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

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

12.4.3 Transmitter diagnostic bits

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

Main board faults

16

Alert

Change in diagnostic data

Cause

A diagnostic bit has changed state.

24

Alert

Main Board CPU Error

Cause

The main board software is corrupted.

Recommended actions

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

25

Alert

Main Board User Data Error

Cause

The main board user EEPROM data is corrupted.

Recommended actions

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

26

Alert

Main Board Factory Data Error

Cause

The main board factory EEPROM data is corrupted.

Recommended actions

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

27

Alert

Main Board Wrong Power Supply

Cause

The existing power supply is incorrect for the turbidity sensor.

Recommended actions

Replace power supply.

Main board warnings

33

Alert

Unknown power supply

Cause

The main board software cannot identify the power supply.

Recommended actions

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

34

Alert

Line frequency unknown

Cause

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

Recommended actions

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

35

Alert

Main board factory call

Cause

The transmitter was not calibrated at the factory.

Recommended actions

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

36

Alert

Keypad error

Cause

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

Recommended actions

Call the factory.

37

Alert

Overheating LCD warning

Cause

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

As the temperature cools, the functions are restored.

Recommended actions

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

38

Alert

Excess output current

Cause

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

Recommended actions

Check analog output wiring. A short from the positive terminal to ground will cause excessive current to flow.
Even if only one output is shorted, all four outputs will be shut down. If no wiring problems are found, the main board has been damaged and must be replaced.

Signal board diagnostic bits 40/72

Alert

SN 1/2 Board Unknown (Fault)

Cause

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

Recommended actions

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

41/73

Alert

SN 1/2 HW SW Mismatch error (Fault)

Cause

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

Recommended actions

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

42/74

Alert

SN ½ Incompatible Error (Fault)

Cause

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

Recommended actions

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

43/75

Alert

SN 1/2 Not Detected

Cause

The sensor board is no longer being detected.

Recommended actions

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

44/76

Alert

SN 1/2 Not Communicating (Fault)

Cause

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

Recommended actions

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

45/77

Alert

SN 1/2 CPU error (Fault)

Cause

The sensor board software is corrupted.

Recommended actions

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

46/78

Alert

SN 1/2 Factory Data Error (Fault)

Cause

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

Recommended actions

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

47/79

Alert

SN 1/2 ADC Error (Fault)

Cause

There is a bad hardware component on the sensor board.

Recommended actions

Replace the sensor board.

50/82

Alert

SN 1/2 Hardware Error (Fault)

Cause

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

Recommended actions

Replace the sensor board.

54/86

Alert

SN 1/2 User Data Error (Fault)

Cause

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

Recommended actions

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

55/87

Alert

SN 1/2 EEPROM Write Error (Fault)

Cause

There is a bad CPU on the sensor board.

Recommended actions

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

104/136

Alert

SN 1/2 Need Factory Cal (Warning)

Cause

The sensor board was not calibrated at the factory.

Recommended actions

Call the factory.

48/80

Alert

SN 1/2 RTD Open (Fault)

Cause

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

Recommended actions

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

49/81

Alert

SN 1/2 RTD Out Of Range (Fault)

Cause

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

Recommended actions

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

105/137 pH and Amperometric Measurements

Alert

SN 1/2 Temperature High (Warning)

Cause

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

Recommended actions

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

105/137 Contacting Conductivity Measurements

Alert

SN 1/2 Temperature High (Warning)

Cause

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

Recommended actions

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

105/137 Toroidal Conductivity Measurements

Alert

SN 1/2 Temperature High (Warning)

Cause

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

Recommended actions

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

106/138 pH and Amperometric Measurements

Alert

SN 1/2 Temperature Low (Warning)

Cause

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

Recommended actions

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

106/138 Contacting and Toroidal Conductivity Measurements

Alert

SN 1/2 Temperature Low (Warning)

Cause

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

Recommended actions

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

107/139

Alert

SN 1/2 RTD Sense Line Open (Warning)

Cause

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

Recommended actions

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

51/83

Alert

SN 1/2 Ref Z Too High (Fault)

Cause

The impedance of the reference junction is too high.

Recommended actions

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

52/84

Alert

SN 1/2 Glass Z Too High (Fault)

Cause

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

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

Recommended actions

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

53/85

Alert

SN 1/2 Broken Glass Fault (Fault)

Cause

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

Recommended actions

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

108/140

Alert

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

Cause

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

Recommended actions

1. Check sensor wiring.
2. Replace sensor.

111/143

Alert

SN 1/2 No Solution Gnd (Warning)

Cause

The sensor is not properly wired.

Recommended actions

Check wiring.

115/147

Alert

SN 1/2 Broken Glass Disabled (Warning)

Cause

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

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

109/141 Contacting Conductivity Measurements

Alert

SN 1/2 Out Of Range Cont/Tor Brd

Cause

The raw conductance is greater than 1 S.

Recommended actions

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

109/141 Toroidal Conductivity Measurements

Alert

SN 1/2 Out Of Range Cont/Tor Brd

Cause

The raw conductance is greater than 2 S.

Recommended actions

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

112/144 Contacting Conductivity Measurements

Alert

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

Cause

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

Recommended actions

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

112/144 Toroidal Conductivity Measurements

Alert

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

Cause

Negative Reading:

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

Recommended actions

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

113/145

Alert

SN 1/2 Out Of Range (Warning)

Cause

The calculated concentration or temperature is out of range.

Recommended actions

1. NaOH: 0 – 12.00%, 0 - 100 °C.
2. HCl: 0 – 15.00%, 0 - 65 °C.
3. H_2SO_4 (low): 0 – 25.00%, -1 - 99 °C.
4. H_2SO_4 (high): 96.0 – 99.7%, 4 - 110 °C.
5. NaCl: 0 – 20.00%, 0 - 100 °C.
6. Salinity: 2 – 42 part per thousand, -2 - 35 °C.

110/142

Alert

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

Cause

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

Recommended actions

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

114/145

Alert

SN 1/2 Pressure Sensor Broken (Warning)

Cause

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

Recommended actions

Replace the sensor board.

117/149

Alert

SN 1/2 No Flow Detected (Warning)

Cause

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

Recommended actions

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

2. Check wiring.
3. Check the sensor.

118/150

Alert

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

Cause

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

Recommended actions

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

119/151

Alert

SN 1/2 Execessive Current (Warning)

Cause

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

Recommended actions

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

120/152

Alert

SN 1/2 Low Current (Warning)

Cause

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

Recommended actions

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

27

Alert

Main Board Wrong Power Supply (Fault)

Cause

The existing power supply is incorrect at the turbidity sensor.

Recommended actions

Replace power supply.

56/88

Alert

SN 1/2 Lamp Led Fail (Fault)

Cause

The lamp or LED has failed.

Recommended actions

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

57/89

Alert

SN ½ Disconnected (Fault)

Cause

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

Recommended actions

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

116/148

Alert

SN 1/2 Weak Lamp (Warning)

Cause

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

Recommended actions

Replace the lamp.

121/153

Alert

SN 1/2 Needs calibration (Warning)

Cause

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

Recommended actions

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

12.5 Installation and wiring

12.5.1 Wire PROFIBUS® cable to PROFIBUS card

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

Procedure

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

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

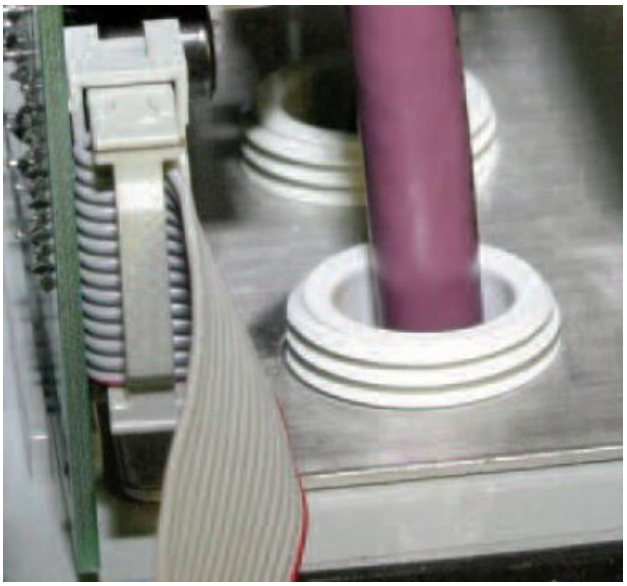
   Figure 12-1: Proper Enclosure Opening Locations for Cable Installation

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

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

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



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

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

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

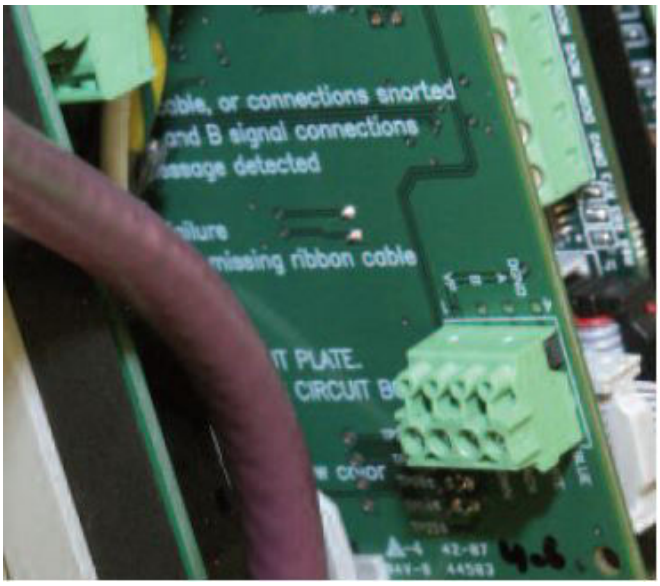
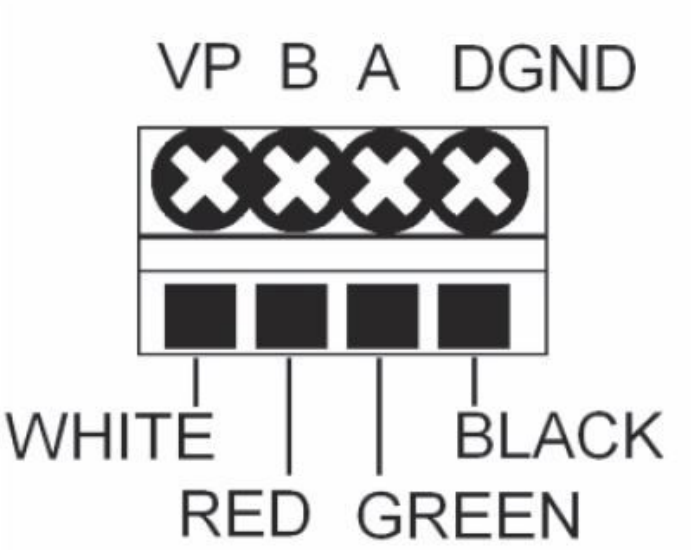


Figure 12-4: 4-Lead Terminal Block



4. **NOTICE**

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

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

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

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

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

   Figure 12-5 shows the 4-lead terminal block properly wired to the PROFIBUS board and installed onto the board.

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

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

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

13 Maintenance

13.1 Maintenance

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

⚠ WARNING

Risk of Electrical Shock

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

⚠ WARNING

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

13.2 Transmitter maintenance

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

13.3 USB port

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

⚠ WARNING

Do not remove the cover during cleaning.

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

A HART® and Device Variables

Table A-1: pH device variables

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

Table A-2: Contacting and Toroidal Conductivity Device Variables

Device Variable Name	Assignable to Dynamic Variables	Variable Range
Sensor 1 / 2 Measurement Type		
Conductivity (7)	PV, SV, TV or QV	0 to 2000000 µS/cm
Resistivity (8)	PV, SV, TV or QV	0 to 50000000 ohm-cm
Concentration		
NaOH (9)	PV, SV, TV or QV	0 to 12%
HCl (10)	PV, SV, TV or QV	0 to 15%
Low H_2SO_4 (11)	PV, SV, TV or QV	0 to 25%
High H_2SO_4 (12)	PV, SV, TV or QV	96 to 99.7%
NaCl (13)	PV, SV, TV or QV	0 to 25%
Custom Concentration (14)	PV, SV, TV or QV	0 to 1000 ppm
		0 to 1000 mg/L
		0 to 100 g/L

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

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

Table A-3: Turbidity Device Variables

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

Table A-4: Amperometric Device Variables

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

Table A-4: Amperometric Device Variables *(continued)*

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

Table A-5: Flow / mA Input Device Variables

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

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

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

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

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

B HART® Status Bits

Table B-1: Common Transmitter Status Bits

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

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

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

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

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

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

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

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

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

Table B-2: Temperature Status Bits

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

Table B-3: pH Board Status Bits

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

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

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

Table B-4: Contacting and Toroidal Conductivity Status Bits

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

Table B-5: Amperometric Status Bits

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

Table B-5: Amperometric Status Bits *(continued)*

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

Table B-6: Flow / mA Input Status Bits

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

Table B-7: Turbidity Input Status Bits

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

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

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

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