bold type. Refer to Figure 35 to select a measurement type.

7.3.2 Select Preamplifier Location

Figure 46 shows the screen from which you can select the preamp location.

12 mV	25.0 °C
SN Preamp	
Analyzer	
Sensor/JBox	

Figure 46: Preamp Screen

The default location (Analyzer) is in bold.

For Hamilton sensors, select Sensor/JBox.

Procedure

Refer to Figure 35 to select a preamplifier location.

7.3.3 Enter Input Filter Value

Figure 47 displays the screen on which you can enter the input filter value in seconds.



Figure 47: Input Filter Value Screen

The default value (04 sec) is displayed in bold.

Procedure

Refer to Figure 35 to enter the input filter value.

7.3.4 Select Reference Impedance

Figure 48 displays the screen from which you can select the reference impedance.

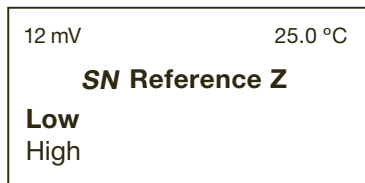


Figure 48: Reference Impedance Screen

The default value (Low) is displayed in bold.

Procedure

Refer to Figure 35 to select the reference impedance.

7.4 Program Contacting Conductivity Measurement

Figure 49 is a detailed flow diagram for conductivity programming to guide you through all basic programming and configuration functions.

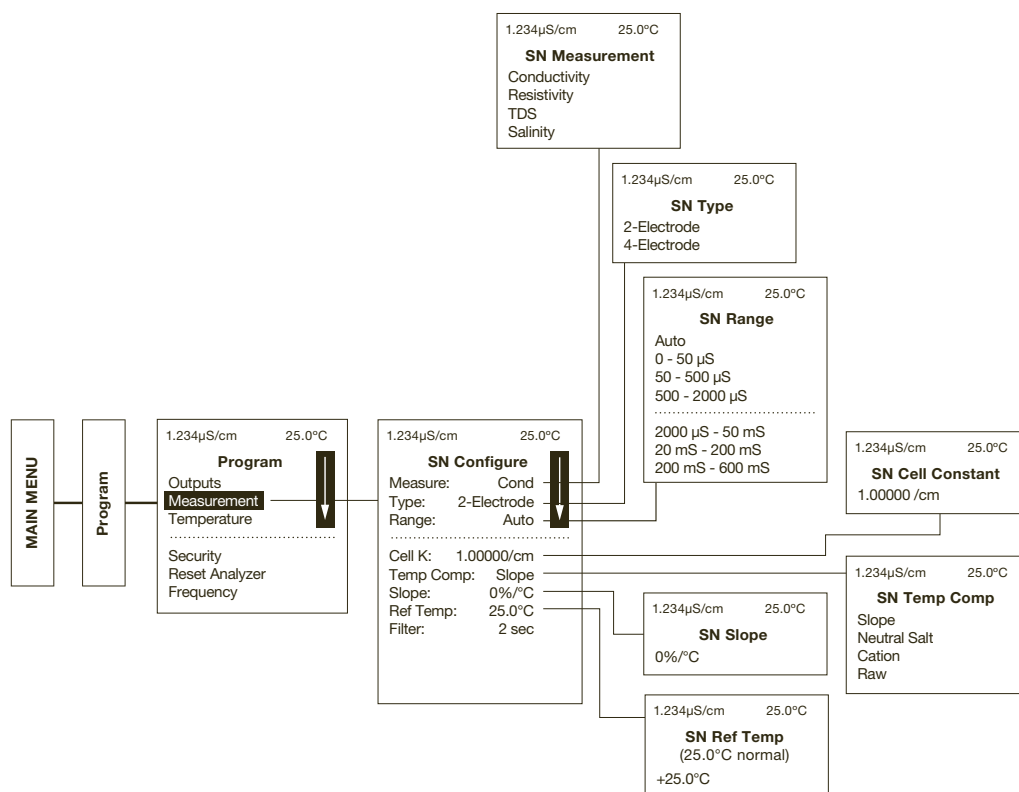


Figure 49: Flow Diagram for Configure Contacting Programming

To configure the conductivity measurement board:

1. Press **MENU**.
2. Go to **Program** → **Measurement**.
3. Select Sensor corresponding to contacting conductivity. Press **ENTER**.

Figure 50 appears; factory default settings are shown.

1.234 $\mu\text{S/cm}$	25.0 $^{\circ}\text{C}$
SN Configure	
Type:	2-Electrode
Measure:	Cond
Range:	Auto
Cell K:	1.00000/cm
Temp Comp:	Slope
Slope:	2.00%/ $^{\circ}\text{C}$
Ref Temp:	25.0 $^{\circ}\text{C}$
Filter:	2 sec

Figure 50: Configure Conductivity Screen

To change any setting, scroll to the desired item and press **ENTER**.

7.4.1 Select Sensor Type

Figure 51 displays the screen from which you can select the sensor type.

1.234 $\mu\text{S/cm}$	25.0 $^{\circ}\text{C}$
SN Type	
2-Electrode	
4-Electrode	

Figure 51: Sensor Type Screen

The default value (2-Electrode) is in bold.

Procedure

Refer to Figure 49 to select a sensor type.

7.4.2 Select Measurement Type

Figure 52 displays the screen from which you can select the measurement type.

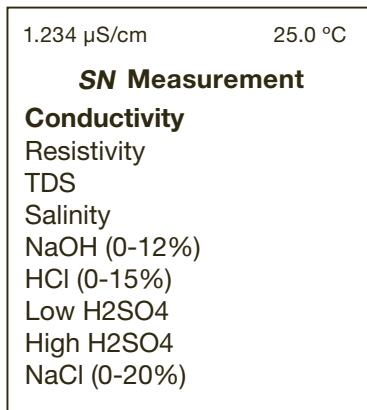


Figure 52: Measurement Screen

The default value (Conductivity) is in bold.

Procedure

Refer to Figure 49 to select a measurement type.

7.4.3 Select Range

Figure 53 displays the screen from which you can select the sensor range.

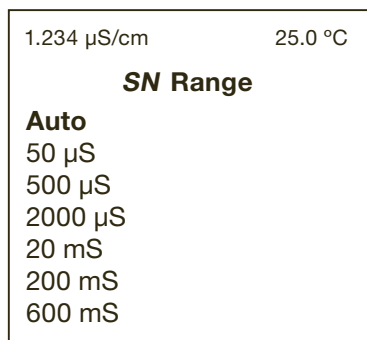


Figure 53: Range Screen

The default value (Auto) is in bold.



Notice: Ranges are shown as conductance, not conductivity.

Procedure

Refer to Figure 49 to select a range.

7.4.4 Enter Cell Constant

Figure 54 displays the screen on which you can enter the cell constant.

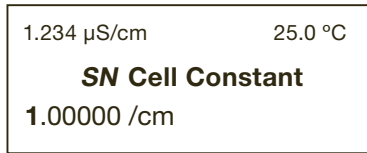


Figure 54: Cell Constant Screen

The default value (1) is in bold.

Procedure

Refer to Figure 49 to enter a cell constant.

7.4.5 RTD Offset

Figure 55 displays the screen from which you can enter the RTD offset for a contacting conductivity sensor.



Figure 55: RTD Offset Screen

The default value (0) is in bold.

Procedure

Refer to Figure 49 to enter a RTD offset.

7.4.6 RTD Slope

Figure 56 displays the screen from which you can enter the RTD slope.



Figure 56: RTD Slope Screen

The default value (2.00%/°C) is in bold.

Procedure

Refer to Figure 49 to enter a RTD Slope.

7.4.7 Enter Temperature Compensation

Figure 57 displays the screen from which you can select the temperature compensation.

1.234 $\mu\text{S/cm}$	25.0 $^{\circ}\text{C}$
SN Temp Comp	
Slope	
Neutral Salt	
Cation	
Raw	

Figure 57: Temperature Compensation Screen

The default value (Slope) is in bold.

Procedure

Refer to Figure 49 to select a temperature compensation.

7.4.8 Enter Slope

Figure 58 displays the screen on which you can enter the slope.

1.234 $\mu\text{S/cm}$	25.0 $^{\circ}\text{C}$
SN Slope	
2.00%/°C	

Figure 58: Slope Screen

The default value (2.00%/°C) is in bold.

Procedure

Refer to Figure 49 to enter the slope.

7.4.9 Enter Reference Temperature

Figure 59 displays the screen on which you can enter the reference temperature manually.

1.234 $\mu\text{S/cm}$	25.0 $^{\circ}\text{C}$
SN Ref Temp	
(25.0 $^{\circ}\text{C}$ normal)	
+25.0$^{\circ}\text{C}$	

Figure 59: Reference Temperature Screen

The default value (+25.0 $^{\circ}\text{C}$) is in bold.

Procedure

Refer to Figure 49 to enter the reference temperature.

7.4.10 Enter Input Filter Value

Figure 60 displays the screen on which you can enter the input filter value in seconds.



Figure 60: Filter Screen

The default value (02 sec) is in bold.

Procedure

Refer to Figure 49 to enter the input filter value.

7.4.11 Enter Cal Factor

Upon initial installation and power up, if 4-electrode was selected for the sensor type in the **Quick Start** menus, enter a **Cell Constant** and a **Cal Factor** using the instrument keypad. The cell constant is needed to convert measured conductance to conductivity as displayed on the transmitter screen. The **Cal Factor** entry is needed to increase the accuracy of the live conductivity readings, especially at low conductivity readings below 20 $\mu\text{S/cm}$.

Cal factor is not used for Hamilton sensors.

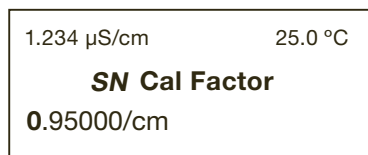


Figure 61: Cal Factor Screen

For Hamilton sensors use a factor of 1.

7.5 Program Oxygen Measurement

You can configure the Hamilton H210X transmitter to measure dissolved and gaseous oxygen using amperometric oxygen sensors.

Figure 62 is a detailed diagram for oxygen programming to guide you through all basic programming and configuration functions.

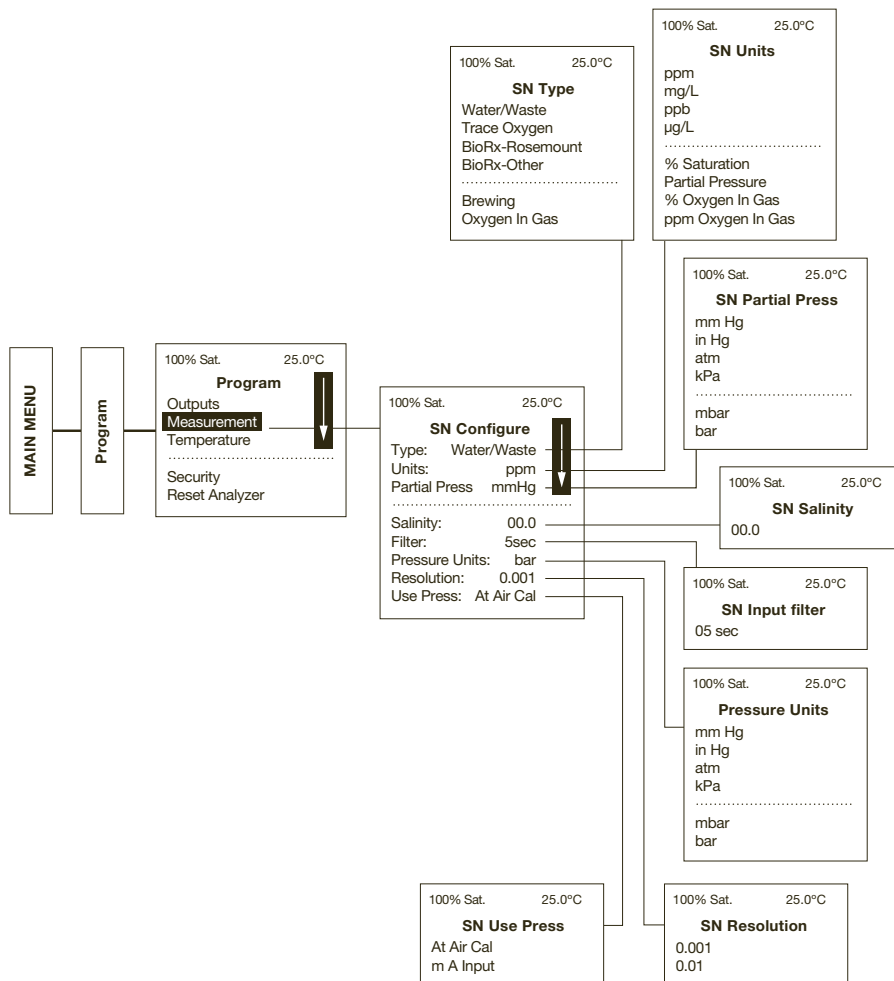


Figure 62: Programming Oxygen Measurement

Procedure

1. Press **MENU**.
2. Scroll down to Program. Press **ENTER**.
3. Scroll down to Measurement. Press **ENTER**.
4. Select Sensor corresponding to oxygen. Press **ENTER**.
Figure 63 appears; factory default settings are shown.
5. To change a setting, scroll to the desired item and press **ENTER**.

100 % Sat	25.0 °C
SN Configure	
Type:	Water/Waste
Units:	ppm
Partial Press:	mmHg
.....	
Salinity:	00.0‰
Filter:	5sec
Pressure Units:	bar
Use Press:	At Air Cal
Custom Setup	

Figure 63: Configure Oxygen Screen

Select oxygen measurement application

Procedure

1. From the Configure Oxygen screen, select Type.
Figure 64 appears.

100 % Sat	25.0 °C
SN Type	
Water/Waste	
Trace Oxygen	
BioRx-Rosemount	
Visiferm/Oxyferm	
.....	
OxyGold G	
OxyGold B	

Figure 64: Type Screen

2. Refer to Figure 62 to select the application.

Select measurement units

The default value is displayed in bold type.

Procedure

1. From the **Configure Oxygen** screen, select Units.
Figure 65 appears.

100 % Sat	25.0 °C
SN Units	
ppm	
mg/L	
ppb	
µg/L	
.....	
% Saturation	
Partial Pressure	
% Oxygen In Gas	
ppm Oxygen In Gas	

Figure 65: Units Screen

Refer to Figure 62 to select a measurement unit.

Select partial pressure units

If you select Partial Pressure as the measurement unit on the **Units** screen, you need to select the partial pressure measurement units.

Procedure

1. From the **Configure Oxygen** screen, select Units.
The **Units** screen appears.
2. Select Partial Pressure.
Figure 66 appears.

100 % Sat	25.0 °C
SN Partial Press	
mm Hg	
in Hg	
atm	
kPa	
.....	
mbar	
bar	

Figure 66: Units Screen

3. Refer to Figure 62 to select a partial pressure unit.

Enter salinity

Procedure

1. From the Configure Oxygen screen, select Salinity.
Figure 67 appears.

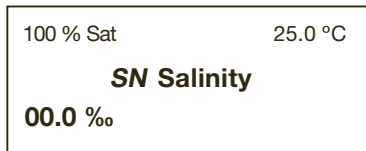


Figure 67: Salinity Screen

2. Enter the percentage of salinity in the process liquid.
Refer to Figure 62.

Enter input filter value

Procedure

1. From the Configure Oxygen screen, select Filter.
Figure 68 appears.



Figure 68: Input Filter Screen

2. Refer to Figure 62 to enter the input filter value in seconds.

Select atmospheric pressure units

Select atmospheric pressure units to determine how the transmitter will display atmospheric pressure measured by the pressure transducer on the oxygen measurement board.

Procedure

1. From the **Configure Oxygen** screen, select Pressure Units.
Figure 69 appears.

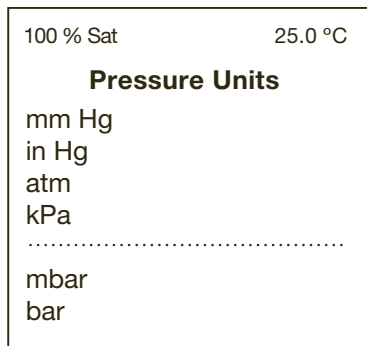


Figure 69: Units Screen

2. Refer to Figure 62 to select the atmospheric pressure unit.

8 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 transmitter's auto-recognition feature will enable the appropriate calibration screens to allow calibration for any single sensor configuration. Completing the Quick Start when first powering up the transmitter enables live measurement, but does not ensure accurate readings in the lab or in process. Calibrate with each attached sensor to ensure accurate, repeatable readings.

8.1 Calibrate pH Sensors

Calibrate new sensors before use and regularly recalibrate them.

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 when calibrating. Once the transmitter successfully completes calibration, it calculates and displays the calibration slope and offset. The slope is reported as the slope at 25 °C (77 °F).

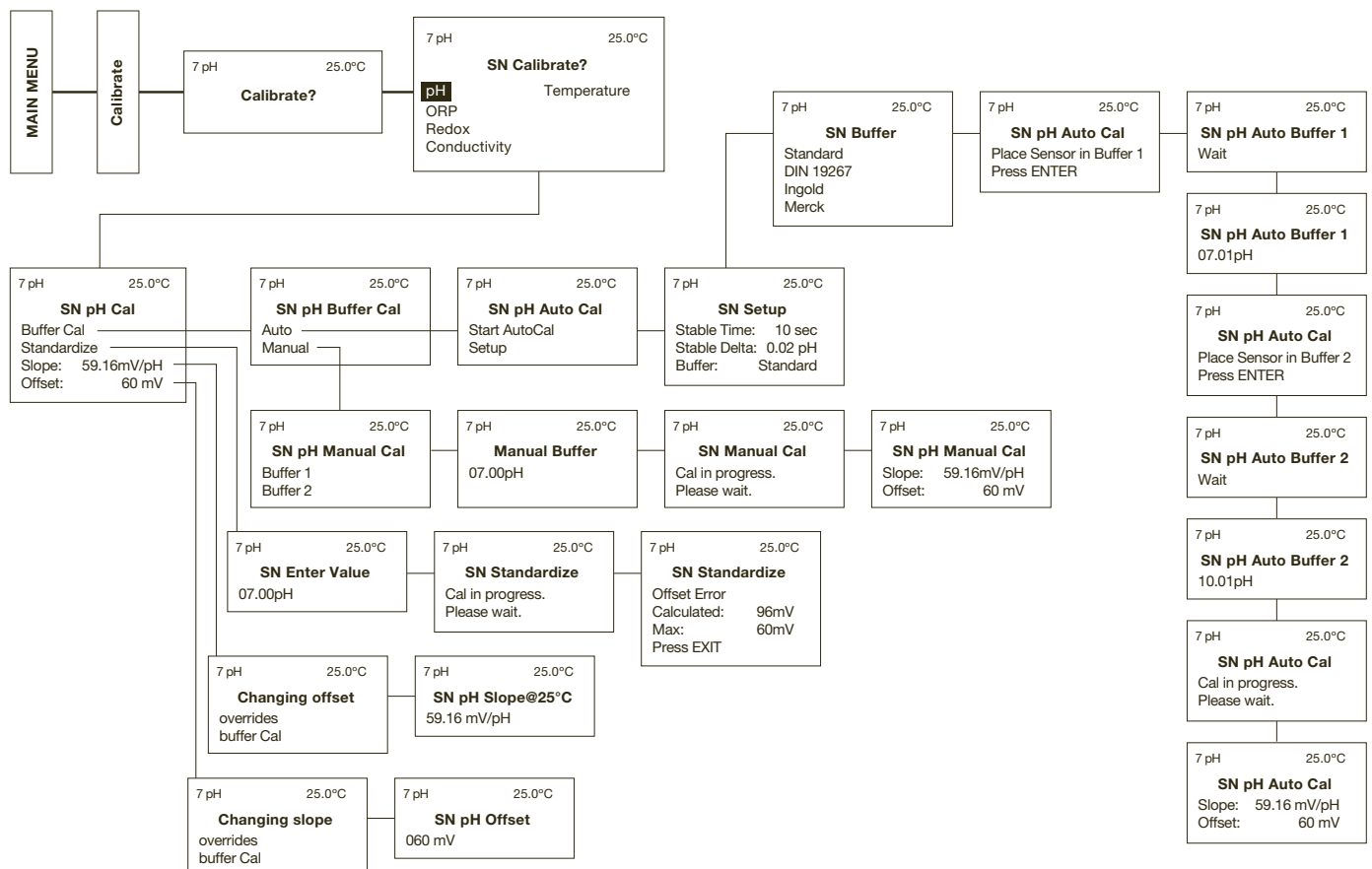


Figure 70: pH Calibration Menu Tree

Procedure

1. Press **MENU**.
2. Select Calibrate. Press **ENTER**.
3. Select Sensor corresponding to pH. Press **ENTER**.
4. Select pH. Press **ENTER**.

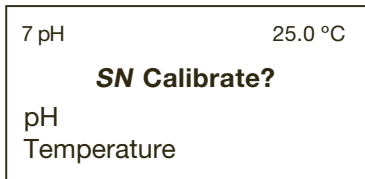


Figure 71: Calibration Screen

5. If desired, change the auto calibration criteria.

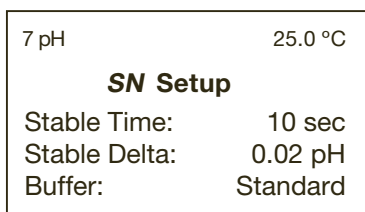


Figure 72: Set up Auto Calibration Screen

You can adjust the following:

- Stabilization time (default 10 seconds)
- Stabilization pH value (default 0.02 pH)
- Type of buffer used for auto calibration (default is standard, non-commercial buffers)

The transmitter recognizes the following commercial buffer tables:

- Hamilton Buffers
- Standard (NIST plus pH 7)
- DIN 19267
- Ingold
- Merck

Figure 73 appears if the auto calibration is successful:

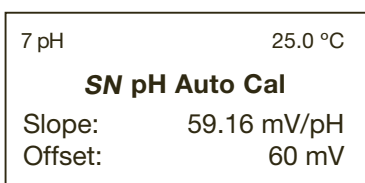


Figure 73: Calibration successful screen

Figure 74 through Figure 76 may appear if the auto calibration is unsuccessful.

7 pH 25.0 °C

SN pH Auto Cal

High Slope Error

Calculated: 62.11 mV/pH

Max: 62.00 mV/pH

Press EXIT

Figure 74: High Slope Error

7 pH 25.0 °C

SN pH Auto Cal

Low Slope Error

Calculated: 39.11 mV/pH

Min: 40.00 mV/pH

Press EXIT

Figure 75: Low Slope Error

7 pH 25.0 °C

SN pH Auto Cal

Offset Error

Calculated: 61.22 mV

Max: 60.00 mV

Press EXIT

Figure 76: Offset Error

8.1.1 Calibrate pH Sensors Manually

Use manual calibration only if using non-standard buffers. Otherwise, use auto calibration. Auto calibration avoids common pitfalls and reduces errors.

7 pH 25.0 °C

SN pH Manual Cal

Buffer 1

Buffer 2

Figure 77: Manual Calibration Screen

8.1.2 Enter a Known Slope Value for pH Sensors

Procedure

If you know the electrode slope from other measurements, enter it directly in the transmitter.

Enter the slope as the slope at 25 °C (77.0 °F).

7 pH	25.0 °C
SN pH Slope@25°C	
59.16 mV/pH	

8.1.3 Standardize pH Sensors (process/product calibration)

Standardization adjusts the pH value measured by the H210X transmitter to match a calibrated reference instrument or result from a sample taken from the process. Hamilton also refers to this procedure as process calibration or product calibration.

Standardization is a one-point adjustment performed under actual process conditions. It changes the measurement offset but does not change the sensor slope or replace a buffer calibration.

Standardization principle

During standardization, the H210X transmitter compares the measured process pH with the reference pH entered by the user. The difference is converted into an equivalent voltage, called the reference offset.

The transmitter adds this offset to all subsequent sensor voltages before converting them to pH.

After standardization, placing the sensor in a buffer solution may produce a measured value that differs from the certified buffer value. This difference corresponds to the applied standardization offset.

7 pH	25.0 °C
SN Enter Value	
07.00pH	

 **Notice:** This screen may appear if pH Cal is unsuccessful. An Offset Error will generate this screen display:

7 pH	25.0 °C
SN Standardize	
Offset Error	
Calculated:	96mV
Max:	60mV
Press EXIT	

If the pH Cal is successful, the screen will return to the Cal submenu.

8.2 Calibrate Oxidation Reduction Potential (ORP) Sensors

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

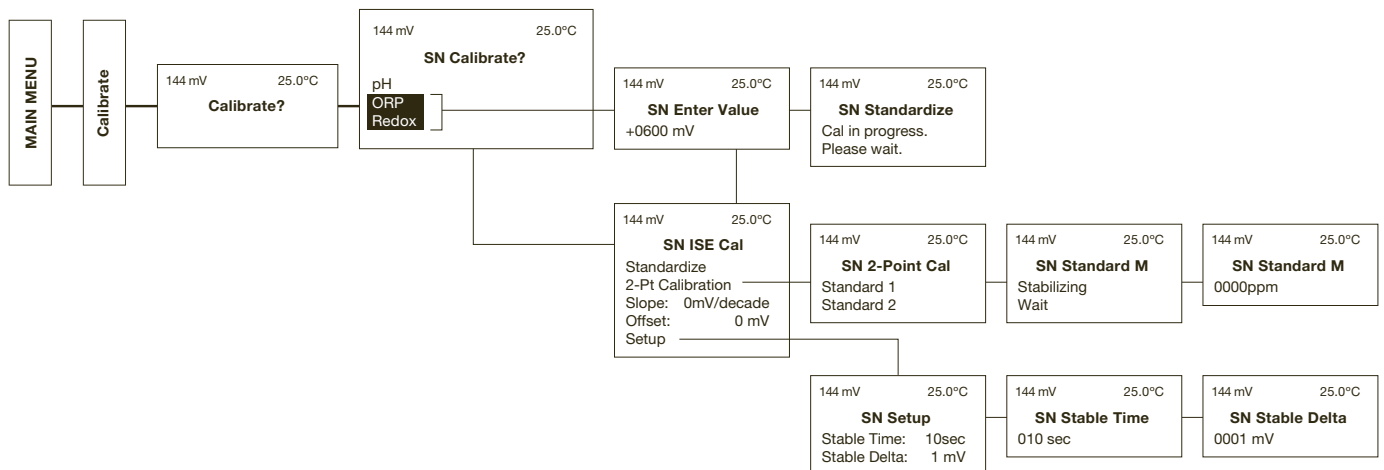


Figure 78: Calibrate ORP Menu Tree

Procedure

1. Press **MENU**.
2. Select Calibrate. Press **ENTER**.
3. Select Sensor corresponding to ORP. Press **ENTER**.

144 mV	25.0 °C
SN Calibrate?	
ORP	
Temperature	

4. Select ORP. Press **ENTER**.

144 mV	25.0 °C
SN Enter Value	
+0600 mV	

Figure 79 may appear if ORP calibration is unsuccessful.

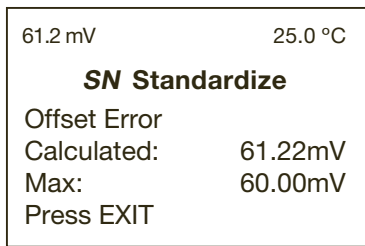


Figure 79: Offset Error

8.3 Calibrate Contacting Conductivity Sensors

Placing a new conductivity sensor in service

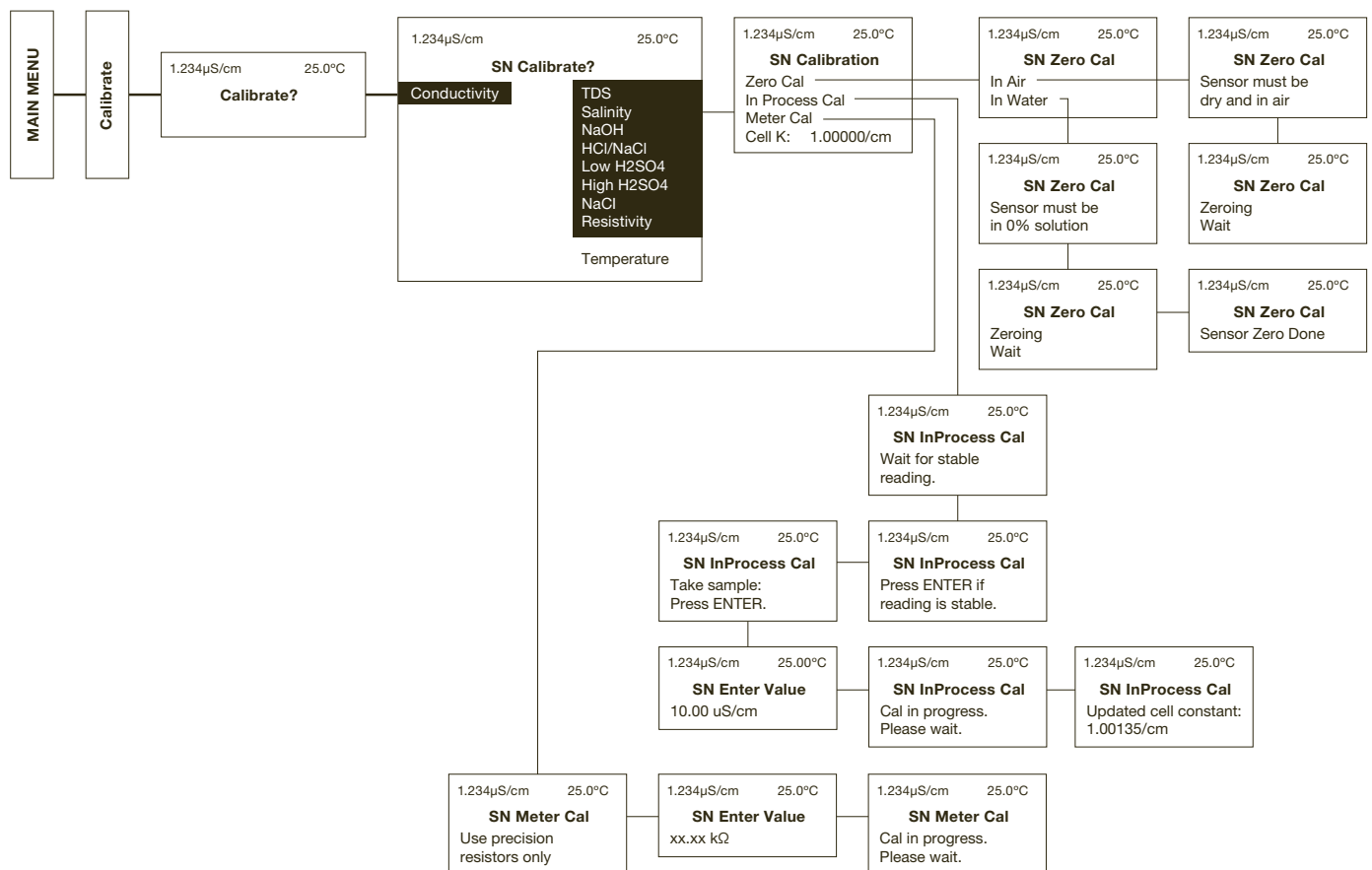


Figure 80: Calibrate Conductivity Sensors Menu Tree

Calibrating an in-service conductivity sensor

After prolonged operation of a conductivity sensor, recalibration may be required. Three calibration methods are available for calibrating the conductivity sensor:

1. Compare Against a Standard Instrument

Use a standard instrument and reference sensor to measure the conductivity of the process stream. This method does not require removal of the sensor from the process piping.

To minimize measurement differences, disable temperature compensation on both the Hamilton H210X Transmitter and the standard instrument before comparing readings.

2. Calibrate Using a Conductivity Standard Solution

Remove the sensor from the process and place it in a solution of known conductivity. Adjust the transmitter reading to match the conductivity value of the standard solution.



Notice: Conductivity standards below 100 $\mu\text{S}/\text{cm}$ are highly susceptible to atmospheric contamination and should be handled carefully.



Caution! Do not calibrate sensors with a 0.01/cm cell constant using conductivity standards above 100 $\mu\text{S}/\text{cm}$. The resistance of these solutions may be too low to provide accurate measurements.

3. Calibrate a 0.01/cm Sensor Using a Reference Sensor

To calibrate a 0.01/cm conductivity sensor, compare it against a standard instrument and a second 0.01/cm sensor while both sensors are measuring water with a conductivity between 5 and 10 $\mu\text{S}/\text{cm}$.

For best results:

- Saturate the sample with air before taking measurements to minimize drift caused by atmospheric carbon dioxide absorption.
- Take the sample downstream of the sensor to ensure adequate flow during calibration.
- Use a flow-through standard cell whenever possible. If the process temperature differs significantly from ambient temperature, keep connecting lines short and insulate the flow cell.

To calibrate the Hamilton H210X with an attached conductivity sensor:

Procedure

1. Press **MENU**.
2. Select Calibrate. Press **ENTER**.
3. Select Sensor corresponding to conductivity. Press **ENTER**.

1.234 $\mu\text{S}/\text{cm}$	25.0 $^{\circ}\text{C}$
SN Calibrate?	
Conductivity	
Temperature	

4. To calibrate conductivity or temperature, scroll to the desired item and press **ENTER**.

1.234 $\mu\text{S/cm}$	25.0 $^{\circ}\text{C}$
SN Calibration	
Zero Cal	
In Process Cal	
Meter Cal	
Cell K:	0.36/cm

5. Enter a cell constant only if you are installing the sensor for the first time, replacing the probe, or troubleshooting.
This procedure sets up the transmitter for the probe type connected to it. Each type of probe has a specific cell constant.

1.234 $\mu\text{S/cm}$	25.0 $^{\circ}\text{C}$
SN Cell Constant	
0.36 /cm	

8.3.1 Zero the Transmitter

The purpose of zeroing the transmitter is to compensate for small offsets to the conductivity signal that are present even when there is no conductivity to be measured. This procedure is affected by the length of extension cable. Always repeat it if you make any changes in the extension cable or sensor.

Prerequisites



Caution! Ensure that the probe is dry.

1.234 $\mu\text{S/cm}$	25.0 $^{\circ}\text{C}$
SN Zero Cal	
In Air	
In Water	

Procedure

1. Zero the transmitter by electrically connecting the conductivity probe as it will actually be used and placing the measuring portion of the probe in the air.
2. Select Zero Cal from the Conductivity Calibration screen.

If zero calibration is successful, Figure 81 appears.

1.234 $\mu\text{S/cm}$	25.0 $^{\circ}\text{C}$
SN Zero Cal	
Sensor Zero Done	

Figure 81: Successful Zero Calibration

The transmitter returns to the **Conductivity Calibration** screen.

If zero calibration is unsuccessful, Figure 82 may appear.

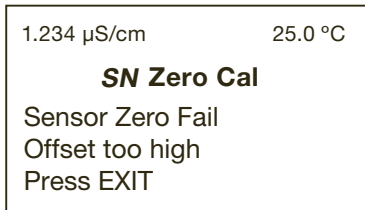


Figure 82: Zero Calibration Unsuccessful

8.3.2 Calibrate the Sensor in a Conductivity Standard (In Process Cal)

Use this procedure to check and correct the transmitter's conductivity reading to ensure it is accurate. To do this, calibrate the sensor and transmitter against a solution of known conductivity.

Prerequisites

- Clean the probe.
- If necessary, check and standardize the temperature reading using a calibrated thermometer.

Procedure

1. Submerge the probe in a sample of known conductivity.
2. If necessary, adjust the displayed value to correspond to the conductivity value of the sample.
3. Turn temperature correction off and use the conductivity of the standard.
4. Select In Process Cal from the Conductivity Calibration screen.



If in process calibration is successful, Figure 83 appears and the transmitter returns to the Conductivity Calibration screen.

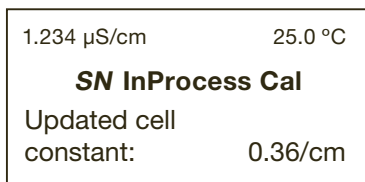


Figure 83: In Process Calibration Successful

If in process calibration is unsuccessful, Figure 84 may appear.

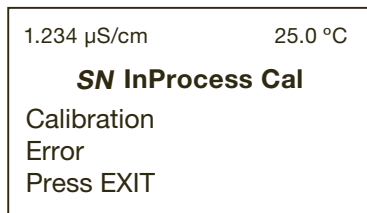


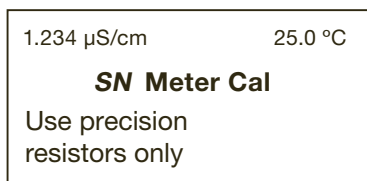
Figure 84: Calibration Error

8.3.3 Calibrate the Sensor to a Laboratory Instrument (Meter Cal)

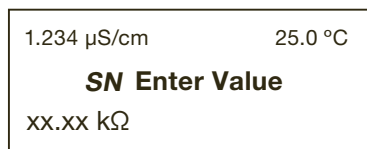
Use this procedure to check and correct the conductivity reading of the transmitter using a laboratory conductivity instrument.

Procedure

1. Submerge the conductivity probe in a bath.
2. Measure the conductivity of a grab sample of the same bath water with a separate laboratory instrument.
3. Adjust the transmitter reading to match the conductivity reading of the lab instrument.
4. Select **Meter Cal** from the **Conductivity Calibration** screen.



5. Press **ENTER**.
The display shows the live value measured by the sensor.



If the meter calibration is successful, the screen returns to the **Conductivity Calibration** screen.
If meter calibration is unsuccessful, Figure 85 appears.

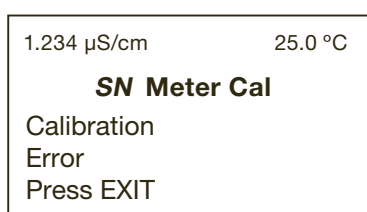


Figure 85: Meter Calibration Error

8.3.4 Enter Calibration Factor

If you selected 4-electrode as the sensor type during the Quick Start procedure, enter the **cell constant** and **calibration factor** specified on the sensor tag.

The cell constant is used to convert the measured conductance into conductivity for display on the transmitter. The calibration factor improves the accuracy of conductivity measurements, particularly at conductivity values below 20 $\mu\text{S}/\text{cm}$.

For Hamilton sensors we recommend a Cal factor of 1.



Related Information

Zero sensor

Calibrate sensor in process

8.3.5 Zero Sensor

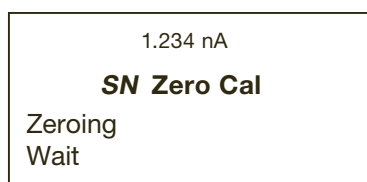
This procedure applies to amperometric sensors only.

Prerequisites

Run the sensor in the zero solution for at least two hours before zeroing.

Procedure

From the **Calibration** screen, select Zero Cal.



If zero calibration is successful, Figure 86 appears.

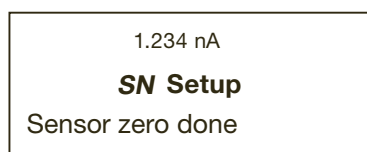


Figure 86: Zero Calibration Successful

The transmitter returns to the **Amperometric Calibration** screen.

If zero calibration is unsuccessful, Figure 87 may appear.

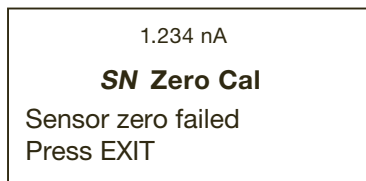


Figure 87: Zero Failed

The transmitter returns to the **Amperometric Calibration** screen.

8.3.6 Calibrate Sensor in Process

Procedure

From the **Calibration** screen, select In Process Cal.



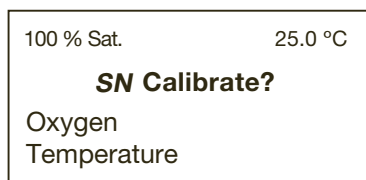
Figure 88: Calibration Screen

If the in process calibration is successful, the transmitter returns to the **Calibration** screen.

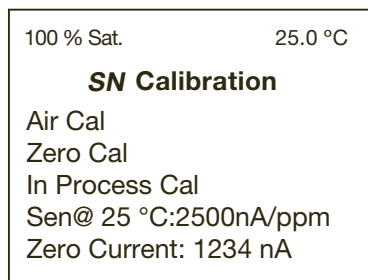
8.4 Calibrate Oxygen

Procedure

1. Press **MENU**.
2. Select Calibrate. Press **ENTER**.
3. Select Sensor corresponding to oxygen. Press **ENTER**.
4. Select Oxygen. Press **ENTER**.



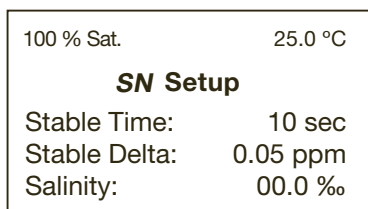
5. To calibrate oxygen or temperature, scroll to the desired item and press **ENTER**.



6. Select Air Cal to adjust air calibration criteria.

You can adjust the following:

- Stabilization time (default 10 sec)
- Stabilisation value/delta (default 0.05 ppm)
- Salinity of the solution to be measured (default 00.0 parts per thousand)



8.4.1 Zero Sensor

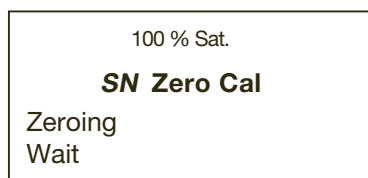
This procedure applies to amperometric sensors only.

Prerequisites

Run the sensor in the zero solution for at least two hours before zeroing.

Procedure

From the Calibration screen, select Zero Cal.



If zero calibration is successful, Figure 89 appears.

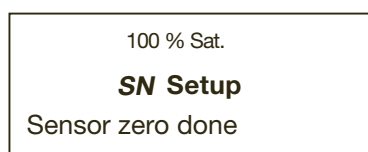


Figure 89: Zero Calibration Successful

The transmitter returns to the **Amperometric Calibration** screen.
If zero calibration is unsuccessful, Figure 90 may appear.

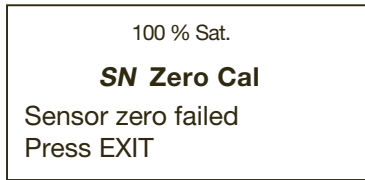


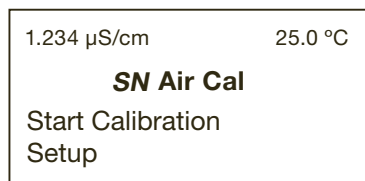
Figure 90: Zero Failed

The transmitter returns to the **Amperometric Calibration** screen.

8.4.2 Calibrate Sensor in Air

Procedure

From the Oxygen Calibration screen, select Air Cal.



If air calibration is successful, Figure 91 appears.

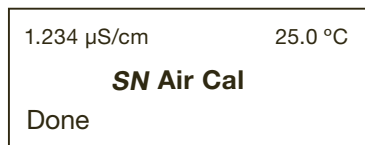


Figure 91: Air Cal Done

The transmitter returns to the **Amperometric Calibration** screen.
If air calibration is unsuccessful, Figure 92 appears.

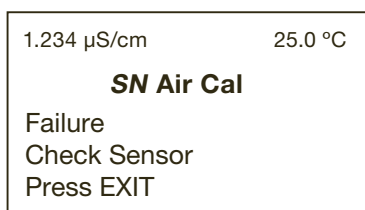


Figure 92: Air Cal Failure

The transmitter returns to the **Amperometric Calibration** screen.

8.5 Calibrate Temperature

Most liquid analytical measurements (except Oxidation Reduction Potential (ORP)) require temperature compensation. The transmitter automatically compensates for temperature by applying internal temperature correction algorithms. You can also turn off temperature correction. If you turn temperature correction off, the transmitter uses the manual temperature you enter in all temperature correction calculations.

To calibrate temperature:

Procedure

1. Press MENU.
2. Select Calibrate. Press ENTER.
3. Select Sensor corresponding to the desired measurement. Press ENTER.
4. Select Temperature. Press ENTER.

1.234 $\mu\text{S/cm}$	25.0 $^{\circ}\text{C}$
SN Calibrate	
+0 25.0 $^{\circ}\text{C}$	

5. The transmitter calibrates temperature.

1.234 $\mu\text{S/cm}$	25.0 $^{\circ}\text{C}$
SN Calibrate	
Cal in progress. Please wait.	

6. If the temperature offset is greater than 5 $^{\circ}\text{C}$ from the default value, Figure 93 may appear.

1.234 $\mu\text{S/cm}$	25.0 $^{\circ}\text{C}$
SN Temp Offset > 5 $^{\circ}\text{C}$	
Continue?	
No Yes	

Figure 93: Temperature Offset Screen

7. To continue, select Yes. To suspend the operation, select No.

If the temperature calibration is successful, the transmitter returns to the Calibration screen.

9 HART® Communications

9.1 Introduction

The Hamilton H210X transmitter supports communication with HART® hosts using either HART Revision 5 or HART Revision 7.

The HART revision can be selected using either the transmitter keypad and display or a HART master, such as AMS or a HART Communicator. The default setting is HART Revision 5.

Some HART host systems do not support HART Revision 7. Therefore, the HART revision should be selected before configuring other transmitter parameters and should be based on the capabilities of the host system.

If supported by the host, HART Revision 7 provides additional functionality, including longer tag names, time-stamped data, measurement status information, and enhanced burst mode capabilities.

When HART Revision 5 is selected, the Hamilton H210X uses Device Revision 1. When HART Revision 7 is selected, the transmitter uses Device Revision 2 or higher.

Ensure that the Device Revision of the DD (Device Description) and the AMS or DeltaV™ installation files match the Device Revision of the transmitter.

A single HART 5 (Device Revision 1) or HART 7 (Device Revision 2 or higher) DD is used for all H210X model variants, including pH/ORP, conductivity, and dissolved oxygen transmitters.

All Hamilton H210X transmitters use the same HART device identification, as shown below.

HART 5 Device Identification (H210X Revision 1)

Manufacturer Name	Emerson
Model Name	46 (0x2E)
Device Type Code	33 (0x0021)
HART Protocol Revision	5.1
Device Revision	1

HART 7 Device Identification (H210X Revision 2)

Manufacturer Name	Emerson
Model Name	H210X
Manufacturer ID	46 (0x2E)
Device Type Code	11809 (0x2E21)
HART Protocol Revision	7.3
Device Revision	2

9.2 Physical Installation and Configuration

9.2.1 HART® Wiring and Output Configuration

HART communications is superimposed on Analog Output 1 for all of the measurements and parameters of the Hamilton H210X.

9.2.2 HART® Multidrop (Bus) Configuration

The HART Polling Address should be left at its default value of 0, unless the H210X 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 **Off** to hold the current output to a minimum value.

9.2.3 HART® Configuration

To access the HART Configuration screens, select the HART menu item in the Main Menu. If HART 7 is chosen (Univ Cmd Rev = 7), the following controls are available:

Univ Cmd Rev:	7
Polling Address:	0
Loop Current Mode:	Off
Find Device Cmd:	Off
Burst Message 0:	Off
Burst Message 1:	Off
Burst Message 2:	Off

Figure 94: HART 7 Configuration Screen: Basic Definitions

Univ Cmd Rev

Toggles between HART version 5 and HART version 7. If the HART host being used can accommodate HART 7, HART 7 should be chosen due to its larger feature set. If the host can only use HART 5, then HART 5 must be chosen.



Notice: If the Hamilton H210X 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.

Polling address

Choose 0 unless Multidrop is being used. If Multidrop is being used, each transmitter should have its own polling address from 1 to 15.

Loop current mode

Set Output 1 current to a minimum value for multidrop applications (HART 7 only).

Find Device Cmd

Setting Find Device to On, enables the H210X to be identified by the host. The transmitter returns identity information including device type, revision level, and device ID (HART 7 only).

Burst Message 0, 1, 2

Toggles burst messages 0, 1, and/or 2 on or off (HART 7 only). See Table 8 for the HART burst commands available.

If HART 5 is chosen (Univ Cmd Rev = 5), the following controls are available:

Univ Cmd Rev:	5
Polling Address:	0
Burst Mode:	Off

Figure 95: HART 5 Configuration Screen: Basic Definitions

Univ Cmd Rev

Toggles between HART version 5 and HART version 7. If the HART host being used can accommodate HART 7, HART 7 should be chosen due to its larger feature set. If the host can only use HART 5, then HART 5 must be chosen.



Notice: If the Hamilton H210X 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.

Burst Mode

Toggles the single HART 5 burst message on or off. See below for the HART burst commands available.

Burst Commands Available in HART® 5 and HART 7

When burst mode is enabled, a HART host can select the data transmitted in burst messages using one of the commands listed in Table 8.

Burst Command	Description
Off	Disables burst mode.
Cmd 1	Bursts the Primary Variable (PV).
Cmd 2	Bursts the loop current and the percentage of range of the Primary Variable (PV).
Cmd 3	Bursts the Primary Variable (PV), Secondary Variable (SV), Tertiary Variable (TV), and Quaternary Variable (QV), together with the loop current.
Cmd 9	Bursts up to eight Device Variables, including time stamp and status information.
Cmd 33	Bursts four Device Variables.
Cmd 48	Bursts additional transmitter status bits (HART 7 only).
Cmd 93	Bursts trend data (HART 7 only).

Table 8: Burst Commands Available in HART® 5 and HART® 7

9.3 Measurements Available via HART®

In addition to the primary process measurement, such as pH or conductivity, the Hamilton H210X provides several live measurement values through HART® communication.

These values are referred to as Device Variables and can be assigned to the HART Dynamic Variables: Primary Variable (PV), Secondary Variable (SV), Tertiary Variable (TV), and Quaternary Variable (QV). This allows compatible HART hosts to read and display multiple process and diagnostic values.

The available Device Variables depend on the transmitter type and the secondary measurements used to calculate the primary measurement.

Chapter 10 provides an overview of the Device Variables available for each transmitter type and shows the Dynamic Variables to which they can be assigned.

9.4 Diagnostics Available via HART®

9.4.1 Status Information – Device Status Bits

Bit	Status	Description
0	Primary Variable Out of Limits	Set when the Primary Variable (PV) exceeds its configured limits.
1	Non-Primary Variable Out of Limits	Set when an active Device Variable other than the PV exceeds its limits.
2	Loop Current Saturated	Set when Analog Output 1 is not fixed and the output current is less than 3.8 mA or greater than 22.0 mA.
3	Loop Current Fixed	Set when Analog Output 1 is being simulated or calibrated, or when a device failure causes the output to be driven to a configured fixed value.
4	More Status Available	Set when one or more Additional Transmitter Status bits become active.
5	Cold Start	Set after a master reset or power cycle. Separate status bits are maintained for primary and secondary masters.
6	Configuration Changed	Set when a configuration or calibration parameter is changed through a HART command or the local user interface. Separate status bits are maintained for primary and secondary masters.
7	Field Device Malfunction	Set when a fault is detected in the transmitter electronics or sensor.

Table 9: Device Status Bits

9.4.2 Additional Transmitter Status (Command 48)

Additional Transmitter Status provides diagnostic status bits related to the condition of the sensor, transmitter electronics, and memory of the Hamilton H210X.

Calibration errors and operational events, such as an active calibration, are also reported through status bits.

Chapter 11 provides an overview of the Command 48 status bits and shows how they are organized according to the H210X transmitter measurement type.

Bit	Status	Description
0	Maintenance Required	Set when a device fault is detected.
1	Device Variable Alert	Set when the status of any enabled Device Variable is not good.
2	Critical Power Failure	Not supported by the Hamilton H210X and always cleared.

Table 10: Device Status Bits

9.5 HART® Hosts

HART host systems, such as Emerson AMS™, access the Hamilton H210X using the associated HART device descriptions and host integration files.

A HART host can be used to view live measurements and diagnostic information, configure measurement parameters, and calibrate the Hamilton H210X.

The available HART® configuration parameters are provided in Chapter 12.

10 Device Variables

10.1 pH Device Variables

Device variable name	Assignable to dynamic variables	Variable range
Primary value type:		
pH (1)	Primary variable (PV), secondary variable (SV), tertiary variable (TV), or quaternary variable (QV)	0 to 14 pH
ORP (2)	PV, SV, TV or QV	-1,500 to 1,500 mV
Redox (3)	PV, SV, TV or QV	-1,500 to 1,500 mV
Other Device variables:		
Temperature	SV, TV or QV	-15 to +200 °C, 5 to +360 °F
Sensor mV input	TV or QV	-750 to 750 mV
Sensor Glass impedance	TV or QV	0 to 2,000 MΩ
Sensor Reference impedance	TV or QV	0 to 10,000 kΩ

10.2 Conductivity Device Variables

Device variable name	Assignable to dynamic variables	Variable range
Primary value type:		
Conductivity (7)	Primary variable (PV), secondary variable (SV), tertiary variable (TV), or quaternary variable (QV)	0 to 2,000,000 μS/cm
Resistivity (8)	PV, SV, TV or QV	0 to 50,000,000 μ -cm
% Concentration:		
NaOH (9)	PV, SV, TV or QV	0 to 12%
HCl (10)	PV, SV, TV or QV	0 to 15%
Low H2SO4 (11)	PV, SV, TV or QV	0 to 25%
High H2SO4 (12)	PV, SV, TV or QV	96 to 99.7%
NaCl (13)	PV, SV, TV or QV	0 to 20%
Custom Concentration	(14) PV, SV, TV or QV	0 to 1,000 ppm, 0 to 1,000 mg/L, 0 to 100 mg/L, 0 to 100 %, 0 to 1,000 None
Total dissolved solids (TDS) (15)	PV, SV, TV or QV	0 to 10,000 ppm
Salinity (16)	PV, SV, TV or QV	0 to 36 ppt
Other Device variables:		
Temperature	SV, TV or QV	-25 to +200 °C, -13 to +360 °F
Conductance	TV or QV	0 to 2,000,000 μS
Input resistance	TV or QV	0 to 500 kΩ
Raw Conductivity	TV or QV	0 to 2,000,000 μS/cm
Raw Resistivity	TV or QV	0 to 50,000,000 ohm-cm

10.3 Dissolved Oxygen Device Variables

Device variable name	Assignable to dynamic variables	Variable range
Primary value type:		
Oxygen (17)	Primary variable (PV), secondary variable (SV), tertiary variable (TV), or quaternary variable (QV)	0 to 100 ppm 0 to 1,000 ppb 0 to 100 mg/L 0 to 1,000 µg/L 0 to 300 % Saturation 0 to 760 mmHg 0 to 30 inHg 0 to 1 bar 0 to 1,000 mbar 0 to 100 kPa 0 to 1 atm
Other Device variables:		
Temperature	PV, SV, TV or QV	-15 to +200 °C +5 to +360 °F
Temperature resistance	TV or QV	0 to 100,000
Sensor input current	PV, SV, TV or QV	0 to 100,000 nA

11 Additional Transmitter Status

Command 48 Status Bits

11.1 Common Status Bits

Byte/Bit	Meaning/Class	Device Status Bits Set
1/0	Cpu Error/Error The software checksum is not as expected. The central processing unit (CPU) memory has been corrupted.	4 – More status available 7 – Field Device Malfunction
1/1	Self-Test Fail/Error An electronic component is out of specification.	4 – More Status available 7 – Field Device Malfunction
1/2	Factory Data Error/Error An error was detected in the factory segment of the nonvolatile memory. At least one factory configuration parameter has been corrupted.	4 – More Status available 7 – Field Device Malfunction
1/3	Hardware/Software Mismatch/Error The software is not compatible with the hardware.	4 – More Status available 7 – Field Device Malfunction
1/4	Internal Communications Error/Error The analog input electronics is non-responsive.	4 – More Status available 7 – Field Device Malfunction
3/0	Keypad Error/Warning At least one key in the device keypad is stuck. This condition makes the local operator interface unusable. If no other alerts are present, the device can still perform its other functions normally.	4 – More Status available

3/1	User Data Error/Warning An error was detected in the non-volatile memory. One or more user configuration parameters may be corrupted. Reset analyzer to factory defaults and reconfigure the device. If the problem persists, replace the device	4 – More Status available
3/2	Need Factory Calibration/Warning The device's non-volatile memory has been corrupted. The device measurements may be out of specification.	4 – More Status available
3/3	Software Mismatch/Warning The input CPU software is not fully compatible with the main CPU software.	4 – More Status available
3/7	Reset In progress/Other The transmitter's configuration is being reset to factory defaults.	4 – More Status available
6/6	Maintenance Required/Other	4 – More Status available
6/1	Device variable alert/Other	4 – More Status available
8/0	Simulation active/Mode A device variable is being simulated.	4 – More Status available
8/1	Non-volatile Memory Defect/Warning	4 – More Status available
8/2	Volatile Memory Defect/Error	4 – More Status available
8/3	Watchdog Reset Executed/Other	4 – More Status available
8/4	Power Supply Condition Out Of Range/Warning	4 – More Status available
8/5	Environmental Condition Out Of Range/Warning	4 – More Status available
8/6	Electronic Defect/Error Reset device or turn power off then on. If problem persists, replace device.	4 – More Status available
8/7	Device locked/Mode Locked device prevents all host modifications. Unlock device to make changes to the device.	4 – More Status available
10/0	Analog Channel 1 Saturated/Warning The primary variable is outside the analog output range. 1. Check the primary value. 2. Check the analog output scaling.	4 – More Status available
10/1	Analog Channel 2 Saturated/Warning The secondary variable is outside the analog output range. 1. Check the secondary value. 2. Check the analog output scaling.	4 – More Status available
13/0	Analog Channel 1 Fixed/Mode Output 1 is either being tested, calibrated, or accidentally left on hold. A fault condition could also set the analog output to a fixed value. If there is no active fault, wait for test or calibration to end or take Output 1 out of hold mode.	4 – More Status available
13/1	Analog Channel 2 Fixed/Mode Output 2 is either being tested, calibrated, or accidentally left on hold. A fault condition could also set the analog output to a fixed value. If there is no active fault, wait for test or calibration to end or take Output 2 out of hold mode.	4 – More Status available

11.2 Temperature Status Bits

Byte/Bit	Meaning/Class	Device Status Bits Set
0/0	Temperature Error / Error The temperature measuring circuit is open or shorted. Check the wiring and the temperature element in the sensor. If the temperature element in the sensor is open or shorted, replace the sensor.	4 – More Status available 7 – Field Device Malfunction
2/0	Temperature High / Warning The measured temperature is above the temperature range of the transmitter and can damage the sensor. The temperature limits are: • H210X DO and pH: Temperature > 150 °C • H210X COND: Temperature > 300 °C 1. Check process temperature. 2. Check sensor and its wiring.	1 – Non-primary variable out of limits 4 – More Status available
2/1	Temperature Low / Warning The measured temperature is below the temperature range of the transmitter and can damage the sensor. The temperature limits are: • H210X DO and pH: Temperature < -15 °C • H210X COND: Temperature < -25 °C 1. Check process temperature. 2. Check sensor and its wiring.	1 – Non-primary variable out of limits 4 – More Status available
2/2	RTD Sense line Open / Warning The sense line of the temperature sensor is not connected. 1. Check sensor wiring. 2. If a 2-wire RTD is being used for temperature compensation, use wire jumper to connect sense and return terminals.	4 – More Status available
5/1	Temperature Calibration In Progress/Other A temperature calibration is or has been performed.	4 – More Status available

11.3 pH/ORP Status Bits

Byte/Bit	Meaning/Class	Device Status Bits Set
0/1	Reference Impedance Too High / Error The reference impedance is above the high fault setpoint. The reference electrode may be coated or plugged. 1. Clean or replace the sensor. 2. Check sensor wiring. 3. Increase the setpoint value. 4. Set the reference impedance level to high.	4 – More Status available 7 – Field Device Malfunction
0/2	Glass Impedance Too High / Error The glass impedance is above the high fault setpoint. The glass electrode may be severely coated.	4 – More Status available 7 – Field Device Malfunction
0/3	Broken pH Glass / Error The glass impedance is too low. The glass electrode of the pH sensor may be cracked.	4 – More Status available 7 – Field Device Malfunction
2/3	pH Voltage Too High / Warning The sensor voltage is outside the expected range for a pH measurement. 1. Check sensor wiring. 2. Replace sensor.	4 – More Status available

4/0	pH Slope Too High / Warning The pH slope calculated during buffer calibration exceeded the maximum slope limit. 1. Check the buffers used and retry buffer calibration. 2. Increase the maximum slope limit (default is 62 mV/pH). Note: A slope of 62 mV/pH or greater indicates that an error occurred during calibration or the pH sensor is faulty. 3. Replace sensor.	4 – More Status available
4/1	pH Slope Too Low / Warning The pH slope calculated during buffer calibration was below the minimum slope limit. The pH electrode may be worn out, damaged, or coated. 1. Check and clean sensor, then retry buffer calibration. 2. Decrease minimum slope limit (default is 40 mV/pH). Note that a pH sensor with a slope less than 50 mV/pH is usually near the end of its useful life.	4 – More Status available
4/2	Zero Offset Error / Warning The zero offset from a buffer calibration or single point standardization has exceeded the limit. The reference electrode may be poisoned or plugged. 1. Check and clean sensor, then retry buffer calibration. 2. Increase maximum offset limit (default is 60 mV). Note that a pH sensor with an offset of 60 mV or greater is likely poisoned and has to be replaced. 3. Replace sensor.	4 – More Status available
4/3	Calibration Error / Warning	4 – More Status available
5/4	pH Standardization In Progress / Other A pH standardization is being or has been performed.	4 – More Status available
5/5	Buffer Calibration In Progress / Other A pH buffer calibration is being or has been performed.	4 – More Status available
5/6	Stabilization In Progress / Other A pH sensor is stabilizing or has been stabilizing.	4 – More Status available
2/5	Need zero Calibration / Warning The sensor offset is too high resulting in a negative reading. • H210X: (conductance - zero offset) < -2 μS A sensor zero calibration should be performed.	4 – More Status available
2/6	Concentration Out Of Range / Warning The measured concentration is outside the conductivity range where a valid concentration can be derived for the following 5 concentrations: • 0 to 20% NaCl • 0 to 12% NaOH • 0 to 15% HCl • 0 to 25% H2SO4 • 96 to 99.7% H2SO4 If there are no other fault conditions check process temperature and check that the actual concentration is outside the range for which curve is defined.	4 – More Status available
2/7	Input Out Of Range / Warning The input is outside the device measurement range. The range limits are: • H210XC (2-electrode conductivity): Conductance > 500 mS • H210XCT (4-electrode conductivity): (Conductance > 3000 mS) or (Vcond < 0 mV) • H210XT: Conductance > 1500 mS 1. Check sensor wiring. 2. Replace sensor.	4 – More Status available

4/3	Calibration Error/Warning An error occurred in the last calibration procedure. 1. Check sensor. 2. Repeat the calibration procedure.	4 – More Status available
4/4	Sensor zero Error/Warning An error occurred in the last calibration procedure. 1. Check sensor. 2. Repeat the calibration procedure.	4 – More Status available
5/2	Sensor zero in progress/other A sensor zero is being or has been performed.	4 – More Status available
5/3	Zero Cal In Water in progress/other A zero calibration in water is being or has been performed.	4 – More Status available
5/4	Meter Calibration in progress/other A meter calibration is being or has been performed.	4 – More Status available
5/5	Curve Fit in progress/other A curve fit is being or has been performed.	4 – More Status available

11.4 Dissolved Oxygen

Byte/Bit	Meaning/Class	Device Status Bits Set
2/4	SENSOR_CURRENT > 300 nA for OXYGEN BioRx - Other SENSOR_CURRENT > 800 nA for OXYGEN Brewing SENSOR_CURRENT > 106 µA for OXYGEN Oxygen in Gas 1. Make sure the device configuration matches the sensor being used. 2. Check sensor wiring. 3. Replace sensor.	4 – More Status available
2/5	Need zero Calibration/Warning The sensor offset is too high resulting in a negative reading. The sensor zero limits are: • PV < -0.5 if unit is ppm or mg/L • PV < -50 if unit is ppb or µg/L • PV < -2.0 % for % Saturation • PV < -2.0 % for Concentration in Gas • PV < -20 ppm for Concentration in Gas • PV < -30 mmHg for Partial Pressure Perform a sensor zero calibration.	4 – More Status available
4/3	Calibration Error/Warning There has been a calibration error. 1. Check the sensor.	4 – More Status available
4/4	Sensor zero Error/Warning An error occurred in the last sensor zero procedure. 1. Check sensor. 2. Repeat sensor zero procedure.	
5/2	Sensor zero In progress/Other A sensor zero is being or has been performed.	4 – More Status available
5/3	Air Cal In progress/Other An air calibration is being or has been performed.	4 – More Status available
5/6	Stabilization In progress/Other The sensor is stabilizing or has stabilized.	4 – More Status available

12 HART® Configuration Parameters

12.1 Parameters Common to all Hamilton H210X Transmitters

	Type	Enumeration/Range	Read/Write	Default
input_filter_type Selects between continuous and adaptive filtering of the measurement.	ENUM	Adaptive Continuous	R/W	Adaptive
pv_damping_value Provides the filter time constant.	FLOAT	0.0 -- 99.0 seconds	R/W	0
instrument_software_version The software version of the main processor.	FLOAT	N/A	R	N/A
input_software_version The software version of the input processor.	FLOAT	N/A	R	N/A
Display parameters:				
Selects the language to be displayed by the H210X.	ENUM	English Italiano Français Português Español Chinese Deutsch Russian	R/W	English
loi_warnings Enables or disables the display of transmitter warnings.	ENUM	Enable Disable	R/W	Enable
loi_configuration_code Locks and unlocks access to configuration from the keypad display of the H210X. "000" disables.	UINT (2)	N/A	R/W	0
loi_calibration_code Locks and unlocks access to calibration from the keypad display of the H210X. "000" disables.	UINT (2)	N/A	R/W	0
loi_main_display_upper Selects the measurement displayed on the upper portion of the main display.	ENUM	Assign primary variable Blank	R/W	Assign PV
loi_main_display_center Selects the measurement displayed on the center portion of the main display.	ENUM	Compensating pH Temperature PV Blank	R/W	Temperature
loi_main_display_left Selects the measurement or output displayed on the left portion of the display.	ENUM	Valid List per H210X Model	R/W	N/A
loi_main_display_lower_left, Selects the measurement or output displayed on the lower left portion of the display.	ENUM	Valid List per H210X Model	R/W	N/A
loi_main_display_right, Selects the measurement or output displayed on the right portion of the display.	ENUM	Valid List per H210X Model	R/W	N/A
loi_main_display_lower_right, Selects the measurement or output displayed on the lower right portion of the display.	ENUM	Valid List per H210X Model	R/W	N/A

	H210X pH / ORP	Valid list Input mv Glass Impedance Ref Impedance Slope zero Offset	N/A	N/A
	H210X contacting	Valid list Raw Conductivity Raw Resistivity	N/A	N/A
	H210X dissolved oxygen	Valid list Input Current ph (if free chlorine)	N/A	N/A
	All H210X	Valid list AO 1 Current AO 1 Output AO 2 Current AO 2 Output	N/A	N/A

12.2 pH Parameters

	Type	Enumeration/Range	Read/Write	Default
zero_offset The zero offset of a pH sensor resulting from a calibration.	FLOAT	N/A	R/W	0.0 mV
ph_slope The slope of a pH sensor resulting from a buffer calibration.	FLOAT	40 -- 62 mV/pH	R/W	59.16 mV/pH
zero_offset_limit The maximum value of the zero offset allowed for a successful calibration.	FLOAT	N/A	R/W	60
min_ph_slope The minimum value of the slope allowed for a successful calibration.	FLOAT	40 -- 62 mV/pH	40 mV/pH	40 mV/pH
max_ph_slope The maximum value of the slope allowed for a successful calibration.	FLOAT	40 -- 62 mV/pH	R/W	62 mV/pH
ph_stabilization_time The period of time used to determine stability of a pH sensor during automatic calibration.	FLOAT	0 -- 99 seconds	R/W	10 seconds
ph_stabilization_value, The pH change used to determine stability of a pH sensor during automatic calibration.	FLOAT	0.01 -- 1.0 pH	R/W	0.02 pH
ph_buffer_standard The types of pH buffers available for automatic calibration.	ENUM	Standard / NIST DIN 19267 Ingold Merck Fisher	R/W	Standard / NIST
preamp_location The location of the preamplifier in a pH measurement.	ENUM	Analyzer sensor / junction box	R/W	N/A

reference_impedance_level Configures the transmitter to use reference electrodes with impedances less than 500 kΩ (low) or greater than 500 kΩ (high).	ENUM	Low High	R/W	Low
ph_solution_temperature_correction Configures the transmitter to correct the pH measurement for changes in the pH of the solution with temperature.	ENUM	Off ultra pure water high pH ammonia custom	N/A	Off
ph_solution_temperature_coefficient The coefficient used to correct solution pH when using custom solution pH temperature correction.	FLOAT	-9.999 -- 9.999 pH / °C	R/W	0.000 pH / °C
ph_display_resolution Changes the resolution of the displayed pH value.	ENUM	0.01 pH 0.1 pH	R/W	0.01 pH
ph_sensor_isopotential The pH at which the millivolt output of the pH sensor remains constant with temperature changes; virtually always 7.00 pH.	FLOAT	0.00 -- 14.00 pH	R/W	7.00 pH
refz_high_fault_setpoint The high setpoint that triggers a reference electrode impedance alert.	FLOAT	0.0 -- 9,999.0 kΩ	R/W	500.0 kΩ
glassz_high_fault_setpoint The high setpoint that triggers a glass pH electrode impedance alert.	FLOAT	0.0 -- 9,999.0 MΩ	R/W	1,500 MΩ
diagnostics_switch Turns the glass and reference electrode impedance measurements on and off.	ENUM	Off On	R/W	Off
glassz_temperature_correction Turns temperature correction of the glass impedance measurement on and off.	ENUM	Off On	R/W	Off
glassz_measurement_type Toggles between a basic glass impedance measurement, and an advanced impedance measurement that is more accurate.	ENUM	Advanced Basic	R/W	Advanced
calculated_offset The preliminary zero offset calculated by a pH calibration before it is accepted by the transmitter.	FLOAT	N/A	R/W	N/A
calculated_slope The preliminary slope calculated by a pH calibration before it is accepted by the transmitter.	FLOAT	N/A	R/W	N/A

12.3 Contacting Conductivity

	Type	Enumeration/Range	Read/Write	Default
conductivity_unit The conductivity unit used by the measurement.	ENUM	μS/cm mS/cm	R/W	μS/cm
cell_constant The cell constant of the conductivity sensor being used, typically determined by calibration.	FLOAT	0.0001--100.0 /cm	R/W	1.00 /cm
cable_correction Selects automatic or manual cable resistance correction.	ENUM	Manual Automatic	R/W	Automatic
manual_cable_resistance The known cable resistance used in manual cable correction.	FLOAT	0.0 -- 99.99 ohm	R/W	0.0 ohm
zero_offset_in_air The zero offset determined by a zero calibration in air.	FLOAT	N/A	R only	0.0 μS
zero_offset_in_soln The zero offset determined by a zero calibration in a solution.	FLOAT	N/A	R only	0.00%
custom_curve_num_data_points The number of conductivity and concentration points to be used to calculate a custom concentration curve.	ENUM	2 3 4 5	R/W	3
Custom Curve Concentration Data points:				
custom_curve_concentration_1	FLOAT	N/A	R/W	N/A
custom_curve_concentration_2	FLOAT	N/A	R/W	N/A
custom_curve_concentration_3	FLOAT	N/A	R/W	N/A
custom_curve_concentration_4	FLOAT	N/A	R/W	N/A
custom_curve_concentration_5	FLOAT	N/A	R/W	N/A
Custom Curve Conductivity Data points:				
custom_curve_conductivity_1	FLOAT	N/A	R/W	N/A
custom_curve_conductivity_2	FLOAT	N/A	R/W	N/A
custom_curve_conductivity_3	FLOAT	N/A	R/W	N/A
custom_curve_conductivity_4	FLOAT	N/A	R/W	N/A
custom_curve_conductivity_5	FLOAT	N/A	R/W	N/A
electrode_type Type of contacting conductivity sensor being used by the transmitter.	ENUM	2-Electrode 4-Electrode	R/W	2-Electrode
cond_range Selects a particular range for the conductivity measurement or automatic ranging for 2 and 4 electrode sensors.	ENUM	N/A	R/W	Automatic
	2-Electrode	Automatic 0-50 μS 40-500 μS 400-2000 μS 1.8-20 mS 18-200 mS	N/A	N/A

	4-Electrode	Automatic 0-42 µS 36-200 µS 180-1000 µS 0.9-10 mS/cm 9-600 mS/cm	N/A	N/A
series_cap_correction Turns capacitance correction on and off.	ENUM	Off On	R/W	Off
cell_factor The second calibration constant used by a 4 electrode sensor in addition to cell constant.	FLOAT	N/A	R/W	N/A
temp_comp_type The type of temperature compensation used by the transmitter.	ENUM	Linear slope Neutral salt Cation Raw/None	R/W	Linear slope
temp_comp_slope Provides a slope value used in linear temperature compensation.	FLOAT	0.2 -- 9.99 % / °C	R/W	2.0% / °C
reference_temperature The temperature that temperature compensation corrects to. It is usually 25 °C.	FLOAT	N/A	R/W	25 °C

12.4 Dissolved Oxygen

	Type	Enumeration/Range	Read/Write	Default
polar_voltage The polarization voltage used by the transmitter; automatically set by sensor selection.	FLOAT	N/A	R/W	0
temp_coeff The temperature coefficient used to compensate temperature; automatically set by sensor selection.	FLOAT	N/A	R/W	0
amp_sensor_sensitivity The response of the sensor to changes in concentration, determined by calibration.	FLOAT	0.1 -- 1,000,000.0 nA/ppm	R/W	2,500 nA/ppm
amp_sensor_zero_current The current output of the sensor when the concentration is 0. It is determined by a zero calibration.	FLOAT	-999.9 -- 999.9 nA	R/W	0.0 nA
oxygen_sensor_type The type of oxygen sensor used.	ENUM	Water/Waste Trace Oxygen BioRx-Rosemount BioRx-Other Brewing Oxygen In Gas	R/W	Water/Waste
oxygen_measurement_type The type of oxygen measurement being made.	ENUM	Concentration in Liquid Percent Saturation Partial Pressure Concentration in Gas	R/W	Concentration in Liquid

oxygen_salinity The salinity of the process solution, which is used by the transmitter to correct for the effect of salinity on the oxygen measurement.	FLOAT	0.0 – 99.9 ppth	R/W	0.0 ppth
pressure_units The units of pressure used by the oxygen measurement.	ENUM	mmHg inHg psi atm kPa mbar bar	R/W	mmHg
oxygen_process_pressure The process pressure used by the transmitter to calculate percent oxygen in gas or % saturation.	FLOAT	N/A	R/W	760.0 mmHg
oxygen_air_pressure The barometric pressure used by the transmitter during an air calibration.	FLOAT	N/A	R/W	760.0 mmHg
oxygen_units The available units used for the various oxygen measurement types.	ENUM	N/A	R/W	N/A
	Concentration in liquid:	Units: ppm ppb mg/l µg/l	N/A	ppm
	Percent Saturation	Units:		%
	Partial pressure	Units: mmHg	kpa, inhg	mbar, psi
	Oxygen In Gas	Units: ppm		%
air_cal_stabilization_time The period of time used to determine stability of an oxygen sensor during an air calibration.	FLOAT	0 -- 99 seconds	R/W	10 seconds
air_cal_stabilization_value The change in the oxygen measurement used to determine stability of an oxygen sensor during an air calibration.	FLOAT	0.001 -- 9,999.0	R/W	0.05
air_cal_stabilization_value_unit The unit used during an air calibration.	FLOAT	N/A	R/W	ppm

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