ELECTRICAL EQUIPMENT O&M

FOR

CITY OF JEFFERSON WWTP

JEFFERSON, GA

WITH

(1) SMART BNR LITE CONTROL PANEL

Project 2033/001848.P.01 (453130-01)
Revision 0
December 22, 2022

N19W23993 Ridgeview Pkwy.
Suite 200
Waukesha, WI 53188

Tel: +1 (262) 547-0141
Fax: +1 (262) 547-4120

www.evoqua.com

Table of Contents

Section 1
Control Narrative

SmartBNR™ Lite Process
643-30087
July 20, 2021

Sequence of Operation

I. Overview

Evoqua Water Technologies SmartBNR™ Process and related components are controlled through one central programmable logic controller (PLC) and human machine interface (HMI). The HMI will be the primary interface that allows the user to interact with the various components, change process set points and monitor current readings of various sensors and probes located throughout the system.

The Smart BNR™ system is designed to enhance energy efficiency of the oxygen delivery to the wastewater while achieving a high quality effluent. A combination of dissolved oxygen (D.O.) and/or Oxidation Reduction Potential (ORP) measurement is utilized to optimize oxygen delivery. The required oxygen is delivered by automatically controlling the speed and number of aerators/blowers running.

The Smart BNR™ Lite controls package is customizable to provide control for a wide variety of equipment configurations. Configurations can include up to ten drives that could be any combination of aerators, blowers, or pumps. In addition, two valves/gates can be controlled to reduce the impact of high plant influent flows. Each Smart Smart BNR™ Lite panel is capable of receiving up to four analog signals from any combination of up two DO probes, up to two ORP probes, or an influent flow meter.

II. Potential Hardware

a. Instrumentation & Sensors

The individual sensors listed below are connected to analyzers located nearby the equipment. The instrument analyzers are Hach model sc200, in NEMA 4X rated enclosures. They require 120VAC, single phase power and generate 4-20mA outputs to transmit back to the main control system, up to two (2) total analyzers may be provided. Each analyzer can accept signals from two (2) probes allowing the Smart BNR Lite system to be configured to use any combination of up to two (2) ORP probes and up to two (2) DO probes.

1. Hach ORP sensors are Model DRS5. The ORP will be measured in a range from -2100mV to +2100mV.

2. Hach Dissolved Oxygen sensors are Model LDO. The DO will be measured from 0.0 to 20.0mg/L.

b. Control System

1. The central control system for the SmartBNR Lite Aeration Control is based on the Allen Bradley Control Logix platform. The central processing unit (CPU) is located in the main PLC enclosure along with various analog and digital input and output modules that are used to control the aerator motors and various processes.
2. The HMI for this system is located on the front of the main PLC enclosure. It is a Siemens TP700, 7" touch-panel that allows the user to view and control all of the connected equipment with a graphical interface.

III. Operation

The primary operation of all of the equipment included in the SmartBNR processes will require that all equipment be placed into AUTO or REMOTE modes at the MCC or at the individual piece of equipment. This will ensure that the PLC & control system will operate properly and allow the logic to determine the proper state of each piece of equipment. If a piece of equipment needs to be taken out of service for any reason, it should be placed in the OFF position on the HMI to prevent any nuisance alarms. When all equipment is in "auto" the PLC will determine the number of drives to run and the speed at which to run them based on the DO and/or ORP probe signals*.

Decreasing D.O. or ORP Situation:

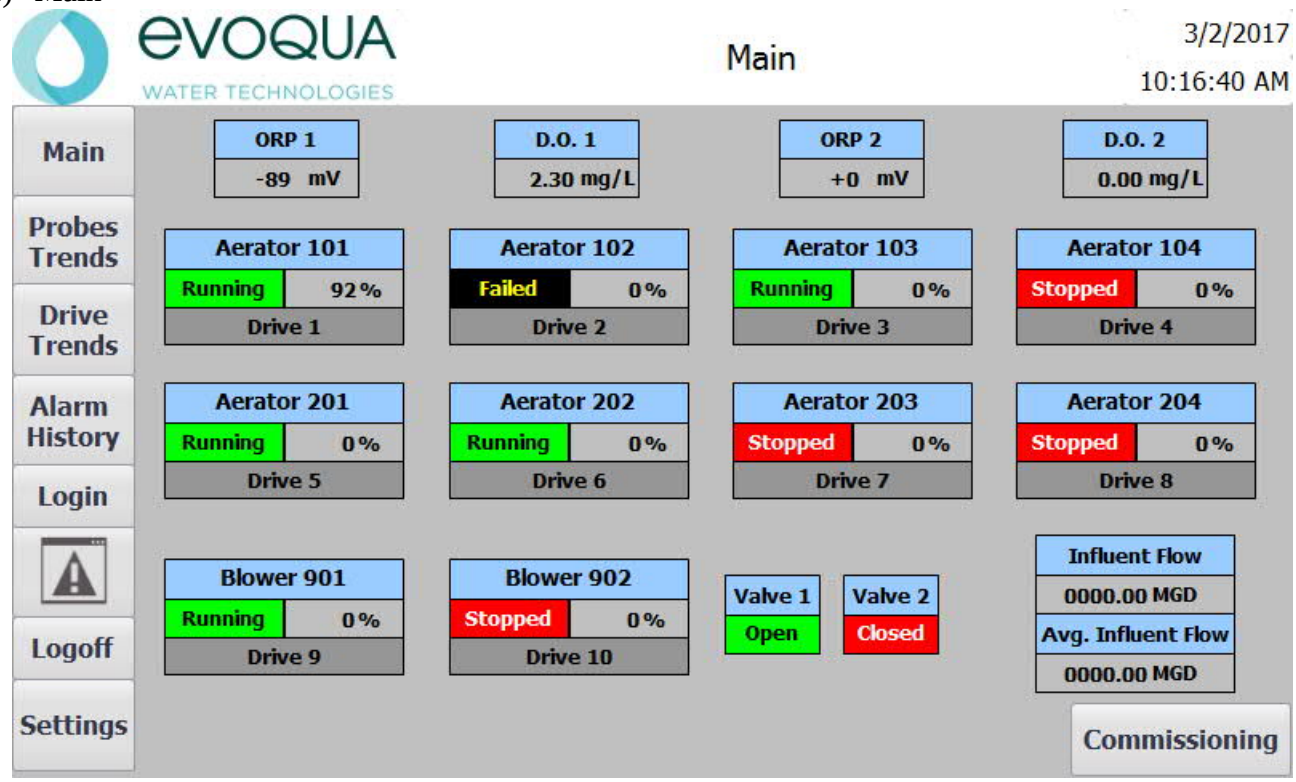
- Assuming that only one drive is running at its minimum speed, as the D.O or ORP. decreases, the PID algorithm will ramp up the one VFD that is currently running at its minimum speed. Once that VFD has reached its maximum speed (100% or 60Hz), and more aeration is still required, a second VFD will turn on. The first drive will then slow to either its minimum speed set point or 50%, whichever is higher, and the second drive will speed up to its minimum speed or 50%, whichever is higher.
- As the D.O./ORP continues decreasing or remaining below the set point, both drives will ramp up to 100%.
- This process continues until all drives available are running at maximum speed.

Increasing D.O. or ORP Situation:

- Assuming multiple drives are running, and the D.O./ORP begins to increase, the PID algorithm will begin to ramp drives down in unison, and assuming the D.O./ORP continues increasing or stays above the set point, the drives will slow down to their minimum speed.
- If the D.O./ORP still remains high or continues increasing, one aerator will shut off, and the remaining aerators will ramp back up to maintain a smooth transition. The remaining aerators will again ramp down assuming the D.O./ORP continues to increase or remain above the set point. This process is repeated until a single aerator is running at minimum speed or until oxygen demand increases once again.

* To ensure quality effluent it is imperative that DO/ORP signals be accurate, and that the related probes are cleaned/maintenance per the manufacturer's recommendation.

1) Main



The SmartBNR Lite Main screen gives the operator a quick overview of all of the equipment controlled by the SmartBNR Process control system. Motor and instrument statuses are updated continuously and displayed near the associated equipment.

Status of each motor and valve is displayed with text/color combinations. Green equipment is considered to be currently in operation, such as "Running" or "Open". Red equipment is currently "Off" or "Closed". Flashing yellow indicates the device is currently "failed".

a. Controls

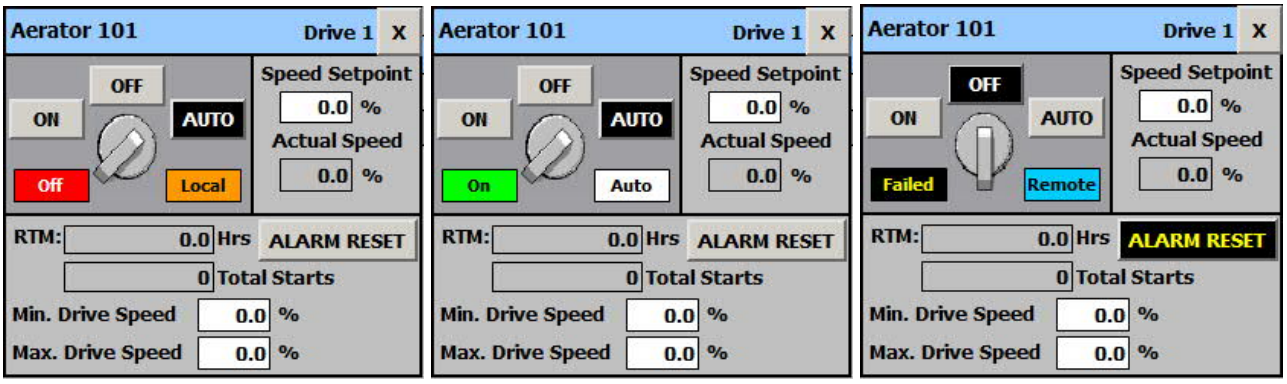


Figure 1 – shows the popup of Drive 1 in all possible status conditions.

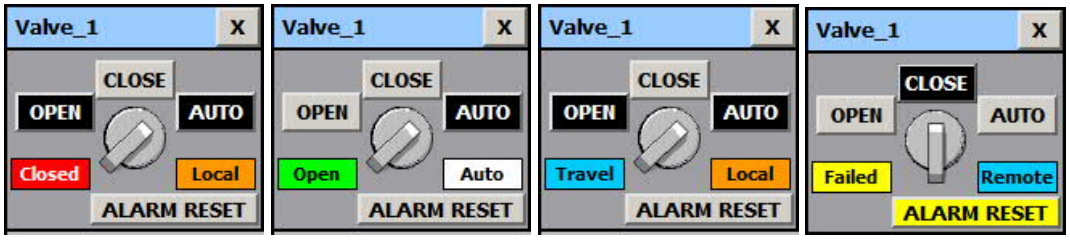


Figure 2 – shows the popup of valve 1 in all possible status conditions.

The SmartBNR Lite Main screen is embedded with pop-ups for each Drive and Valve (see Figures 1 and 2 above). Controls are provided in a familiar On-Off-Auto fashion, mimicking a physical three position selector switch. The control of this switch is typical of others found on most SCADA systems.

i. Equipment Status

A motor status will display as “Off” (Red), “On” (Green), or “Failed” (Flashing Yellow). While a valve status will display as “Closed” (Red), “Open” (Green), “Travel” (Blue), or “Failed” (Flashing Yellow).

ii. Equipment Control Status

Control status for both motors and valves with display as “Local” (orange), “Remote” (blue), or “Auto” (white). The control status is determined by the state of the local Hand-Off-Auto (HOA) switch and the state of the On-Off-Auto switch on HMI popup. When the local HOA is in the “Hand” or “Off” position the HMI will display a control status of “Local” indicating that the SmartBNR panel does not have control of the equipment. When the local HOA is in the “Auto” position and the On-Off-Auto switch on HMI popup is in the “On” or ”Off” position the HMI will display a control status of “Remote” to indicate the PLC has control of the equipment, but the operator has chosen to override the PLC logic for that equipment. When the local HOA is in the “Auto” position and the On-Off-Auto switch on HMI popup is in the “Auto” position the HMI

will display a control status of “Auto” to indicate the PLC has full control of the equipment.

iii. RTM

Each motor popup also has a run time meter (RTM). The run time meters are stored on the PLC, so they may not match the RTMs found on the MCCs, due to running the motors prior to starting up the PLC, or while the PLC is powered down.

iv. Total Starts

Each motor popup displays the number of motor starts. The start counters are stored on the PLC, so they may not match counters found on the MCCs, due to running the motors prior to starting up the PLC, or while the PLC is powered down.

v. Manual Speed Set Point

The speed set point allows the operator to control the speed of the motor when the On-Off-Auto switch is placed in the “On” position.

vi. Alarm Reset

The alarm reset allows the operator to clear and motor/valve failures. The reset button will only allow the failure to reset if the condition causing the failure is no longer active.

vii. Drive Speed Set Points

The Minimum and Maximum drive speed set points allows the operator to override the PLC calculated speeds when the On-Off-Auto switch is placed in the “On” and “Auto” positions.

b. Set Point Numeric Entry

When selecting any of the numeric set point fields a numeric keypad will pop up that will facilitate value entry (see figure 3). To accept an entered value, the user must press the enter/return key similar to one found on a physical keyboard. If no entry is required the pop up can be closed using the “esc” button or the small “x” button in the upper right corner.

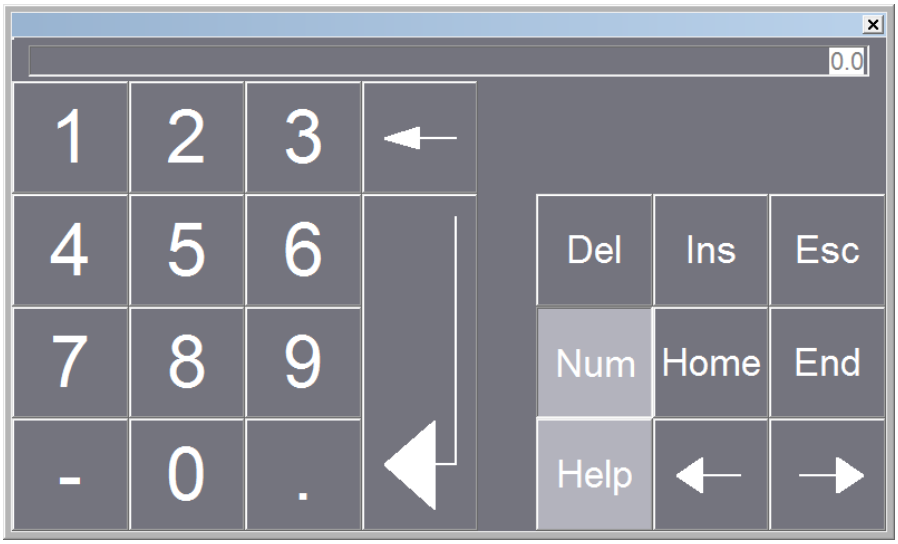
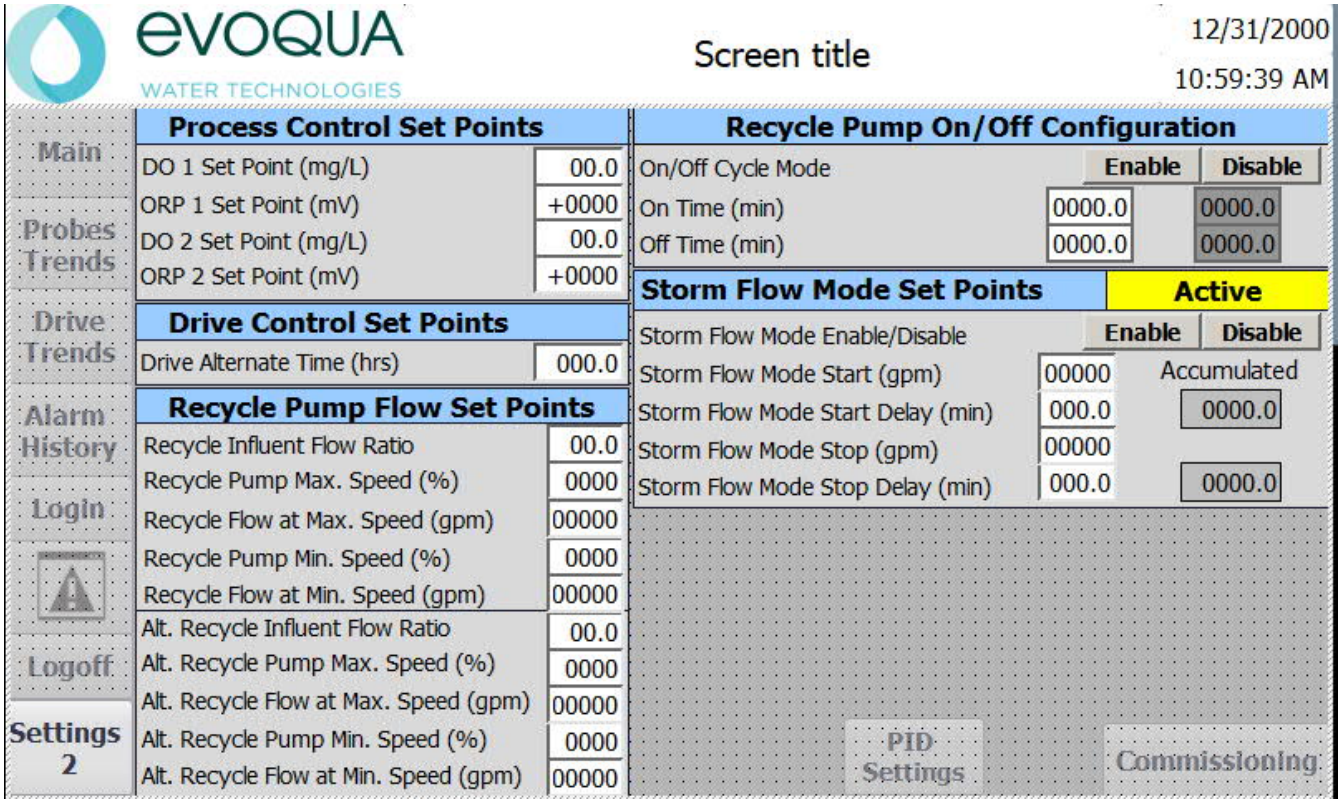


Figure 3 – Numeric keypad Pop up.

2) SmartBNR Settings 1



The SmartBNR Settings screen is used to control the automatic SmartBNR process. All of the white entry fields operate just as the manual speed set point on the SmartBNR Overview screen, clicking in the white entry field will pop up a numeric entry window for changing the value.

Since the SmartBNR Lite system is configurable to each site's needs, all the set points shown here may or may not be visible on your HMI.

a. Process Control Set Points

These set points allow the operator to enter the desired DO/ORP levels to be maintained by the PLC. The aerators/blowers will be turned on and off and ramped up and down based on the current DO/ORP readings to maintain the desired DO/ORP set point.

b. Drive Control Set Points

If all aerators are not in use the "Drive Alternate Time" set point this is the time required between alternating between running aerators/blowers. This is intended to maintain an even runtime on all equipment. To disable this function set the set point to 0.0.

c. Storm Flow Mode Set Points

Storm flow mode is used to control influent flow paths during periods of high influent flow by changing valve/gate positions. When influent flow exceeds the "Storm Flow Mode Start" set point the "storm Flow Mode Start Delay" is started. If influent flow stays above the start set point for the duration of this delay "Storm Flow Mode" is initiated. "Storm Flow Mode" will stay active until the influent flow drops below the "Storm Flow Mode Stop" set point for the "Storm Flow Mode Stop Delay" period of time.

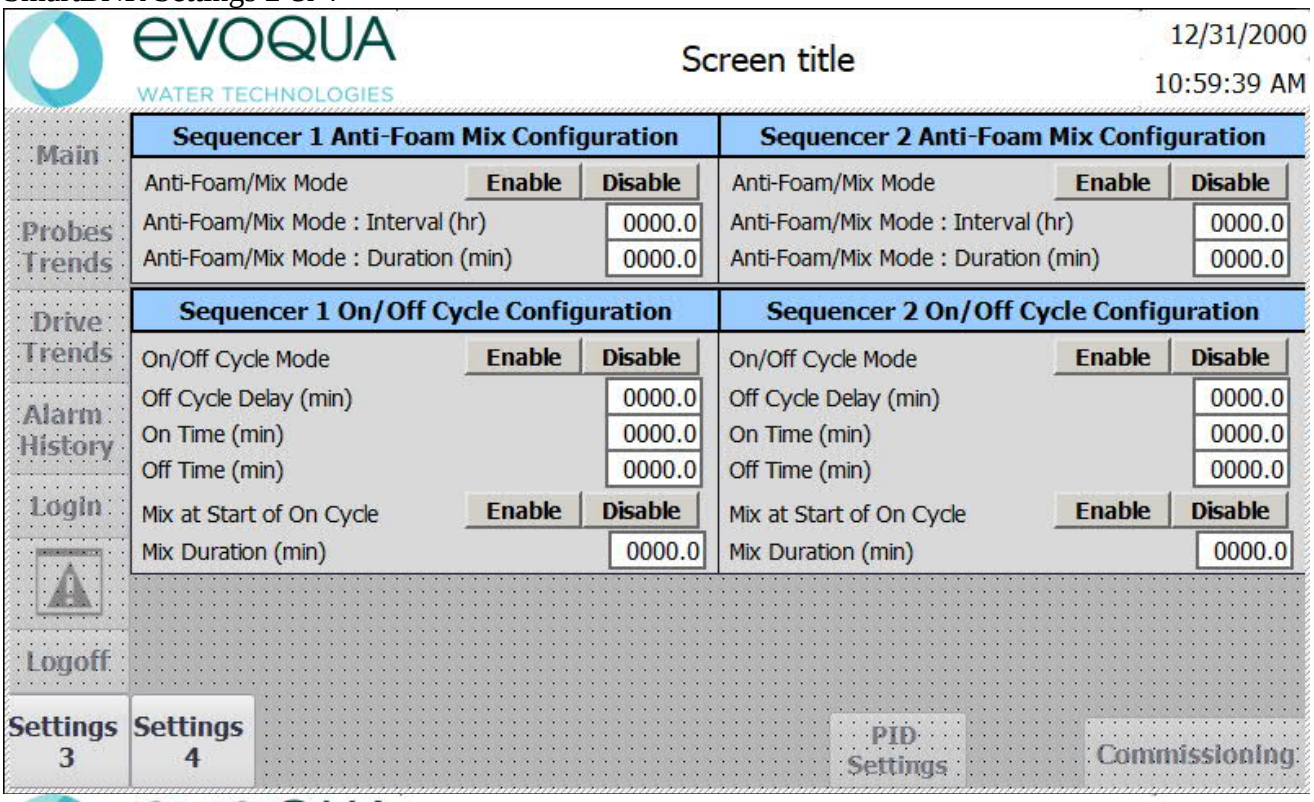
d. Recycle Pump Flow Set Points

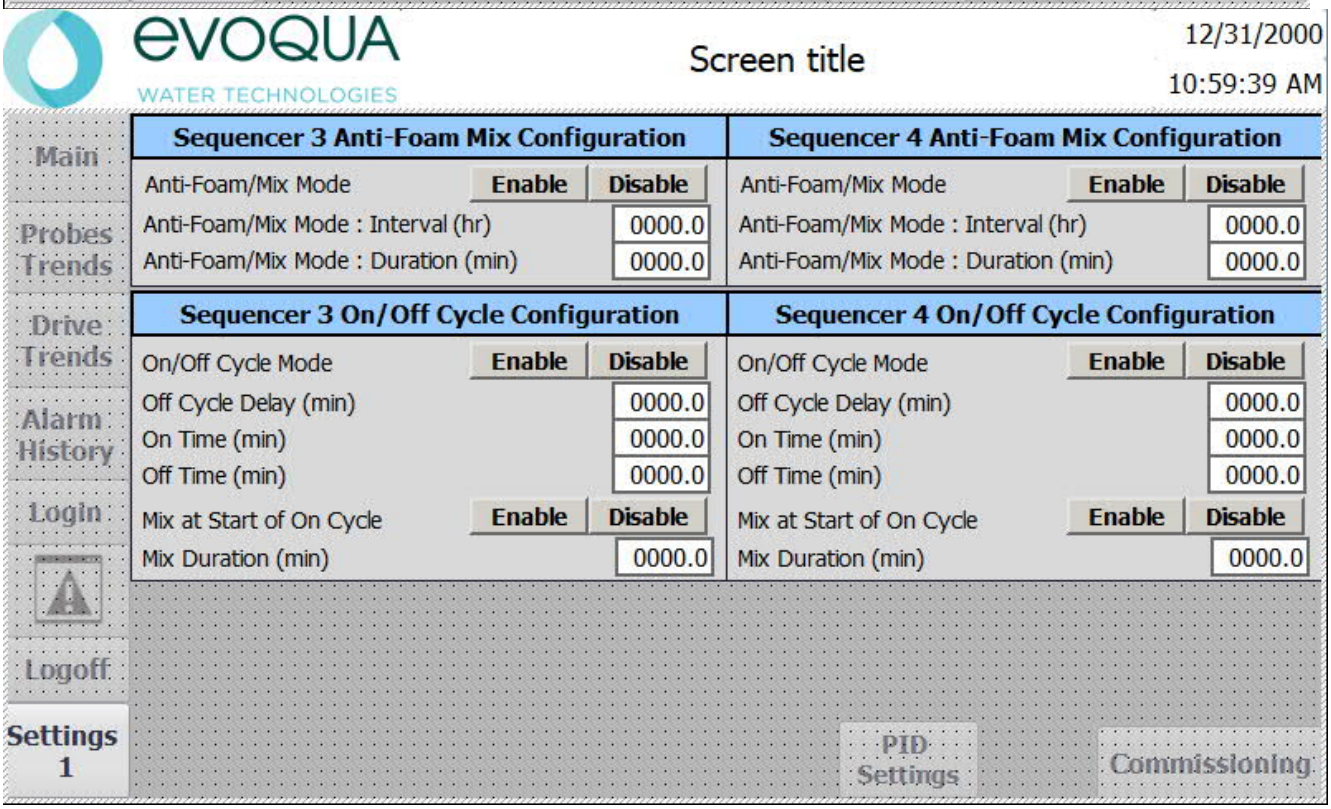
These set points are used to control Recycle pump flow rates based on influent flow rates. The "Recycle Influent Flow Ratio" is the percentage of influent flow that the RAS pump will produce. For example, a set point value of 200% would cause the RAS pumps to create flow rates double the influent flow rate. The RAS pumps will not be controlled using a flow meter, as a result the PLC needs flow information about the RAS pumps in order to control RAS pump flow accurately. The needed information is input here with the four set points below the "Recycle Influent Flow Ratio." If a plant has multiple RAS pumps that need to flow at different flow rates there are two sets of recycle pump flow set points available for configuration.

e. Recycle Pump Flow Set Points

If On/Off cycling Mode is desired select the "Enable" button. When this mode is active the recycle pump will cycle on and off using the "On Time" and "Off Time" set points (in minutes).

3) SmartBNR Settings 2 & 4





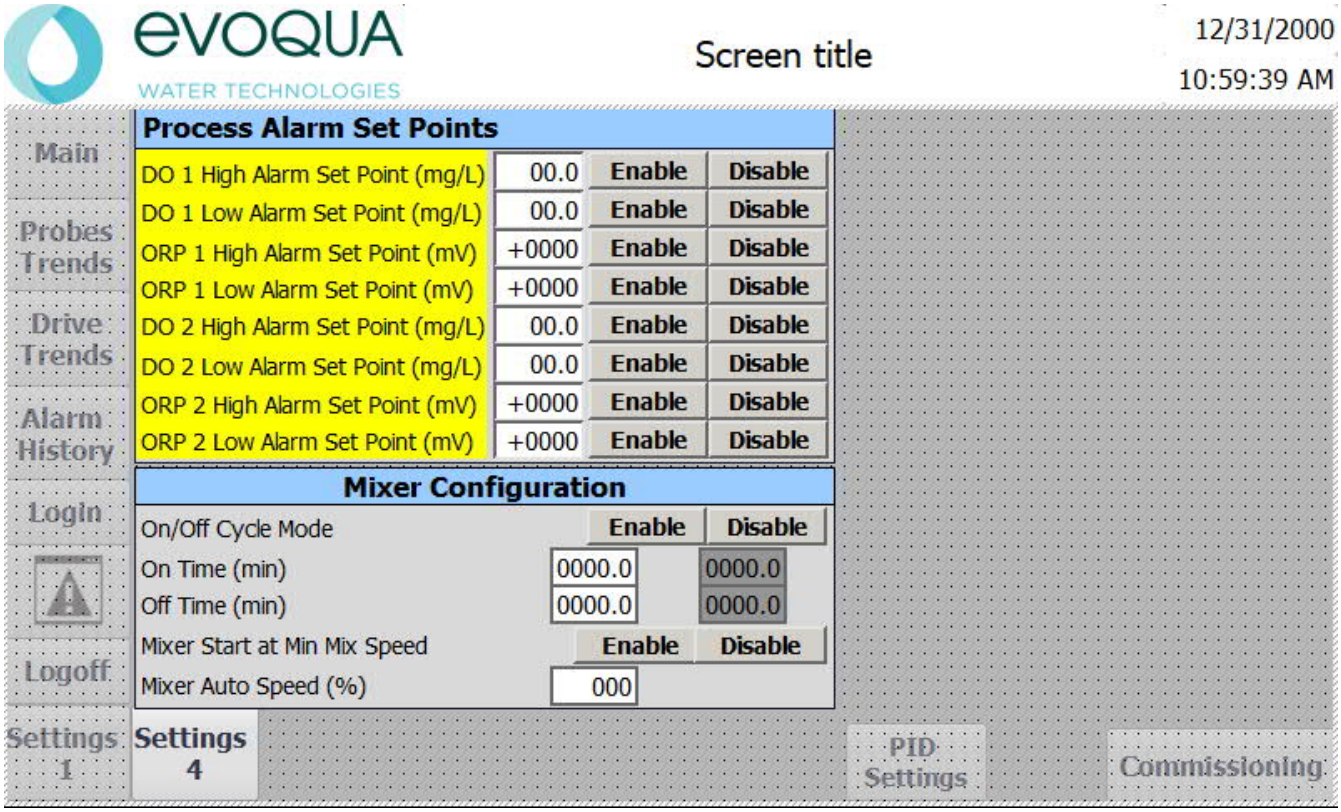
a. Sequencer 1 through 4 Anti-Foam Mix Set Points

If Anti-Foam/Mix Mode is desired select the “Enable” button. This mode will run all drives available to any given sequencer at maximum speed for a period of time to a) help eliminate foam or b) re-suspend solids that have settled as a result of aerators running at minimum speeds for long periods of time. The Interval time set point (in hours) is the time between mixing. The Duration time set point (in minutes) is the mixing time. Note: this mix mode will not start any drives that are designated as blowers.

b. Sequencer 1 through 4 On/Off Cycle Set Points

If On/Off cycling Mode is desired select the “Enable” button. On/Off cycling mode is active when a sequencer has been running at minimum output for the specified “Off Cycle Delay” (in minutes). When this mode is active the aerator will cycle on and off using the “On Time” and “Off Time” set points (in minutes). During the “on time” an aerator will run at minimum speed. If at any time the sequencer output increase because of a lack of oxygen in the process this mode will cancel and normal operation will resume. Mix at Start of On Cycle can be enabled with the “Enable” button. This mode will turn on all Aerators at the start of the “On Cycle” to resuspend the solids.

4 SmartBNR Settings 3



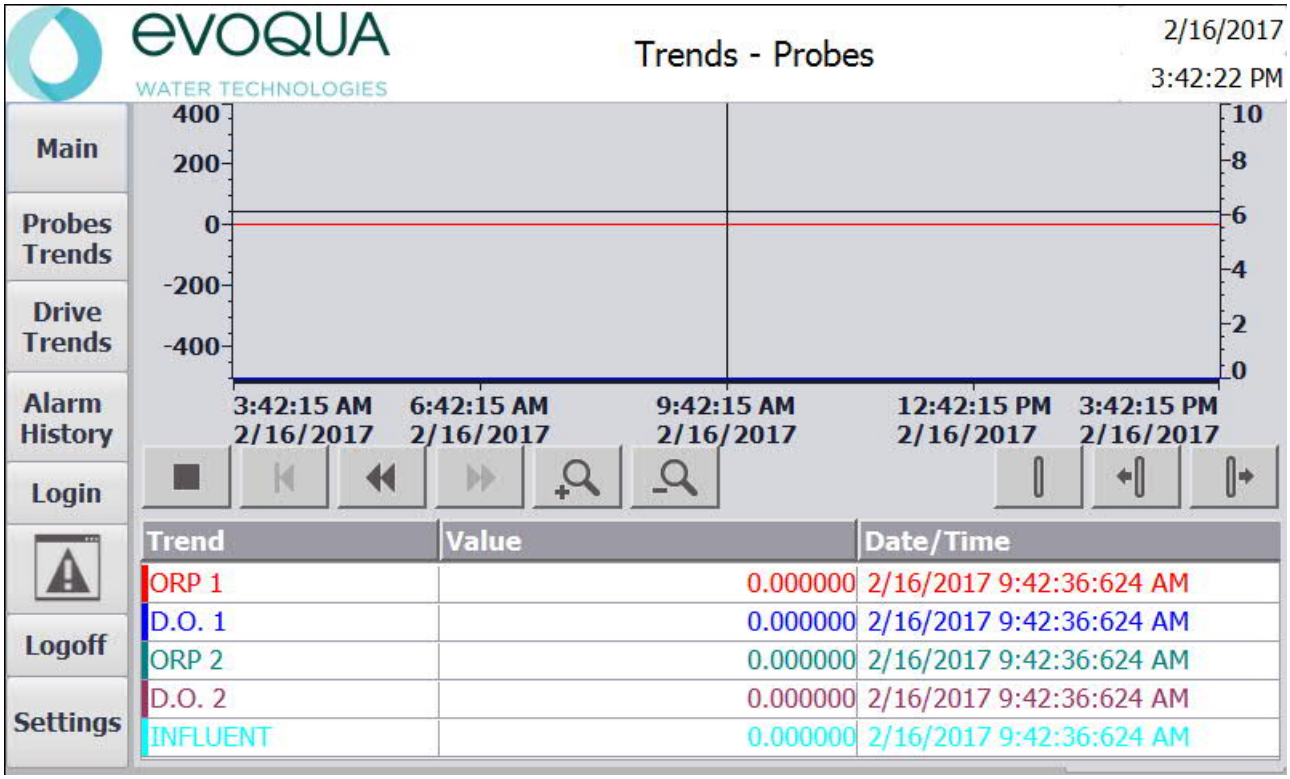
a. Process Alarm Set Points

Process alarms are provided to inform the operator if process conditions have been outside of desired ranges for extended periods of time. Each of these alarms can be enable and disabled as desired. Each alarm also has a set point at which to trigger the alarm. Each alarm condition must be true for 60 minutes before the alarm is triggered.

b. Mixer Set Points

If On/Off cycling Mode is desired select the “Enable” button. When this mode is active the mixer will cycle on and off using the “On Time” and “Off Time” set points (in minutes). Mixer Start at Min Mix Speed can be enabled using the “Enable” button. When this mode is enabled the Mixer will turn on once the aerator speed drops to minimum mix speed and will run until the aerator speed increases above minimum mix speed. If the mixer is on a VFD the speed the mixer runs at is entered in the Mixer Auto Speed setpoint.

4) Probe Trends

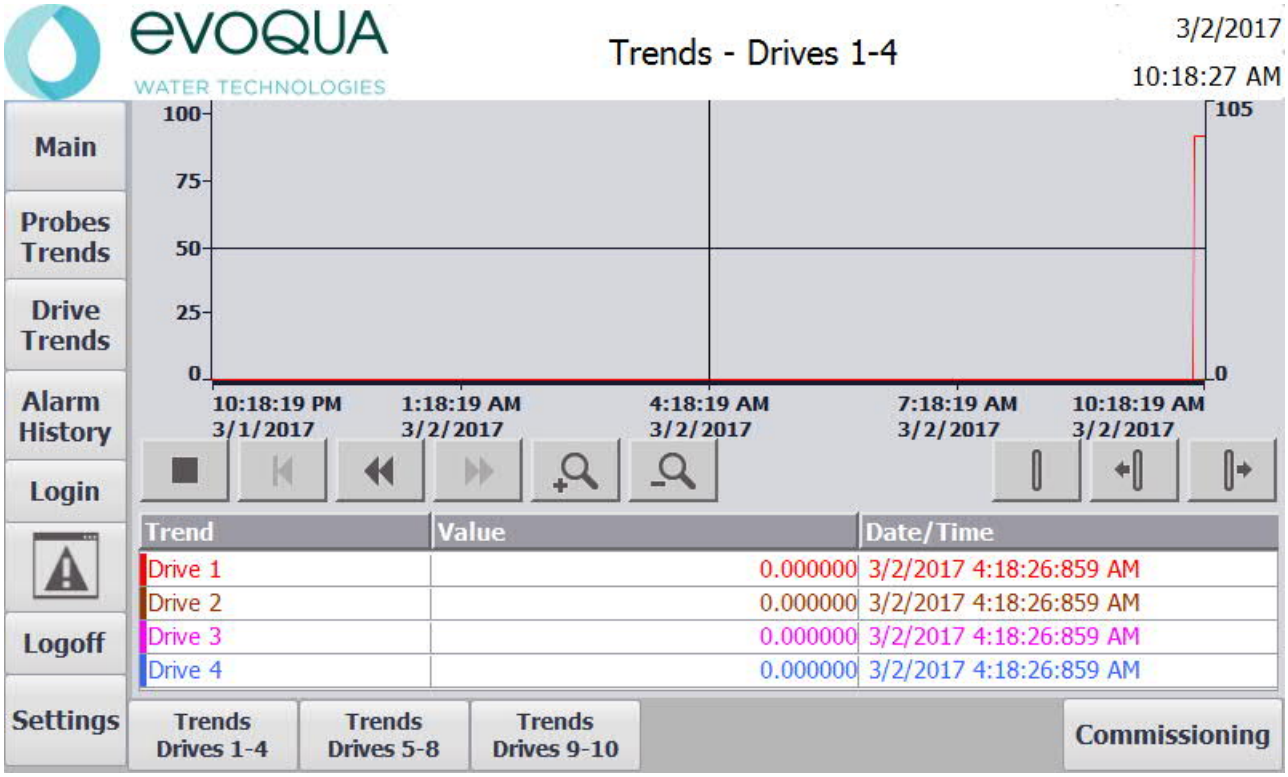


Trend screens are provided to assist the operator in troubleshooting process conditions. This trend screen displays trends for the all of the optional analog instrumentation including DO, ORP, and Influent flow. ORP uses the left hand side Y axis scale while DO and influent flow (in MGD) use the right hand side Y axis scale.

The trend screens by default display the last 12 hours of data. Using the << or >> buttons allow the operator to scroll backward and forward through the data. The operator can also zoom in and out using the buttons with the magnifying glass icons. The vertical data line can be moved by dragging it or by using the buttons on the lower right hand side of the trend screen. The values displayed for each trend in the "Value" column are populated from the time where the vertical data line is located.

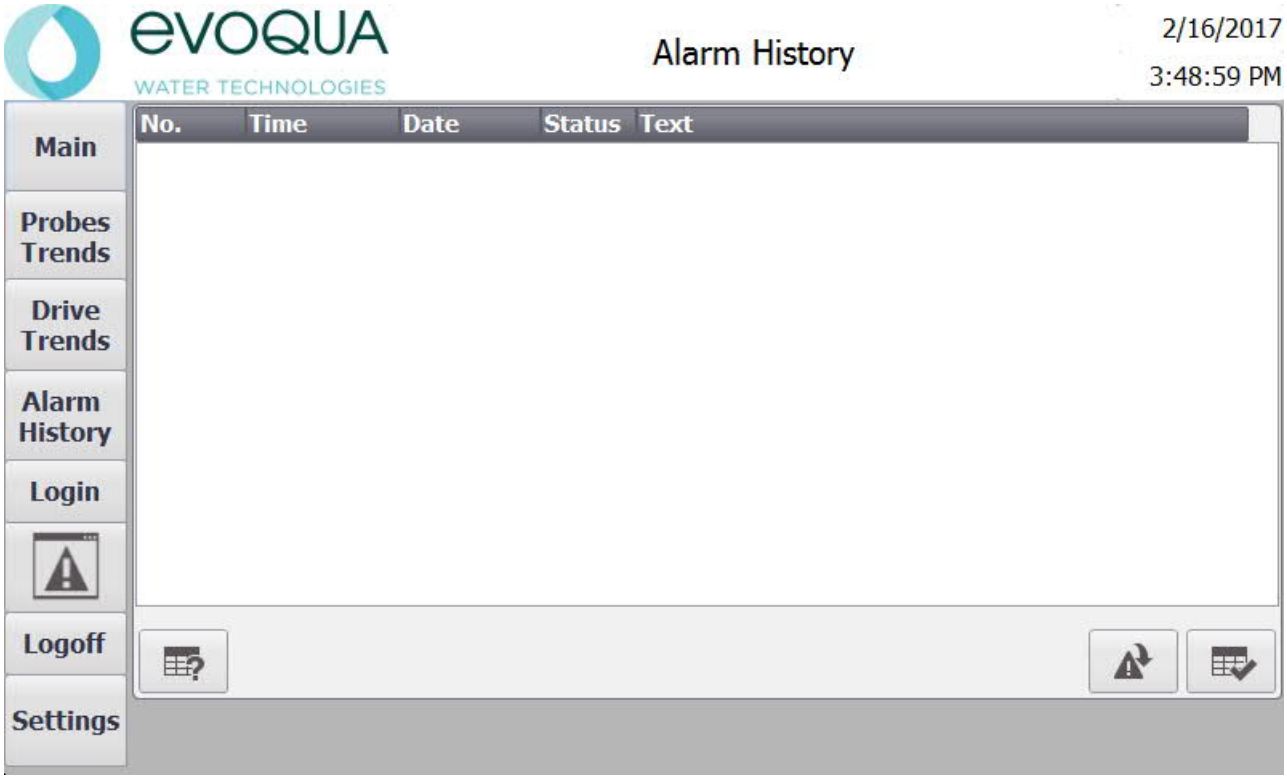
Trending data is stored in a USB flash drive on the back of the HMI. Trending screens will not function without this flash drive.

5) Drive Trends



Trend screens are provided to assist the operator in troubleshooting process conditions. This trend screen displays trends for the all drive speeds. All the graph controls are the same as outlined for the probe trends screen. Depending on the number of drives configured there may be up to three separate drive trend screens. The first drive trend will display drive speeds for drives 1-4, while the second drive trend will display drive speeds for drives 5-8, and the third trend will display drive speeds for drives 9-10.

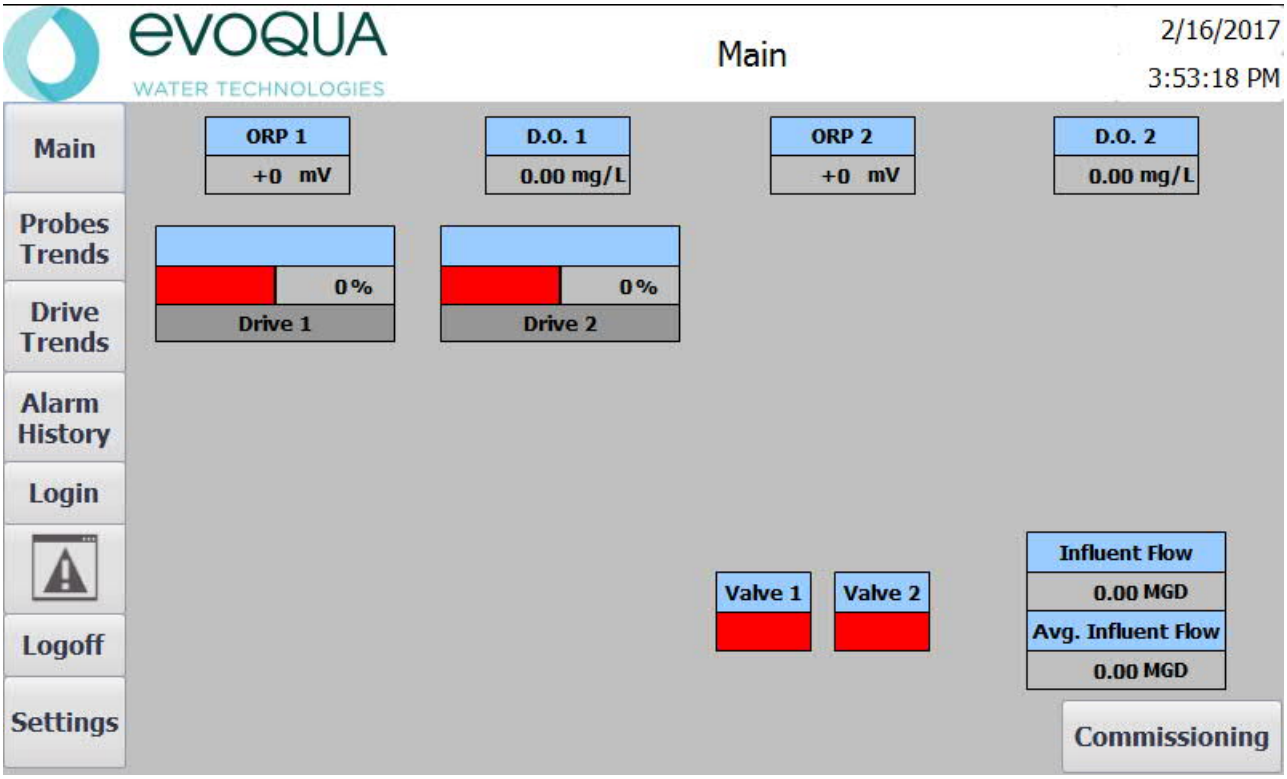
6) Alarm Screen



A full alarm history is shown on the Alarms screen. A short description of the alarm is show, along with the time and date that the alarm occurred. In addition to this static alarm window, an alarm pop up window will be visible whenever an alarm becomes active to indicate a new alarm event. This popup will show on every screen, and can be closed with the X button in the upper right corner. In addition, a small icon will be visible indicating the number of active alarms (see figure 4 below).

Figure 4 – Alarm icon indicating the number of active alarms

7) Login



Login buttons are supplied that allow entry to the settings and commissioning screens. The settings screen is used by supervisors to change set points on the settings screen. Once an administrator user is logged in a new "Commissioning" button will be visible in the lower right corner of the HMI.

The supervisor's login credentials are as follows
User : supervisor
Password: water

The commissioning functions are intended to be used by commissioning personnel. Changes to any of the Commissioning functions should be made at the recommendation of Evoqua WT.
Commissioning functions include:

i) Number of drives, drive types, and configurations
ii) Number of probes, probe type, probe I/O locations, probe scaling
iii) PID control constants
iv) Access to screen operating system Control Panel functions

8) SCADA Communication

1. Data registers are provided for a SCADA PLC that is connected over Ethernet that will allow information from the Smart BNR Lite panel to be displayed on a SCADA system. Data can be read from the following registers:

   SCADA_ALARMS (DINT) where
   SCADA_ALARMS.0 is DO 1 High Alarm
   SCADA_ALARMS.1 is DO 1 Low Alarm
   SCADA_ALARMS.2 is ORP 1 High Alarm
   SCADA_ALARMS.3 is ORP 1 Low Alarm
   SCADA_ALARMS.4 is DO 2 High Alarm
   SCADA_ALARMS.5 is DO 2 Low Alarm
   SCADA_ALARMS.6 is ORP 2 High Alarm
   SCADA_ALARMS.7 is ORP 2 Low Alarm
   SCADA_ALARMS.8 is Storm Flow Mode Active indication
   SCADA_ALARMS.9 is Valve/Gate 1 Failed
   SCADA_ALARMS.10 is Valve/Gate 2 Failed

   SCADA_BOOLS (DINT) where
   SCADA_BOOLS.0 is drive 1 running status
   SCADA_BOOLS.1 is drive 1 failed status
   SCADA_BOOLS.2 is drive 1 in remote status
   SCADA_BOOLS.3 is drive 2 running status
   SCADA_BOOLS.4 is drive 2 failed status
   SCADA_BOOLS.5 is drive 2 in remote status
   SCADA_BOOLS.6 is drive 3 running status
   SCADA_BOOLS.7 is drive 3 failed status
   SCADA_BOOLS.8 is drive 3 in remote status
   SCADA_BOOLS.9 is drive 4 running status
   SCADA_BOOLS.10 is drive 4 failed status
   SCADA_BOOLS.11 is drive 4 in remote status
   SCADA_BOOLS.12 is drive 5 running status
   SCADA_BOOLS.13 is drive 5 failed status
   SCADA_BOOLS.14 is drive 5 in remote status
   SCADA_BOOLS.15 is drive 6 running status
   SCADA_BOOLS.16 is drive 6 failed status
   SCADA_BOOLS.17 is drive 6 in remote status
   SCADA_BOOLS.18 is drive 7 running status
   SCADA_BOOLS.19 is drive 7 failed status
   SCADA_BOOLS.20 is drive 7 in remote status
   SCADA_BOOLS.21 is drive 8 running status
   SCADA_BOOLS.22 is drive 8 failed status
   SCADA_BOOLS.23 is drive 8 in remote status

SCADA_BOOLS.24 is drive 9 running status
SCADA_BOOLS.25 is drive 9 failed status
SCADA_BOOLS.26 is drive 9 in remote status
SCADA_BOOLS.27 is drive 10 running status
SCADA_BOOLS.28 is drive 10 failed status
SCADA_BOOLS.29 is drive 10 in remote status

SCADA_REALS (REAL[7]) where
SCADA_REALS[0] is DO 1 probe output in mg/L
SCADA_REALS[1] is ORP 1 probe output in mV
SCADA_REALS[2] is DO 2 probe output in mg/L
SCADA_REALS[3] is ORP 2 probe output in mV
SCADA_REALS[4] is Drive 1 speed in %
SCADA_REALS[5] is Drive 2 speed in %
SCADA_REALS[6] is Drive 3 speed in %
SCADA_REALS[7] is Drive 4 speed in %
SCADA_REALS[8] is Drive 5 speed in %
SCADA_REALS[9] is Drive 6 speed in %
SCADA_REALS[10] is Drive 7 speed in %
SCADA_REALS[11] is Drive 8 speed in %
SCADA_REALS[12] is Drive 9 speed in %
SCADA_REALS[13] is Drive 10 speed in %
SCADA_REALS[14] is Influent Flow in MGD

2. If all four analog inputs to the Smart BNR Lite panel are used for DO and ORP probes it is possible for a SCADA PLC to write the influent flow value to the Smart BNR Lite panel over Ethernet. The SCADA PLC would need to write to the following register:

   INFLUENT_METER.INPUT

   Where INFLUENT_METER.INPUT is an integer value between 0 and 10,000. This integer value should match the 4-20 mA scaling values in units of MGD. Scaling values need to be confirmed in the commissioning screen of the Smart BNR Lite panel.

   For customers utilizing micrologix PLC's the alarms and status information can be read from the following registers.

   N100 where
   N100:0 is DO 1 High Alarm
   N100:1 is DO 1 Low Alarm
   N100:2 is ORP 1 High Alarm
   N100:3 is ORP 1 Low Alarm

N100:4 is DO 2 High Alarm
N100:5 is DO 2 Low Alarm
N100:6 is ORP 2 High Alarm
N100:7 is ORP 2 Low Alarm
N100:8 is Storm Flow Mode Active indication
N100:9 is Valve/Gate 1 Failed
N100:10 is Valve/Gate 2 Failed

N102 where
N102:0 is drive 1 running status
N102:1 is drive 1 failed status
N102:2 is drive 1 in remote status
N102:3 is drive 2 running status
N102:4 is drive 2 failed status
N102:5 is drive 2 in remote status
N102:6 is drive 3 running status
N102:7 is drive 3 failed status
N102:8 is drive 3 in remote status
N102:9 is drive 4 running status
N102:10 is drive 4 failed status
N102:11 is drive 4 in remote status
N102:12 is drive 5 running status
N102:13 is drive 5 failed status
N102:14 is drive 5 in remote status
N102:15 is drive 6 running status
N103:0 is drive 6 failed status
N103:1 is drive 6 in remote status
N103:2 is drive 7 running status
N103:3 is drive 7 failed status
N103:4 is drive 7 in remote status
N103:5 is drive 8 running status
N103:6 is drive 8 failed status
N103:7 is drive 8 in remote status
N103:8 is drive 9 running status
N103:9 is drive 9 failed status
N103:10 is drive 9 in remote status
N103:11 is drive 10 running status
N103:12 is drive 10 failed status
N103:13 is drive 10 in remote status

F105 through F111 where
F105 is DO 1 probe output in mg/L
F106 is ORP 1 probe output in mV

F107 is DO 2 probe output in mg/L
F108 is ORP 2 probe output in mV
F109 is Drive 1 speed in %
F110 is Drive 2 speed in %
F111 is Drive 3 speed in %
F112 is Drive 4 speed in %
F113 is Drive 5 speed in %
F114 is Drive 6 speed in %
F115 is Drive 7 speed in %
F116 is Drive 8 speed in %
F117 is Drive 9 speed in %
F118 is Drive 10 speed in %
F119 is Influent Flow in MGD

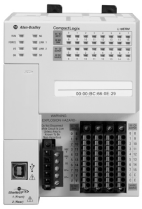
Section 2
Equipment Manuals

Allen-Bradley

CompactLogix Controllers Specifications

CompactLogix 5370 Controller Catalog Numbers

~~1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B, 1769-L24ER-QB1B,~~
1769-L24ER-QBFC1B, ~~1769-L27ERM-QBFC1B,1769-L30ER, 1769-L30ER-NSE,~~
~~1769-L30ERM, 1769-L33ER, 1769-L33ERM, 1769-L36ERM~~



1769 Packaged Controller Catalog Numbers

1769-L23-QBFC1B, 1769-L23E-QB1B, 1769-L23E-QBFC1B

1769 Modular Controller Catalog Numbers

1769-L31, 1769-L32C, 1769-L35CR, 1769-L32E, 1769-L35E

1768 Controller Catalog Numbers

1768-L43, 1768-L43S, 1768-L45, 1768-L45S

Memory Card Catalog Numbers

1784-CF128, 1784-SD1, 1784-SD2

Table 1 - Environmental Specifications - 1768 and 1769 CompactLogix Controllers and CompactLogix 5370 Controllers

Attribute	1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B	1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B	1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM, 1769-L33ER, 1769-L33ERM, 1769-L36ERM	1769-L23-QBFC1B, 1769-L23E-QB1B, 1769-L23E-QBFC1B	1769-L31, 1769-L32C, 1769-L35CR, 1769-L32E, 1769-L35E	1768-L43, 1768-L43S, 1768-L45, 1768-L45S
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Na, Operating Thermal Shock)	-20…60 °C (-4…140 °F)	0…60 °C (32…140 °F)				
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)					
Temperature, surrounding air, max	60 °C (140 °F)					
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5...95% noncondensing					
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz[1]		5 g @ 10…500 Hz	2 g @ 10…500 Hz	5 g @ 10…500 Hz	
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g[1]		20 g - DIN rail 30 g - Panel	30 g	20 g - DIN rail 30 g - Panel	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g[1], [2]		30 g - DIN rail 40 g - Panel	30 g	30 g - DIN rail 40 g - Panel	50 g
Emissions CISPR 11	Group 1, Class A					
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges			4 kV contact discharges 8 kV air discharges	1769-L31 4 kV contact discharges 8 kV air discharges 1769-L32C, 1769-L35CR, 1769-L32E, 1769-L35E 6 kV contact discharges 8 kV air discharges	6 kV contact discharges 8 kV air discharges

(1) If you are mounting a CompactLogix™ 5370 L1 controller on a EN 50 022 - 35 x 15 mm (1.38 x 0.59 in.) DIN rail, you must first adhere a bumper on the back of the controller. Failure to install the bumper before mounting the controller results in the system failing to meet this specification. For more information, see the CompactLogix 5370 Controllers User Manual, publication 1769-UM021.

(2) If you are mounting a CompactLogix 5370 L1 controller on a EN 50 022 - 35 x 15 mm (1.38 x 0.59 in.) DIN rail, the Shock, nonoperating specification = 30 g.

Table 1 - Environmental Specifications - 1768 and 1769 CompactLogix Controllers and CompactLogix 5370 Controllers

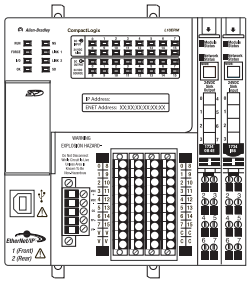
Attribute	1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B	1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B	1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM, 1769-L33ER, 1769-L33ERM, 1769-L36ERM	1769-L23-QBFC1B, 1769-L23E-QB1B, 1769-L23E-QBFC1B	1769-L31, 1769-L32C, 1769-L35CR, 1769-L32E, 1769-L35E	1768-L43, 1768-L43S, 1768-L45, 1768-L45S
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 10V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz			10V/m with 200 Hz 50% Pulse 100% AM at 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM at 1890 MHz 10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz	1769-L31, 1769-L32C, 1769-L35CR 10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 1769-L32E, 1769-L35E 10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz	10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz
EFT/B immunity IEC 61000-4-4	±3 kV at 5 kHz on power ports ±3 kV at 5 kHz on signal ports ±3 kV at 5 kHz on communication ports		±3 kV at 5 kHz on communication ports	±2 kV at 5 kHz on power ports ±2 kV at 5 kHz on signal ports ±2 kV at 5 kHz on communication ports	1769-L31, 1769-L32C, 1769-L35CR ±2 kV at 5 kHz on communication ports 1769-L32E, 1769-L35E ±3 kV at 5 kHz on power ports ±3 kV at 5 kHz on communication ports	±4 kV at 5 kHz on communication ports
Surge transient immunity IEC 61000-4-5	±1 kV line-line (DM) and ±2 kV line-earth (CM) on power ports ±1 kV line-line (DM) and ±2 kV line-earth (CM) on signal ports ±2 kV line-earth (CM) on communication ports	±1 kV line-line (DM) and ±2 kV line-earth (CM) on power ports ±1 kV line-line (DM) and ±2 kV line-earth (CM) on signal ports ±2 kV line-earth (CM) on shielded ports ±2 kV line-earth (CM) on communication ports	±2 kV line-earth (CM) on communication ports	±1 kV line-line (DM) and ±2 kV line-earth (CM) on power ports ±1 kV line-line (DM) and ±2 kV line-earth (CM) on signal ports ±2 kV line-earth (CM) on shielded ports ±2 kV line-earth (CM) on communication ports	1769-L31 Channel 0: ±2 kV line-earth (CM) on shielded ports Channel 1: ±1 kV line-earth (CM) on shielded ports 1769-L32C, 1769-L35CR, 1769-L32E, 1769-L35E ±2 kV line-earth (CM) on communication ports	±2 kV line-earth (CM) on communication ports
Conducted RF immunity IEC 61000-4-6	10Vrms with 1 kHz sine-wave 80% AM from 150 kHz…80 MHz					

(1) If you are mounting a CompactLogix 5370 L1 controller on a EN 50 022 - 35 x 15 mm (1.38 x 0.59 in.) DIN rail, you must first adhere a bumper on the back of the controller. Failure to install the bumper before mounting the controller results in the system failing to meet this specification. For more information, see the CompactLogix 5370 Controllers User Manual, publication 1769-UM021.

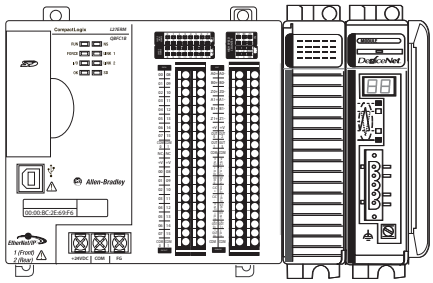
(2) If you are mounting a CompactLogix 5370 L1 controller on a EN 50 022 - 35 x 15 mm (1.38 x 0.59 in.) DIN rail, the Shock, nonoperating specification = 30 g.

CompactLogix 5370 Controllers

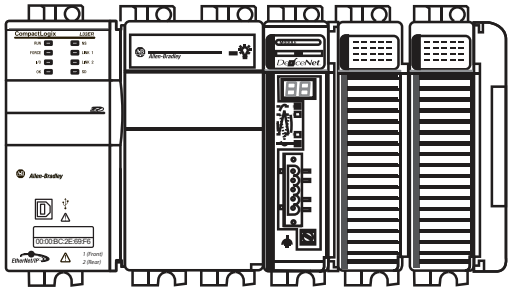
CompactLogix 5370 L1 Control System



CompactLogix 5370 L2 Control System



CompactLogix 5370 L3 Control System



CompactLogix 5370 controllers provide scalable controller solutions capable of addressing a wide variety of applications. All CompactLogix 5370 controllers provide the following functionality:

- Two EtherNet/IP ports
- One USB port
- Support for local expansion modules
- Control of local and distributed I/O modules
- Use of 1784-SD1 or 1784-SD2 Secure Digital (SD) card for nonvolatile memory
- Internal energy storage solution eliminating the need for a battery

Some CompactLogix 5370 controllers provide the following functionality:

- Built-in power supply
- Some combination of embedded digital, analog and high-speed counter modules
- Support for Integrated Motion over an EtherNet/IP network
- Access to DeviceNet networks

Table 2 - Features - CompactLogix 5370 Controllers

Feature	1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B	1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B	1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM, 1769-L33ER, 1769-L33ERM, 1769-L36ERM
Controller tasks: • Continuous • Periodic	• 32 tasks • 100 programs/task		
Built-in communication ports	• Two EtherNet/IP ports - CompactLogix 5370 controllers have two EtherNet/IP ports to connect to an EtherNet/IP network. The ports carry the same network traffic as part of the controller's embedded switch. However, the controller uses only one IP address. • One USB port (for temporary connection only)		
Communication options	EtherNet/IP	• EtherNet/IP • DeviceNet via 1769-SDN scanner module	
EtherNet/IP node, max	• 1769-L16ER-BB1B: Up to four nodes • 1769-L18ER-BB1B, 1769-L18ERM-BB1B: Up to 8 nodes	• 1769-L24ER-QB1B, 1769-L24ER-QBFC1B: Up to 8 nodes • 1769-L27ERM-QBFC1B: Up to 16 nodes	• 1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM: Up to 16 nodes • 1769-L33ER, 1769-L33ERM: Up to 32 nodes • 1769-L36ERM: Up to 48 nodes
Controller connections	256		
Embedded I/O modules	• 16 DC digital inputs • 16 DC digital outputs	All controllers: • 16 DC digital inputs • 16 DC digital outputs 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B only: • 4 high-speed counters • 4 high-speed counter outputs • 4 universal analog inputs • 2 analog output points	None

Table 2 - Features - CompactLogix 5370 Controllers

Feature	1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B	1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B	1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM, 1769-L33ER, 1769-L33ERM, 1769-L36ERM
Sockets, max	32		
Integrated Motion over an EtherNet/IP network	1769-L18ERM-BB1B - 1 or 2 axes	1769-L27ERM-QBFC1B - As many as 4 axes	• 1769-L30ERM - As many as 4 axes • 1769-L33ERM - As many as 8 axes • 1769-L36ERM - As many as 16 axes
Programming languages	• Relay ladder • Structured text • Function block • SFC		

Table 3 - Technical Specifications - CompactLogix 5370 Controllers

Attribute	1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B	1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B	1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM, 1769-L33ER, 1769-L33ERM, 1769-L36ERM
User memory	• 1769-L16ER: 384 KB • 1769-L18ER, 1769-L18ERM: 512 KB	• 1769-L24ER-QB1B, 1769-L24ER-QBFC1B: 750 KB • 1769-L27ERM-QBFC1B: 1 MB	• 1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM: 1 MB • 1769-L33ER, 1769-L33ERM: 2 MB • 1769-L36ERM: 3 MB
Optional nonvolatile memory	1784-SD1 card with 1 Gb of available memory (shipped with controller) 1784-SD2 card with 2 Gb of available memory (available for separate ordering)		
Number of local expansion modules, max[1]	• 1769-L16ER-BB1B: Six 1734 POINT I/O™ modules • 1769-L18ER-BB1B, 1769-L18ERM-BB1B: Eight 1734 POINT I/O modules	Four 1769 Compact I/O modules	• 1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM: Eight 1769 Compact I/O™ modules • 1769-L33ER, 1769-L33ERM: Sixteen 1769 Compact I/O modules • 1769-L36ERM: Thirty 1769 Compact I/O modules
Number of I/O module banks, max	NA	1	3
Current draw @ 5V DC, controller power	1 A	• 1769-L24ER-QB1B: 1.54 A Value rated at the following ambient temperatures: 40 °C (104 °F), 55 °C (131 °F), 60 °C (140 °F). • 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B: 1 A Value rated at the following ambient temperatures: 40 °C (104 °F), 55 °C (131 °F), 60 °C (140 °F).	500 mA
Current draw @ 24V DC, controller power	NA	• 1769-L24ER-QB1B: 0.95A Value rated at the following ambient temperatures: 40 °C (104 °F), 55 °C (131 °F), 60 °C (140 °F). • 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B: 0.8 A Value rated at the following ambient temperatures: 40 °C (104 °F), 55 °C (131 °F), 60 °C (140 °F).	225 mA
Current draw @ 24V DC, field power, max	3 A - Combined total for all devices drawing current from field power connections Input: 5mA Output: 500mA	NA	NA
Power dissipation, max	12 W	• 1769-L24ER-QB1B: 12 W • 1769-L24ER-QBFC1B, L27ERM-QBFC1B: 21 W	4.5 W
Isolation voltage	50V (continuous), Basic Insulation Type Tested at 500V AC for 60 s, System to Field	30V (continuous), Basic Insulation Type, USB to system, Ethernet to system and Ethernet to Ethernet Type tested at 500V AC for 60 s	
Short circuit protection, field power	Internal fuse, Non-replaceable	NA	NA
Recommended external short circuit protection, field power	User-provided 4…6 A @ 52.5…68.25 $A2^t$ fuse	NA	NA

Table 3 - Technical Specifications - CompactLogix 5370 Controllers

Attribute	1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B	1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B	1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM, 1769-L33ER, 1769-L33ERM, 1769-L36ERM
Weight, approx	0.66 kg (1.5 lb)	• 1769-L24ER-QB1B = 0.63 kg (1.39 lb) • 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B = 0.9 kg (1.9 lb)	0.31 kg (0.68 lb)
Module width	100.00 mm (3.94 in.)	1769-L24ER-QB1B = 115.00 mm (4.53 in.) 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B = 140 mm (5.51 in.)	55.00 mm (2.17 in.)
Module location	DIN rail mount	DIN rail or panel mount	
Panel-mounting screw torque	NA	1.1…1.8 N•m (10…16 lb•in) - use M4 or #8 screws	
Embedded power supply	24V DC input, non-isolated	24V DC Input, isolated	1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4
Power supply distance rating	NA		• Controller and 1769-SDN: 4 • 1769 Compact I/O modules: 1…8, depending on module
Wire category[2]	1 - signal ports 1 - power ports 2 - communication ports		2 - communication ports
Wire type, Ethernet	RJ-45 connector according to IEC 60603-7, 2 or 4 pair Category 5e minimum cable according to TIA 568-B.1 or Category 5 cable according to ISO/IEC 24702		
Wire type, power terminals and embedded I/O connections	Copper		NA
Wire size, power terminals[3]	0.051…3.31 mm^2 (30…12 AWG) solid or stranded copper wire rated at 75 °C (167 °F), or greater, 1.2 mm (3/64 in.) insulation, max Each terminal accepts 1 or 2 wires	0.25…2.50 mm^2 (22...14 AWG) solid copper wire rated at 75 °C (167 °F), or greater 1.2 mm (3/64 in.) insulation, max Each terminal accepts only 1 wire	NA
Wire stripping length, power terminals[3]	10 mm (0.39 in)	8 mm (0.31 in)	NA
Screw torque, power terminals [3]	0.5…0.6 N•m (4.4…5.3 lb•in)	1.0…1.2 N•m (8.9…10.6 lb•in)	NA
Wire size, embedded I/O connections	0.205…1.31 mm^2 (24…16 AWG) solid or stranded copper wire rated at 75 °C (167 °F), or greater 1.2 mm (3/64 in.) insulation, max or 90 °C (194 °F) Each terminal accepts only 1 wire		NA
Wire stripping length, embedded I/O connections	10 mm (0.39 in)		NA
North American temperature code	T4A	T3C	T5
IEC temperature code	T4		T5
Enclosure type rating	None (open-style)		

(1) You can use up to the maximum number of local expansion modules with the CompactLogix 5370 L1 controllers listed as long as the total current drawn by the embedded I/O and local expansion modules does not exceed both the available POINTBus backplane current of 1 A and the field power current of 3 A. For more information on POINTBus backplane current and field power current considerations when installing local expansion modules, see page 9.

(2) Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1 and the appropriate system-level installation manual.

(3) With respect to the CompactLogix 5370 L1 controllers, this specification applies to connecting wires to the power connector that is inserted in the controller. With respect to the CompactLogix 5370 L2 controllers, this specification applies to connecting wires to power terminals built into the controller.

I/O Module Support - CompactLogix 5370 L1 Controllers

The CompactLogix 5370 L1 controllers offer an embedded I/O module and the option of using 1734 POINT I/O modules as local expansion modules.

The embedded I/O module provides the following:

- 16 sinking 24V DC digital input points
- 16 sourcing 24V DC digital output points

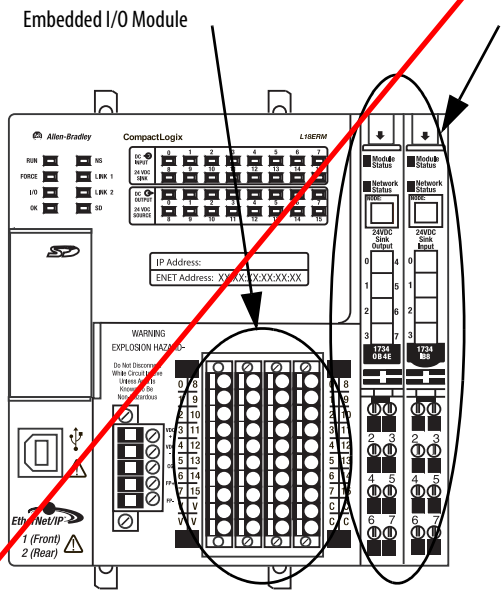
To use 1734 POINT I/O modules as local expansion modules, keep in mind the following:

- Local expansion modules must be installed in the same system as the CompactLogix 5370 L1 controller.
- The modules are installed to the right of the controller.
- The maximum number of local expansion modules available depends on the controller catalog of that system.

Table 4 lists the number of 1734 POINT I/O modules the CompactLogix 5370 L1 controllers support. Each I/O module's minimum RPI is 1.0 ms and can be changed by 0.5 ms increments.

Table 4 - 1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B Controllers - Local I/O Module Support

Cat. No.	Local 1734 POINT I/O Modules Supported, max
1769-L16ER-BB1B	6
1769-L18ER-BB1B	8
1769-L18ERM-BB1B	



You can use up to the maximum number of 1734 POINT I/O modules with the CompactLogix 5370 L1 controllers listed in Table 4, as long as the total current drawn by the embedded I/O and local expansion modules does not exceed both the available POINTBus backplane current of 1 A and the field power current of 3 A.

Depending on your application's configuration, you can use one of the following devices to make additional POINTBus backplane current and/or field power current available:

- **1734-EP24DC POINT I/O Expansion Power Supply** - An expansion power supply is installed between embedded I/O modules and local expansion modules or between local expansion modules.

  The expansion power supply breaks the available POINTBus backplane current between the modules to its left and right. With the expansion power supply installed, the modules to its left can draw up to 1 A of POINTBus backplane current and the modules to its right can draw as much current as that provided by the expansion power supply.

  Additionally, the expansion power supply breaks the available field power current between the modules to its left and right With the expansion power supply installed, the modules to its left can draw up to 3 A of field power current and the modules to its right can draw as much field power current as allowed by the expansion power supply.

  For more information on the 1734-EP24DC expansion power supply, see the POINT I/O 24V DC Expansion Power Supply Installation Instructions, publication 1734-IN058.

- **1734-FPD POINT I/O Field Power Distributor Module** - A field power distributor module can also be installed between embedded I/O modules and local expansion modules or between local expansion modules.

  The field power distributor module breaks the available field power current between the modules to its left and right. With the field power distributor module installed, the modules to its left can draw up 3 A of field power current, and the modules to its right can draw as much field power current as allowed by the field power distributor.

  For more information on the 1734-FPD POINT I/O Field Power Distributor module, see the POINT I/O Field Power Distributor Module Installation Instructions, publication 1734-IN059.

IMPORTANT Remember, the field power distributor module only changes the level of field power current available in the system. It does not affect the level of POINTBus backplane current available.

CompactLogix 5370 L1 Controllers' Local I/O Performance

The requested packet interval (RPI) defines the frequency at which the controller sends data to and receives data from I/O modules. You set an RPI rate for each I/O module in your system.

CompactLogix 5370 L1 controllers always attempt to scan an I/O module at the configured RPI rate. For individual I/O modules, a Module RPI Overlap minor fault occurs if there are enough I/O modules with RPI rates set too fast that they cannot all be serviced in the allotted interval.

The specific configuration parameters for a system determine the impact on actual RPI rates. These configuration factors can impact the effective scan frequency for any individual module:

- Rates at which other 1734 POINT I/O modules' RPI rates are set
- Number of other 1734 POINT I/O modules in the system
- Types of other 1734 POINT I/O modules in the system
- Application user task priorities

In general, follow these guidelines when setting the RPI rates in a CompactLogix 5370 L1 control system:

- For **digital** modules:
  - 1...2 modules can be scanned in 2 ms.
  - 3...4 modules can be scanned in 4 ms.
  - 5...8 modules can be scanned in 8 ms.

IMPORTANT	When considering digital I/O modules, remember that they can be the embedded I/O module on the controller or 1734 POINT I/O modules used as local expansion modules. Therefore, the consideration for using two modules can be the embedded I/O module and a 1734 POINT I/O module or two 1734 POINT I/O modules.

- For **specialty and analog** modules (except 1734-485ASC modules):
  - 1 module can be scanned at 20 ms.
  - For each additional module add 20 ms.

  For example, if a CompactLogix 5370 L1 control system uses two analog modules, the module can be scanned in 40 ms.

- For **1734-485ASC** modules, the sum total data size for all ASC modules determines the RPI rates:
  - For total data size less than 20 bytes, each module can be scanned in 20 ms.
  - For data size greater than 20 bytes, use the size value as the RPI.

  For example, if the total data size is 40 bytes, each ASC module can be scanned in 40 ms.

You are not required to set individual 1734 POINT I/O modules' RPI values to the values listed above. For example, if your application scans one or two modules, you do not have to use RPI rates of 2 ms. Remember, though, that higher RPI rates result in scanning the data less frequently.

The RPI shows how quickly modules can be scanned, not how quickly an application can use the data. The RPI is asynchronous to the program scan. Other factors, such as program execution duration, affect I/O throughput.

Table 5 - Embedded DC Input Specifications

Attribute	1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B
Inputs	16
Voltage category	24V DC sink
Operating voltage range	10…28.8V DC 24V DC nom
Digital filter, off to on	0.5 ms hardware plus 0…65 ms (user selectable)
Input delay, off to on	
Digital filter, on to off	0.5 ms hardware plus 0…65 ms (user selectable)
Input delay, on to off	
Off-state voltage, max	5V DC
Off-state current, max	1.5 mA
On-state current, min	2 mA @ 24V DC
Input impedance, max	4.7 kΩ
Cyclic update time	1 ms…750 ms
Isolation voltage	50V DC (continuous), Basic Insulation Type Tested at 500V AC for 60 s, system to field No isolation between individual channels
IEC input compatibility	Type 3
Isolated groups	None

Table 6 - Embedded DC Output Specifications

Attribute	1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B
Outputs	16
Voltage category	24V DC source
Operating voltage range	10…28.8V DC 24V DC nom
Output delay, off to on	0.1 ms
Output delay, on to off	0.1 ms
Off-state leakage current, max	0.5 mA @ 24V DC
On-state current, min	1 mA per channel
On-state voltage drop, max	0.6V DC
Current per point, max	0.5 A
Current per module, max	3 A
Surge current per point, max	1 A for 100 ms per point, repeatable every 2 s
Isolation voltage	50V DC (continuous), Basic Insulation Type Tested at 500V AC for 60 s, system to field No isolation between individual channels
Isolated groups	None
Pilot duty rating	0.5 A

Table 7 - Embedded Power Supply

Attribute	1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B
Input voltage range	10…28.8V DC
Input voltage, nom	24V DC
Line requirement (VDC), min	50VA, Class 2/SELV
Available 5V DC POINTBus backplane current	1 A @ 5V DC
Inrush, max	15 A
Line loss ride through	10 ms…10 s
Output bus current capacity, max	0.1 …3 A @ 5V DC
Load current, min	300 mA
Short circuit protection	Internal fuse Not user replaceable
Overvoltage protection	Yes

I/O Module Support - CompactLogix 5370 L2 Controllers

The CompactLogix 5370 L2 controllers offer embedded I/O modules and the option of using 1769 Compact I/O modules as local expansion modules. The following table describes theembedded I/O modules and local expansion modules supported by CompactLogix 5370 L2 controllers.

Cat. No.	Embedded I/O Module Support						Local Expansion Modules Support
	Sinking/Sourcing 24V DC Digital Input Points	Sourcing 24V DC Digital Output Points	High-speed Counters	High-speed Counter Output Points	Universal Analog Input Points	Analog Output Points	1769 Compact I/O Modules
1769-L24ER-QB1B	16	16	-	-	-	-	As many as 4 modules
1769-L24ER-QBFC1B			4	4	4	2	
1769-L27ERM-QBFC1B							

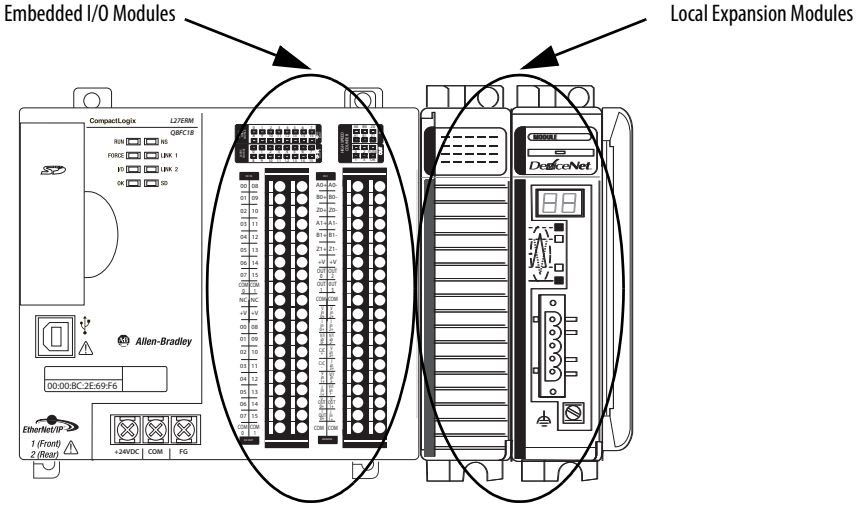
IMPORTANT Remember the following when using the embedded I/O modules on CompactLogix 5370 L2 controllers:

- 1769-L24ER-QB1B controller - The digital input points and digital output points are located on a single embedded I/O module. Therefore, the 1769-L24ER-QB1B controller is considered to have one embedded I/O module.
- 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B controllers - The digital input points and digital output points are located on a single embedded I/O module. The high-speed counter input output points, universal analog input points, and analog output points are located on another single embedded I/O module. Therefore, the 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B controllers are considered to have two embedded I/O modules.

You configure an RPI rate for the embedded I/O modules to establish specific time intervals at which data is transmitted between the controller and the embedded I/O modules. The embedded I/O modules' available RPI range is 0.5…750.0 ms and can be changed by 0.5 ms increments. The default setting is 20 ms.

To use 1769 Compact I/O modules as local expansion modules, keep in mind the following:

- Local expansion modules must be installed in the same system as the CompactLogix 5370 L2 controller.
- Local expansion modules are installed to the right of the embedded I/O modules.
- You must install a 1769-ECR Compact I/O end cap on the right side of control system. The end cap can be installed on the right side of the embedded I/O modules or, if local expansion modules are used, on the right side of 1769 Compact I/O module.



CompactLogix 5370 L2 Controllers' Local I/O Performance

The requested packet interval (RPI) defines the frequency at which the controller sends data to and receives data from I/O modules. In the programming software, you set an RPI rate for each I/O module in your system, including embedded I/O modules, local expansion modules, or distributed I/O modules over an EtherNet/IP network.

The CompactLogix 5370 L2 controllers always attempt to scan an I/O module at the configured RPI rate. The controller scans distributed I/O modules at the configured RPI rates.

With embedded I/O modules and local expansion modules, however, some specific system configuration parameters determine the actual rate at which the controller scans the modules. That is, the controller may be configured to scan an I/O module at one rate, but actually scan the module at a different rate.

For individual I/O modules, a Module RPI Overlap minor fault occurs if there is at least one I/O module that cannot be serviced within its RPI time.

The specific configuration parameters for a system determine the impact on actual RPI rates. These configuration factors can impact the effective scan frequency for any individual embedded or local expansion module:

- Rates at which embedded I/O modules' RPI values are set
- Number of embedded I/O modules used in the system
- Types of embedded I/O modules used in the system
- Rates at which 1769 Compact I/O modules' RPI values are set
- Number of 1769 Compact I/O modules in the system
- Types of 1769 Compact I/O modules in the system
- Application user task priorities

Table 8 describes RPI rate guidelines.

Table 8 - RPI Rate Guidelines

Type of Module	Guidelines
Digital and analog (any mix)	The following guidelines apply: • 1…2 modules can be scanned in 0.5 ms. • 3…4 modules can be scanned in 1 ms. • 5…6 modules can be scanned in 2 ms. • Some input modules have a fixed 8 ms filter, so selecting a faster RPI has no effect.
Specialty	The following conditions apply: • For every full-sized 1769-SDN module in the system, increase every other module's RPI by 2 ms. • For every 1769-HSC module in the system, increase every other module's RPI by 1 ms. • For every full-sized 1769-ASCII module system, increase every other module's RPI by 1 ms. • For every 1769-SM2 module in the system, increase every other module's RPI by 2 ms. For example, if the system includes four I/O modules configured with an RPI = 1 ms and you add a 1769-SDN module to the system, you should increase the RPI value for all four I/O modules by 2 ms. Therefore, when the 1769-SDN module is added to the system, the four I/O modules should use an RPI = 3 ms. If, in the same system, you add a second 1769-SDN module, the four I/O modules' RPI value should be increased to 5 ms.

IMPORTANT When considering the number of I/O modules, remember that they can be the embedded I/O modules on the controller or 1769 Compact I/O modules used as local expansion modules.

Therefore, the consideration for using modules can be any of the following system configurations:

- Embedded I/O modules only
- 1769 Compact I/O modules only
- Some combination of embedded I/O modules and 1769 Compact I/O modules

You can set individual 1769 Compact I/O modules' RPI rates higher than those listed in Table 8. The RPI shows how quickly modules can be scanned, not how quickly an application can use the data. The RPI is asynchronous to the program scan. Other factors, such as program execution duration, affect I/O throughput.

Table 9 - Embedded DC Input Specifications

Attribute	1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B
Inputs	16
Voltage category	24V DC sink/source
Operating voltage range	1769-L24ER-QB1B: 10…28.8V DC @ 40 °C (104 °F) 10…26.4V DC @ 60 °C (140 °F) 24V DC nom 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B : 10…28.8V DC @ 40 °C (104 °F) 10…27.0V DC @ 55 °C (131 °F) 10…26.4V DC @ 60 °C (140 °F) 24V DC nom
Digital filter, off to on	0 s, 100 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms
Input delay, off to on	100 µs, min 8 ms, max
Digital filter, on to off	0 s, 100 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms
Input delay, on to off	100 µs, min 8 ms, max
Off-state voltage, max	5V DC
Off-state current, max	1.5 mA
On-state current, min	2 mA @ 24V DC per channel
On-state current, max	5 mA @ 24V DC per channel
Input impedance, max	5.2 kΩ @ 24V dc 6.1 kΩ @ 30V dc
Cyclic update time	0.5 ms…750 ms
Isolation voltage	75V (continuous), Reinforced Insulation Type Type tested at 1200V AC for 1 s and at 1700V DC for 1 s; group to system, group to group
IEC input compatibility	Type 3
Isolated groups	Group 1: inputs 0…7 Group 2: inputs 8…15 Isolated groups operate in either sink or source configurations

Table 10 - Embedded DC Output Specifications

Attribute	1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B
Outputs	16
Voltage category	24V DC source
Operating voltage range	20.4…26.4V DC 24V DC nom
Output delay, off to on	0.05 ms
Output delay, on to off	0.5 ms
Off-state leakage current, max	0.1 mA @ 26.4V DC
On-state current, max	0.5 mA @ 24V DC per channel
On-state voltage drop, max	1.0V DC @ 1.0 A

Table 10 - Embedded DC Output Specifications

Attribute	1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B
Current per point, max	1769-L24ER-QB1B: 0.83 A @ 40 °C (104 °F) 0.5 A @ 60 °C (140 °F) 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B : 0.83 A @ 40 °C (104 °F) 0.58 A @ 55 °C (131 °F) 0.5 A @ 60 °C (140 °F)
Current per module, max	1769-L24ER-QB1B: 6.64 A @ 40 °C (104 °F) 4.0 A @ 60 °C (140 °F) 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B : 6.64 A @ 40 °C (104 °F) 4.64 A @ 55 °C (131 °F) 4.0 A @ 60 °C (140 °F)
Surge current per point, max	2.0 A for 10 ms per point, repeatable every 2 s
Isolation voltage	75V (continuous), Reinforced Insulation Type Type tested at 1200V AC for 1 s and at 1700V DC for 1 s; group to system, group to group
Isolated groups	Group 1: inputs 0…7 Group 2: inputs 8…15

Embedded DC Output Temperature Derating

The area within the curves represents the safe operating range for the embedded DC outputs under various conditions of user supplied voltages and ambient temperatures.

Figure 1 - Embedded DC Outputs Maximum Amperes per Point versus Temperature

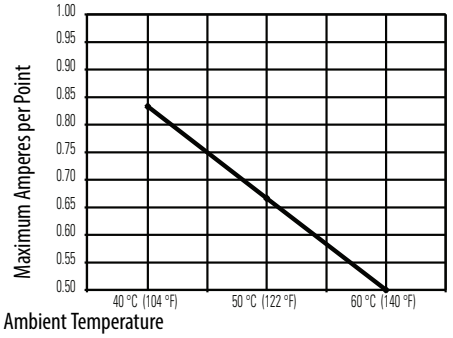


Figure 2 - Embedded DC Outputs Maximum Amperes per Module versus Temperature

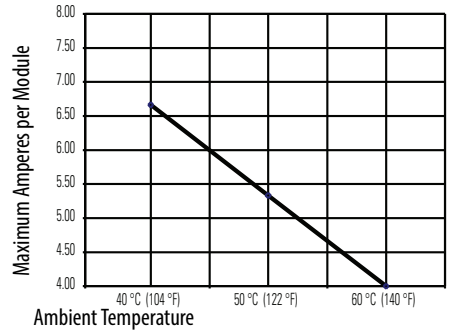


Table 11 - Embedded Analog Input Specifications

Attribute	1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B
Inputs	4 channels of thermocouple/voltage/current 2 channels of RTD/Resistance inputs
Operating voltage range	2.6…30.0V DC @ 40 °C (104 °F) 2.6…26.4V DC @ 55 °C (131 °F) 2.6…5V DC @ 60 °C (140 °F)
Input types	• Thermocouple: J, K, T, E, R, S, B, N and C • Voltage • Current • RTD: Platinum 385, Platinum 3916, Copper 426, Nickel 672, Nickel 618, Nickel-Iron 518 • Resistance
Input ranges[1]	Thermocouple: • K at 1370…1372 °C (2498…2501.6 °F) • K at -170…1370 °C (-274…2498 °F) • K at -200…1370 °C (-328…2498 °F) • S and R at 0…1768 °C (32…3214.4 °F) • S and R at -50…0 °C (-58…32 °F) • B at 300…1820 °C (572…3308 °F) • B at 250…300 °C (482…572 °F) • J at -210…1200 °C (-328…2192 °F) • T at -170…400 °C (-274…752 °F) • T at -200…-170 °C (-328…-274 °F) • E at -200…1000 °C (-328…1832 °F) • N at -110…1300 °C (-166…2372 °F) • N at -200…-110 °C (-328…-166 °F) • C at 0…2315 °C (32…4199 °F) Voltage: • -50…50 mV • -100…100 mV • 0…5V • 1…5V • 0…10V • -10V…10V Current: • 0…20 mA • 4…20 mA RTD: • 0…100 Ω Platinum 385 • 0…200 Ω Platinum 385 • 0…500 Ω Platinum 385 • 0…1000 Ω Platinum 385 • 0…100 Ω Platinum 3916 • 0…200 Ω Platinum 3916 • 0…500 Ω Platinum 3916 • 0…1000 Ω Platinum 3916 • 0…10 Ω Copper 426 • 0…120 Ω Nickel 618 • 0…120 Ω Nickel 672 • 0…604 Ω Nickel-Iron 518 Resistance: • 0…150 Ω • 0…500 Ω • 0…1000 Ω • 0…3000 Ω
Resolution , max	15 bits plus sign (Bipolar) 16 bits (Unipolar)
Input impedance	Voltage: 10 MΩ Current: 250 Ω
Converter type	Sigma-Delta
Cyclic update time	11 ms…5000 ms dependent on user configuration
Rated working voltage	30V AC/30V DC
Common mode voltage	±10V DC per channel
Common mode rejection ratio, min	115 dB at 50 Hz at 10V 115 dB at 60 Hz at 10V

Table 11 - Embedded Analog Input Specifications

Attribute	1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B
Normal mode rejection ratio, min	85 dB at 50 Hz at 1.5V 85 dB at 60 Hz at 1.5V
Accuracy, overall at 25 °C (77 °F)[2]	Thermocouple types: • J at -210…1200 °C (-328…2192 °F): ±0.6 °C (1.1 °F) • N at -110…1300 °C (-166…2372 °F): ±1.0 °C (1.8 °F) • N at -200…-110 °C (-328…-166 °F): ±1.0 °C (1.8 °F) • T at -170…400 °C (-274…752 °F): ±1.0 °C (1.8 °F) • T at -200…-170 °C (-328…-274 °F): ±1.0 °C (1.8 °F) • K at 1370…1372 °C (2498…2501.6 °F): ±1.2 °C (2.2 °F) • K at -200…1370° C (-328…2498° F): ±1.0° C (1.8° F) • E at -200…1000 °C (-328…1832 °F): ±0.5 °C (0.9 °F) • S and R at 0…1768 °C (32…3214.4 °F): ±1.7 °C (3.1°F) • S and R at -50…0 °C (-58…32 °F): ±4.0 °C (7.2 °F) • B at 300…1820 °C (572…3308 °F): ±3.0 °C (5.4 °F) • B at 250…300 °C (482…572 °F): ±6.0 °C (10.8 °F) • C at 0…2315 °C (32…4199 °F): ±1.8 °C (3.2 °F) Voltage inputs: • ±50 mV: +15 µV • ±100mV: ±20 µV • 0…5V: ±2.5 mV • 1…5V: ±2 mV • 0…10V: ±5 mV • ±10V: ±10 mV Current inputs: • 0…20 mA: ±20 µA • 4…20 mA: ±16 µA RTD types: • Platinum 385: ±0.5 °C (0.9 °F) • Platinum 3916: ±0.4 °C (0.7 °F) • Nickel: ±0.2 °C (0.4 °F) • Nickel-Iron: ±0.3 °C (0.5 °F) • Copper: ±0.6 °C (1.1 °F) Resistance types: • 0…150 Ω: ±0.15 Ω • 0…500 Ω: ±0.5 Ω • 0…1000 Ω: ±1.0 Ω • 0…3000 Ω: ±1.5 Ω
Accuracy, overall at 0...60 °C (32...140 °F)[2]	Thermocouple types: • J at -210…1200 °C (-328…2192 °F): ±0.9 °C (1.6 °F) • N at -110…1300 °C (-166…2372 °F): ±1.5 °C (2.7 °F) • N at -200…-110 °C (-328…-166 °F): ±1.5 °C (2.7 °F) • T at -170…400 °C (-274…752 °F): ±1.5° C (2.7° F) • T at -200…-170 °C (-328…-274 °F): ±1.5° C (2.7° F) • K at 1370…1372 °C (2498…2501.6 °F): ±1.8 °C (3.2 °F) • K at -200…1370 °C (-328…2498 °F): ±1.5 °C (2.7 °F) • E at -200…1000 °C (-328…1832 °F): ±0.8 °C (1.4 °F) • S and R at 0…1768 °C (32…3214.4 °F): ±3.5 °C (6.3 °F) • S and R at -50…0 °C (-58…32 °F): ±4.0 °C (7.2 °F) • B at 300…1820 °C (572…3308 °F): ±4.5 °C (8.1 °F) • B at 250…300 °C (482…572 °F): ±9.0 °C (16.2 °F) • C at 0…2315 °C (32…4199 °F): ±3.5 °C (6.3 °F) Voltage inputs: • ±50 mV: ±25 µV • ±100mV: ±30 µV • 0…5V: ±5 mV • 1…5V: ±4 mV • 0…10V: ±10 mV • ±10V: ±20 mV Current inputs: • 0…20 mA: ±50 µA • 4…20 mA: ±40 µA RTD types: • Platinum 385: ±0.9 °C (1.6 °F) • Platinum 3916: ±0.8 °C (1.4 °F) • Nickel: ±0.4 °C (0.7 °F) • Nickel-Iron: ±0.5 °C (0.9 °F) • Copper: ±1.1 °C (2.0 °F) Resistance types:[2] • 0…150 Ω: ±0.25 Ω • 0…500 Ω: ±0.8 Ω • 0…1000 Ω: ±1.5 Ω 0…3000 Ω: ±2.5 Ω

Table 11 - Embedded Analog Input Specifications

Attribute	1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B
Cold junction compensation accuracy at 0...60 °C (32...140 °F)(2)	±1.3° C (34.34° F)
Calibration	Cyclic calibration by user configuration
Non-linearity (in percent full scale)	±0.05%
Repeatability at 25 °C (77 °F) with 10 Hz filter	Thermocouple types: • J at -210…1200 °C (-328…2192 °F): ±0.1 °C (0.2 °F) • N at -110…1300 °C (-166…2372 °F): ±0.1 °C (0.2 °F) • N at -200…-110 °C (-328…-166 °F): ±0.25 °C (0.5 °F) • T at -170…400 °C (-274…752 °F): ±0.1 °C (0.2 °F) • T at -200…-170 °C (-328…-274 °F): ±1.5 °C (2.7 °F) • K at 1370…1372 °C (2498…2501.6 °F): ±0.15 °C (0.3 °F) • K at -170…1370 °C (-274…2498 °F): ±0.1° (0.2 °F) • K at -200…-170 °C (-328…-274 °F): ±2.0° C (3.6 °F) • E at -200…1000 °C (-328…1832 °F): ±0.1° (0.2 °F) • S and R at 0…1768 °C (32…3214.4 °F): ±0.4 °C (0.7 °F) • S and R at -50…0 °C (-58…32 °F): ±1.0 °C (1.8 °F) • B at 300…1820 °C (572…3308 °F): ±0.7 °C (1.3 °F) • B at 250…300 °C (482…572 °F): ±1.5 °C (2.7 °F) • C at 0…2315 °C (32…4199 °F): ±0.2 °C (0.4 °F) Voltage inputs: • ±50 mV: ±6 µA • ±100mV: ±6 µV • 0…5V: ±150 mV • 1…5V: ±150 mV • 0…10V: ±150 mV • ±10V: ±150 mV Current inputs: • 0…20 mA: ±0.3 µA • 4…20 mA: ±0.3 µA RTD types: • Platinum 385: ±0.2 °C (0.4 °F) • Platinum 3916: ±0.2 °C (0.4 °F) • Nickel: ±0.01 °C (0.02 °F) • Nickel-Iron: ±0.01 °C (0.02 °F) • Copper: ±0.2° C (0.4 °F) Resistance types: • 0…150 Ω: ±0.04 Ω • 0…500 Ω: ±0.2 Ω • 0…1000 Ω: ±0.2 Ω • 0…3000 Ω: ±0.2 Ω
Overload at input terminals, max	Voltage: ±35V DC continuous Current: 32 mA continuous, ±7.6V DC
Channel diagnostics	Invalid configuration, Over- or under-range by bit reporting, open circuit
Isolation voltage	30V AC/30V DC (continuous), reinforced insulation type Type tested at 720V DC for 60 s; inputs to system backplane

(1) Values for these input types rated at the following ambient temperatures: 40 °C (104 °F), 55 °C (131 °F), 60 °C (140 °F).

(2) These specification values are based on cyclic calibration and connecting a 4-wire device to the module.

Table 12 - Embedded Analog Output Specifications

Attribute	1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B
Outputs	2 single-ended
Output types	• Voltage: • Current
Output ranges(1)	Voltage: • 0…5V • 1…5V • 0…10V • -10V…10V Current: • 0…20 mA • 4…20 mA
Converter type	R-2R Ladder Voltage Switching
Resolution, max	15 bits plus sign (Bipolar) 16 bits (Unipolar)
Cyclic update time, nom	2.5 ms
Cyclic update time, max	9.5 ms
Current load on voltage output	10 mA max
Resistive load on current output	0…300 Ω
Load range on voltage output	> 1 kΩ at 10V DC
Inductive load, max (current outputs)	0.1 mH
Capacitive load, max (Voltage Outputs)	1 µF
Accuracy, overall at 25 °C (77 °F)	Voltage: ±0.5% full scale Current: ±0.5% full scale
Accuracy, overall at 0…60 °C (32…140 °F)	Voltage: ±0.8% full scale Current: ±0.8% full scale
Accuracy drift with temperature	Voltage: ±0.0086% full scale per °C Current: ±0.0086% full scale per °C
Output ripple range 0...50 kHz (referred to output range)	±0.05%
Non-linearity	±0.05% (in percent full scale)
Repeatability	± 0.05%
Output impedance	Voltage: <1 Ω Current: >1 MΩ
Short-circuit protection	Yes
Short-circuit, nom	Current: 16 mA
Open circuit, max	16V
Output response at system powerup and powerdown	Current: ± 1.0V spike for < 5 ms Voltage: ± 1.0V DC spike < 5 ms
Isolation voltage	30V AC/30V DC (continuous), reinforced insulation type Type tested at 500V AC or 710V DC for 60 s; outputs to system backplane

(1) Values for these input types rated at the following ambient temperatures: 40 °C (104 °F), 55 °C (131 °F), 60 °C (140 °F).

Table 13 - Embedded Analog Output Module Data(1)

Analog Output Module Range	Input Value	Example Data		Output Range State	Raw/Proportional Data		Engineering Unit		Scaled-for-PID		Percent Full Range	
		Controller Ordered	Embedded Analog Module Output		Decimal Range		Decimal Range		Decimal Range		Decimal Range	
					Controller Ordered	Embedded Analog Module Output	Controller Ordered	Embedded Analog Module Output	Controller Ordered	Embedded Analog Module Output	Controller Ordered	Embedded Analog Module Output
+/- 10V	Over 10.5V	+11.0V	+10.5V	Over	N/A	N/A	11000		17202		11000	
	+10.5V	+10.5V	+10.5V	Over	32767	32767	10500	10500	16793	16793	10500	10500
	±10V	+10.0V	+10.0V	Normal	31207	31207	10000	10000	16383	16383	10000	10000
		0.0V	0.0V	Normal	0	0	0	0	8192	8192	0	0
		-10.0V	-10.0V	Normal	-31207	-31207	-10000	-10000	0	0	-10000	-10000
	-10.5V	-10.5V	-10.5V	Under	-32767	-32767	-10500	-10500	-410	-410	-10500	-10500
	Under 10.5V	-11.0V	-10.5V	Under	N/A	N/A	-11000	-10500	-819	-410	-11000	-10500
0…5V	Over 5.25V	5.5V	+5.25V	Over	N/A	N/A	5500	5250	18021	17202	11000	10500
	5.25V	5.25V	+5.25V	Over	32767	32767	5250	5250	17202	17202	10500	10500
	0…5.0V	5.0V	+5.0V	Normal	31207	31207	5000	5000	16383	16383	10000	10000
		0.0V	0.0V	Normal	0	0	0	0	0	0	0	0
	-0.5V	-0.5V	-0.5V	Under	-3121	-3121	-500	-500	-1638	-1638	-1000	-1000
	Under -0.5V	-1.0V	-0.5V	Under	-6241	-3121	-500	-500	-3277	-1638	-2000	-1000
0…10V	Over 10.5V	11.0V	+10.5V	Over	N/A	N/A	11000	10500	18021	17202	11000	10500
	+10.5V	+10.5V	+10.5V	Over	32767	32767	10500	10500	17202	17202	10500	10500
	0…10.0V	+10.0V	+10.0V	Normal	31207	31207	10000	10000	16383	16383	10000	10000
		0.0V	0.0V	Normal	0	0	0	0	0	0	0	0
	-0.5V	-0.5V	-0.5V	Under	-1560	-1560	-500	-500	-819	-819	-500	-500
	Under -5.0V	-1.0V	-0.5V	Under	-3121	-1560	-1000	-500	-1638	-819	-1000	-500
4…20 mA	Over 21.0 mA	+22.0 mA	21mA	Over	N/A	N/A	22000	21000	18431	17407	11250	10625
	21.0 mA	+21.0 mA	21mA	Over	32767	32767	21000	21000	17407	17407	10625	10625
	4…20.0 mA	+20.0 mA	20mA	Normal	31207	31207	20000	20000	16383	16383	10000	10000
		+4.0 mA	+4.0 mA	Normal	6241	6241	4000	4000	0	0	0	0
	3.2 mA	+3.2 mA	+3.2 mA	Under	4993	4993	3200	3200	-819	-819	-500	-500
	Under 3.2	0.0 mA	+3.2 mA	Under	0	4993	0	3200	-4096	-819	-2500	-500
1…5V	Over 5.25V	+5.5V	+5.25V	Over	N/A	N/A	5500	5250	18431	17407	11250	10625
	+5.25V	+5.25V	+5.25V	Over	32767	32767	5250	5250	17407	17407	10625	10625
	1…5.0V	+5.0V	+5.0V	Normal	31207	31207	5000	5000	16383	16383	10000	10000
		+1.0V	+1.0V	Normal	6241	6241	1000	1000	0	0	0	0
	0.5V	+0.5V	+0.5V	Under	3121	3121	500	500	-2048	-2048	-1250	-1250
	Under 0.5V	0.0V	0.0V	Under	0	3121	0	500	-4096	-2048	-2500	-1250
0…20 mA	Over 21.0 mA	+22.0 mA	21mA	Over	N/A	N/A	22000	21000	18201	17202	11000	10500
	21.0 mA	21.0 mA	21mA	Over	32767	32767	21000	21000	17202	17202	10500	10500
	0…20.0 mA	20.0 mA	20mA	Normal	31207	31207	20000	20000	16383	16383	10000	10000
		0.0 mA	0.0 mA	Normal	0	0	0	0	0	0	0	0
	Under 0.0 mA	-1.0 mA	0.0 mA	Under	-1560	0	0	-1000	-819	0	-500	0

(1) If Clamping is enabled, the output value will be the clamped value defined in the configuration.

Table 14 - Embedded HSC Input Specifications

Attribute	1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B
Input frequency, max	250 kHz
Input current, max	15 mA per channel
Input current, min	6.8 mA
Input voltage range	2.6…30V DC(1)
On-state voltage, max	30V DC
On-state current, min	6.8 mA
Off-state voltage, max	1.0V DC
Off-state current, max	1.5 mA
Off-state leakage current, max	1.5 mA
Input impedance, nom	1950 Ω
Pulse width, min	2.5 µs
Phase separation, min	1.3 µs
Isolation voltage	75V (continuous), reinforced insulation type Type tested at 1200V AC for 60 s; inputs to system backplane and input to input

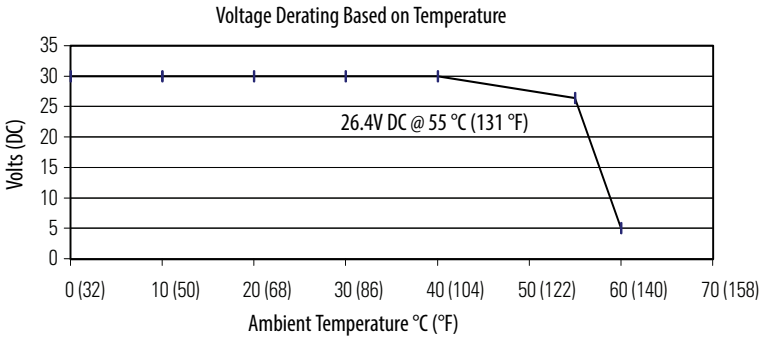
(1) See Maximum Input Voltage - 24V DC Operation temperature derating.

Table 15 - Embedded HSC Output Specifications

Attribute	1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B
Output voltage range	5…30V DC
On-state voltage, max	User power - 0.1V DC
On-state output current, max	0.25 A per channel
On-state output current, min	1 mA
On-state voltage drop, max	0.5V DC
Off-state leakage current, max	5 µA
Turn-on time, max	400 µs
Turn-off time, max	200 µs
Reverse polarity protection	30V DC
Isolation voltage	75V (continuous), basic insulation type Type tested at 1200V AC for 60 s; inputs to system backplane and input to input
Current per channel, max	1.0 A @ 40 °C (104 °F) 0.5 A @ 55 °C (131 °F) 0.25 A @ 60 °C (140 °F)
Current per module, max	4.0 A @ 40 °C (104 °F) 2.0 A @ 55 °C (131 °F) 1.0 A @ 60 °C (140 °F)

Embedded HSC Temperature Derating

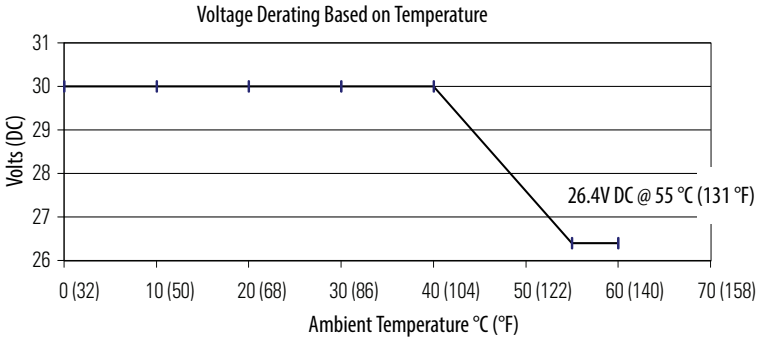
Figure 3 - Maximum Input Voltage - 24V DC Operation



Temperature	Derated Voltage(1)
40 °C (104 °F)	30V DC
55 °C (131 °F)	26.4V DC
60 °C (140 °F)	5V DC

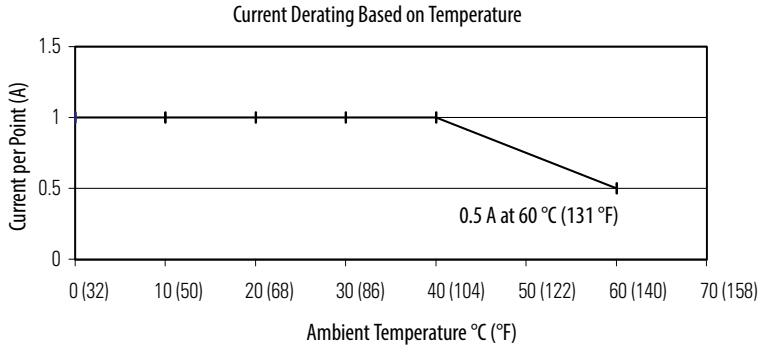
(1) Input voltage derating between 55 °C and 60 °C (131 °F and 140 °F) is achieved by using a dropping resistor.
For 24V DC input voltage, use a 2.4 kΩ, 1/2 W resistor.
For input voltages other than 24V DC, use a 1/2 W resistor with value: 125 x (V_{in} - 5V).

Figure 4 - Maximum Output Voltage - 24V DC Operation



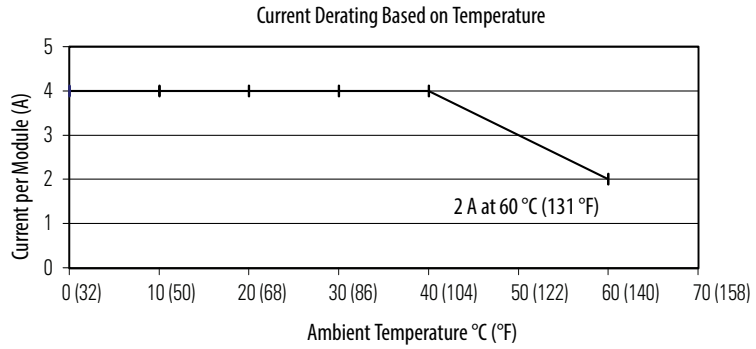
Temperature	Derated Voltage
40 °C (104 °F)	30V DC
55…60 °C (131...140 °F)	26.4V DC

Figure 5 - Maximum Output Current per Point - 5V DC Operation



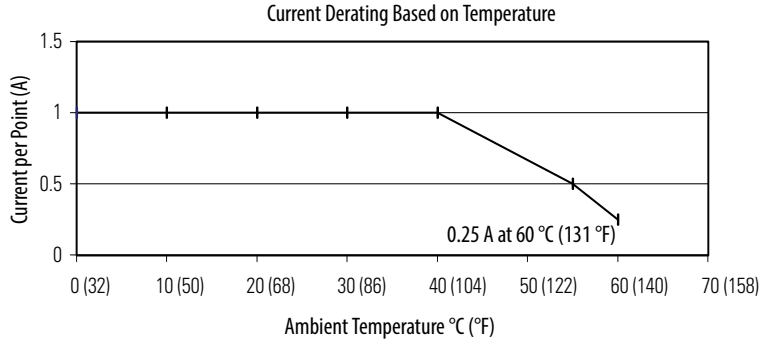
Temperature	Derated Current
0…40 °C (32…104 °F)	1 A
60 °C (140 °F)	0.5 A

Figure 6 - Maximum Output Current per Module - 5V DC Operation



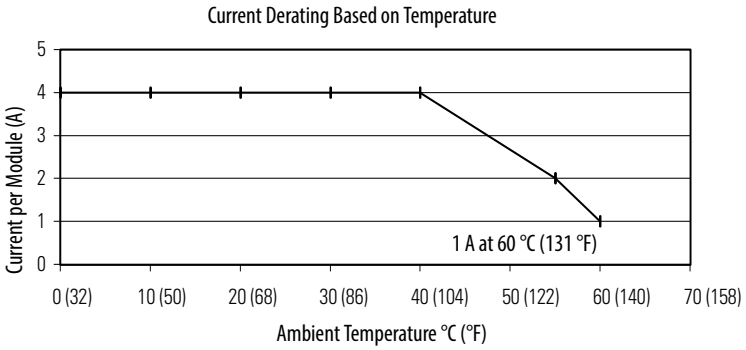
Temperature	Derated Current
0…40 °C (32…104 °F)	4 A
60 °C (140 °F)	2 A

Figure 7 - Maximum Output Current per Point - 24V DC Operation



Temperature	Derated Current
0...40 °C (32...104 °F)	1 A
55 °C (131 °F)	0.5 A
60 °C (140 °F)	0.25 A

Figure 8 - Maximum Output Current per Module - 24V DC Operation



Temperature	Derated Current
40 °C (104 °F)	4 A
55 °C (131 °F)	2 A
60 °C (140 °F)	1 A

Table 16 - Embedded Power Supply

Attribute	1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B
Input voltage range	19.2…31.2V DC
Input voltage, nom	24V DC
Line requirement, max(1)	2.1 A @ 24V DC, Class 2/SELV
Available 5V DC bus current	• 1769-L24ER-QB1B: 1.54 A • 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B: 1.0 A
Available 24V DC bus current	• 1769-L24ER-QB1B: 0.95 A • 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B: 0.8 A
Inrush, max	< 30 A @ 19.2…31.2V DC
Line loss ride through	10 ms…10 s
Short circuit protection	Internal fuse Not user replaceable
Overvoltage protection	Yes
Isolation voltage	30V AC/30V DC (continuous), reinforced insulation type Type tested at 500V AC or 710V DC for 60 s; outputs to system backplane

(1) Value rated at the following ambient temperatures: 40 °C (104 °F), 55 °C (131 °F), 60 °C (140 °F).

I/O Module Support - CompactLogix 5370 L3 Controllers

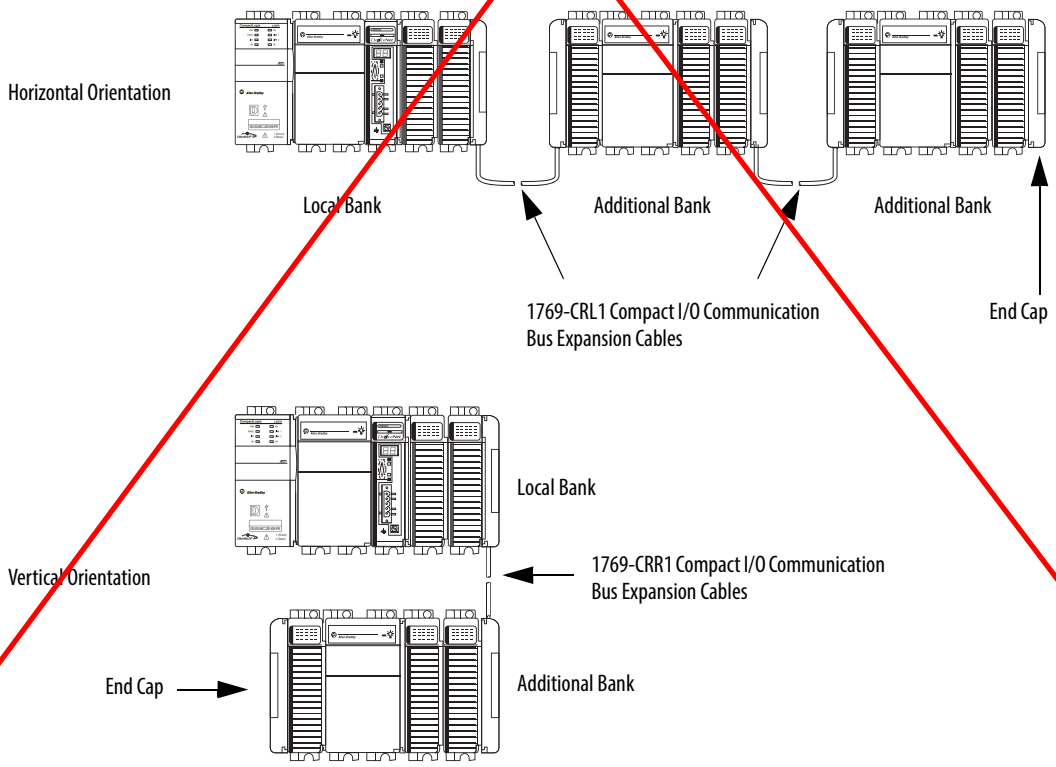
The CompactLogix 5370 L3 controllers offer local expansion modules installed across up to three banks of modules. You must use 1769 Compact I/O modules with these controllers.

Remember the following when using I/O modules with the CompactLogix 5370 L3 controllers:

- The controller must be the leftmost module in the local bank of the system.
- The number of I/O modules supported in a controller system varies by controller catalog number.

Cat. No.	Local 1769 Compact I/O Modules Supported, max
1769- L30ER 1769-L30ERM 1769-L30ER-NSE	8
1769-L33ER 1769-L33ERM	16
1769-L36ERM	30

- You can install I/O modules in as many as three banks, that is, the local bank and two additional banks.
- You can install as many as three I/O modules between the controller and power supply.
- You can install as many as eight I/O modules to the right of the power supply in the local bank or on both the left and right sides of the power supply in additional banks.
- You must consider the controller's and all I/O modules' distance rating and current draw when designing you system.
- Systems with multiple banks can be installed vertically or horizontally.
- You must use expansion cables to connect banks in multi-bank systems.
- You must terminate the end of the last bank in a system.



CompactLogix 5370 L3 Controllers' Local I/O Performance

The requested packet interval (RPI) defines the frequency at which the controller sends data to and receives data from I/O modules. In the programming software, you set an RPI rate for each I/O module in your system.

The CompactLogix 5370 L3 controllers always attempt to scan an I/O module at the configured RPI rate. If there is not enough system bandwidth, that is, if other, higher priority tasks prevent the 1769 Compact I/O subsystem task from completing before the next scheduled time for it to run again, an I/O Task Overlap minor fault occurs.

For individual I/O modules, a Module RPI Overlap minor fault occurs if there is at least one I/O module which cannot be serviced within its RPI time.

The specific configuration parameters for a system determine the impact on actual RPI rates. These configuration factors can impact the effective scan frequency for any individual module:

- Rates at which other 1769 Compact I/O modules' RPI rates are set
- Number of other 1769 Compact I/O modules in the system
- Types of other 1769 Compact I/O modules in the system
- Application user task priorities

Table 17 - RPI Rate Guidelines

Type of Module	Guidelines
1769 Compact I/O digital and analog (any mix) modules	The following guidelines apply: • 1…2 modules can be scanned in 0.5 ms. • 3…4 modules can be scanned in 1 ms. • 5…30 modules can be scanned in 2 ms. • Some input modules have a fixed 8 ms filter, so selecting a faster RPI has no effect.
1769 Compact I/O specialty modules	The following conditions apply: • For every full-sized 1769-SDN module in the system, increase every other module's RPI by 2 ms. • For every 1769-HSC module in the system, increase every other module's RPI by 1 ms. • For every full-sized 1769-ASCII module system, increase every other module's RPI by 1 ms. • For every 1769-SM2 module in the system, increase every other module's RPI by 2 ms. For example, if there are four digital I/O modules in the system configured with an RPI = 1 ms and a 1769-SDN module is added to the system, you should increase the RPI value for all four digital I/O modules by 2 ms. Therefore, when the 1769-SDN module is added to the system the four digital I/O modules should use an RPI = 3 ms. If, in the same system, you add a second 1769-SDN module, the four digital I/O modules' RPI value should be increased to 5 ms.

You can set individual 1769 Compact I/O modules' RPI values higher than those listed in Table 17. For example, if your application scans one or two modules, you do not have to use RPI values = 0.5 ms. You can set the RPI to a higher values, such as 1.0 ms, if necessary. Remember, higher RPI values result in scanning the data less frequently.

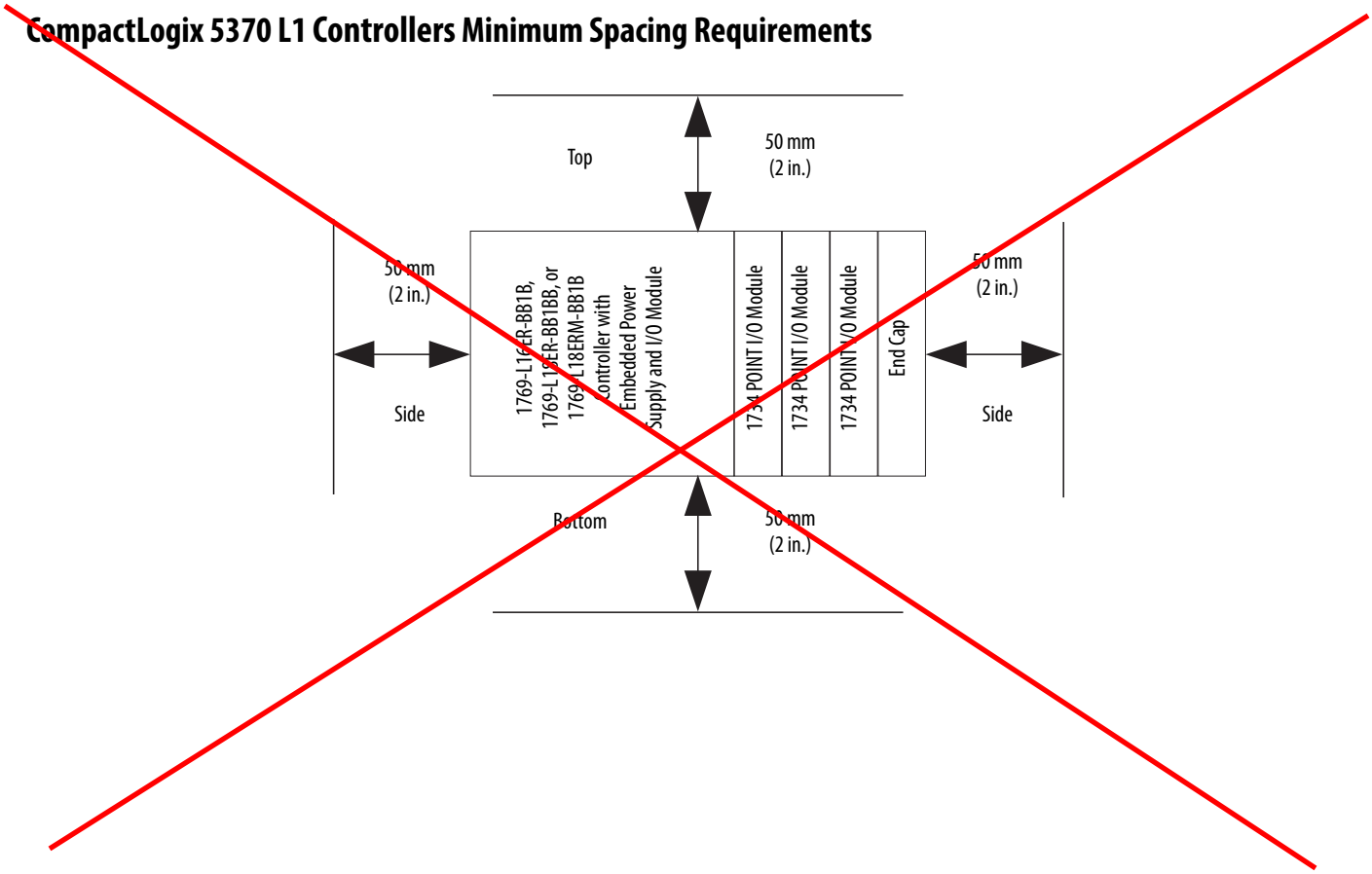
The RPI is asynchronous to the program scan. Other factors, such as program execution duration, affect I/O throughput.

Table 18 - Certifications - CompactLogix 5370 Controllers

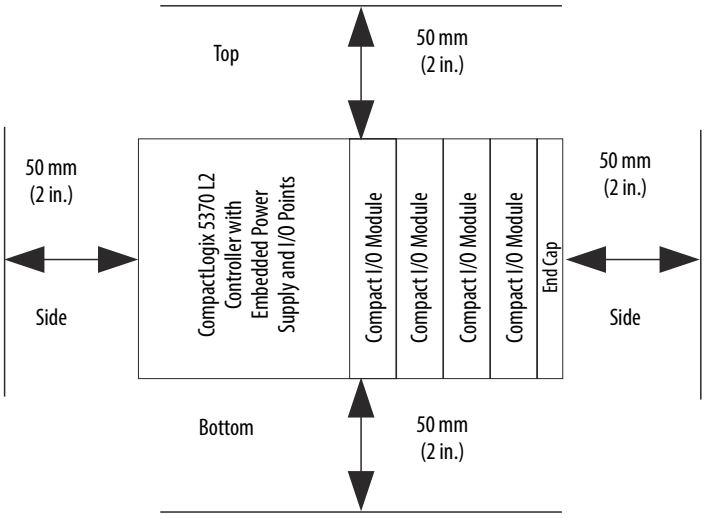
Certification[1]	1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B	1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B	1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM, 1769-L33ER, 1769-L33ERM, 1769-L36ERM
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E194810.		
CE	European Union 2004/108/EC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)		
C-Tick	Australian Radiocommunications Act, compliant with: • AS/NZS CISPR 11; Industrial Emissions		
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements • II 3 G Ex nA IIC T4 X	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements • II 3 G Ex nA IIC T4 Gc	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements • II 3 G Ex nA IIC T5 X
EtherNet/IP	ODVA conformance tested to EtherNet/IP specifications.		
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: • Article 58-2 of Radio Waves Act, Clause 3		

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

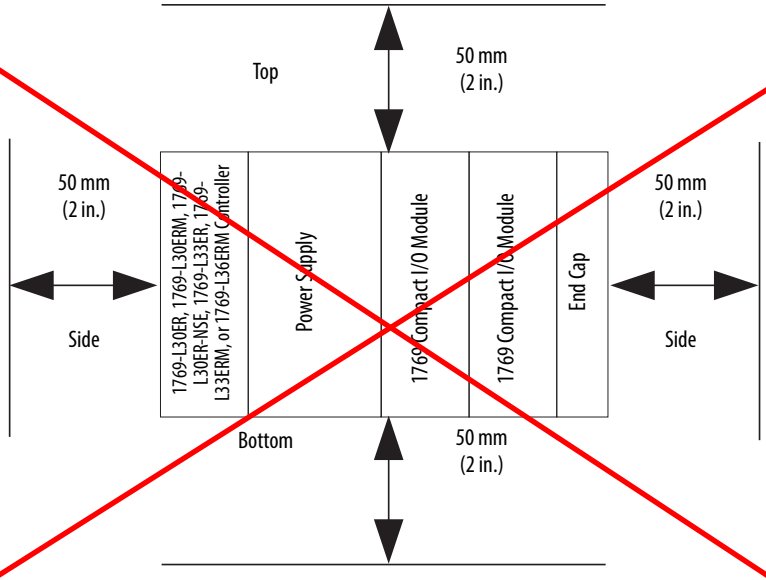
CompactLogix 5370 L1 Controllers Minimum Spacing Requirements



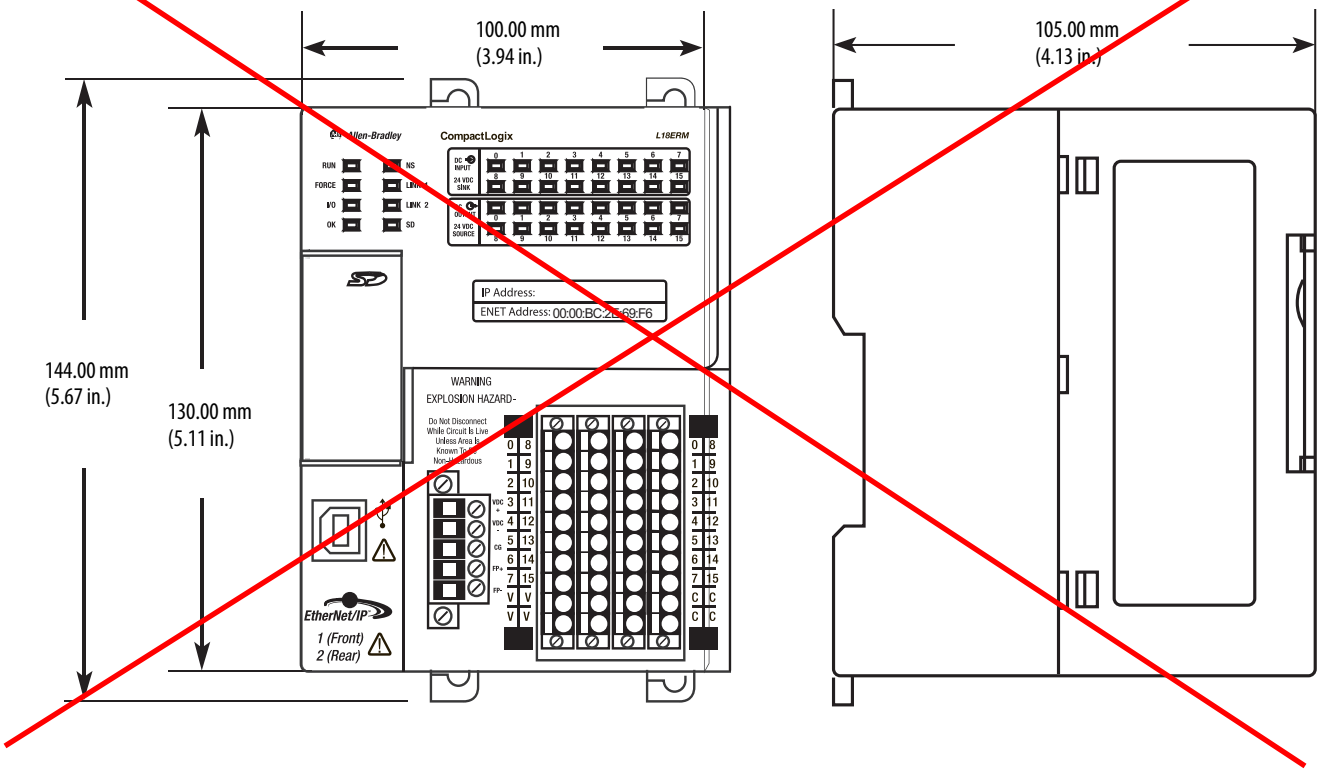
CompactLogix 5370 L2 Controllers Minimum Spacing Requirements



CompactLogix 5370 L3 Controllers Minimum Spacing Requirements

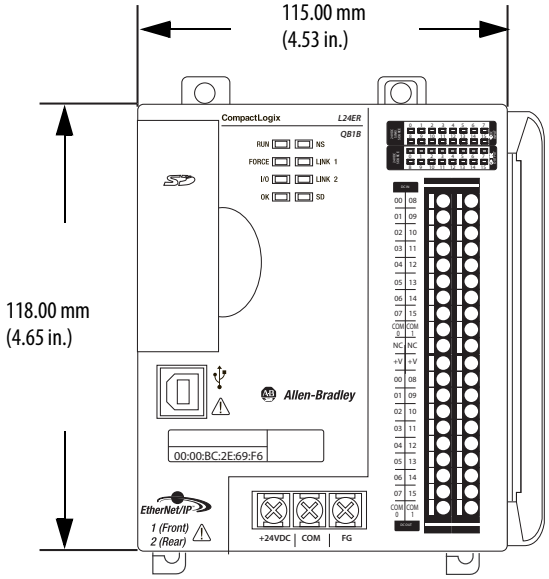


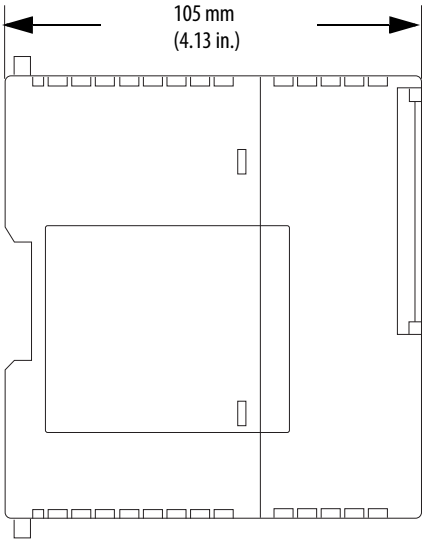
CompactLogix 5370 L1 Controllers Dimensions



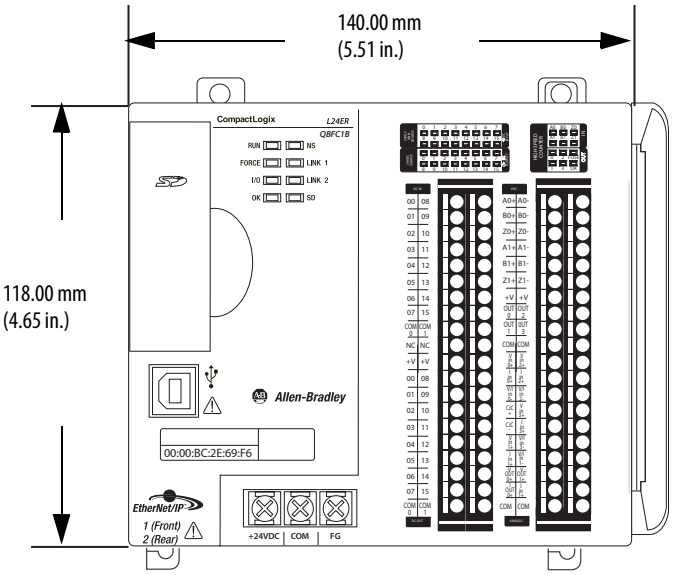
CompactLogix 5370 L2 Controllers Dimensions

1769-L24ER-QB1B

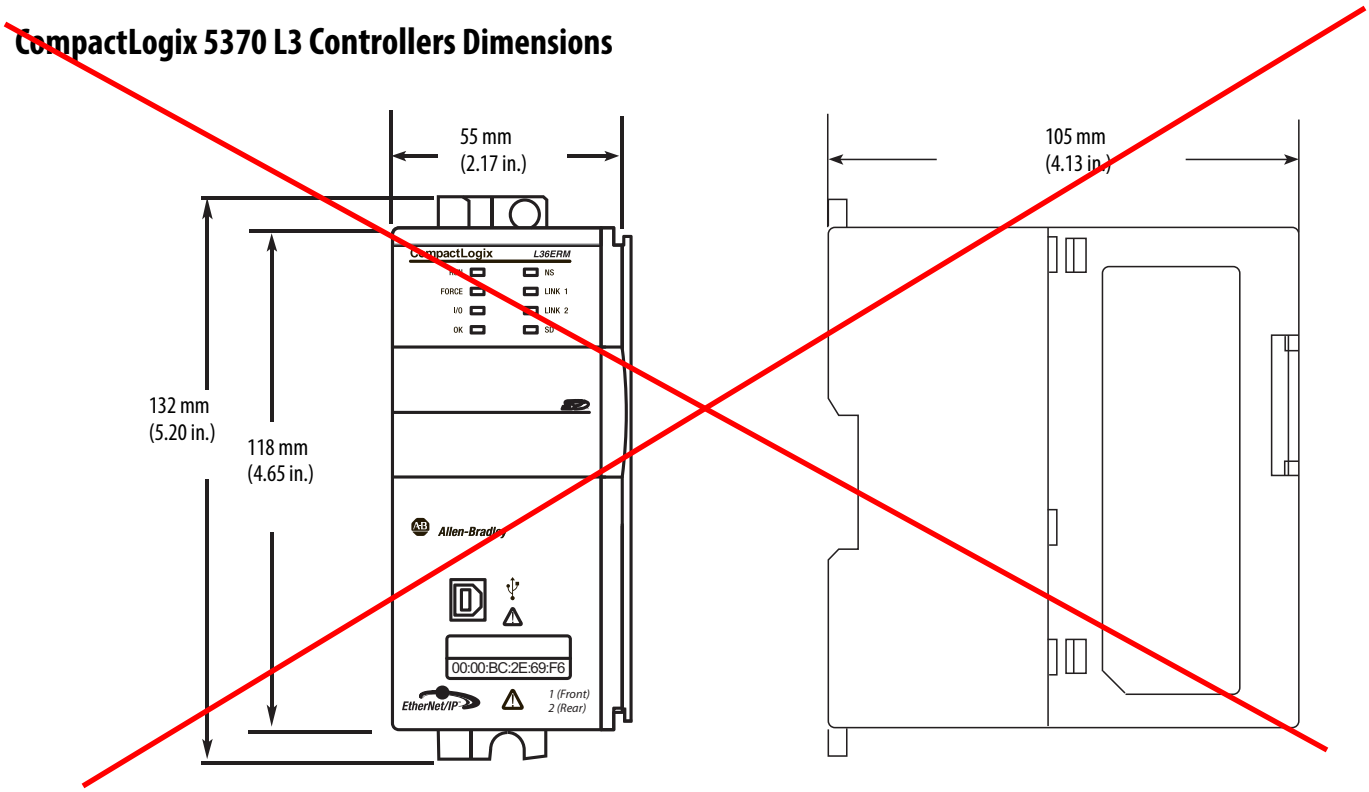




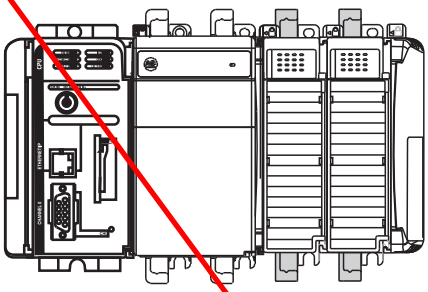
1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B
(Dimensions are the same on both controller catalog numbers.)



CompactLogix 5370 L3 Controllers Dimensions



1769 Modular CompactLogix Controllers

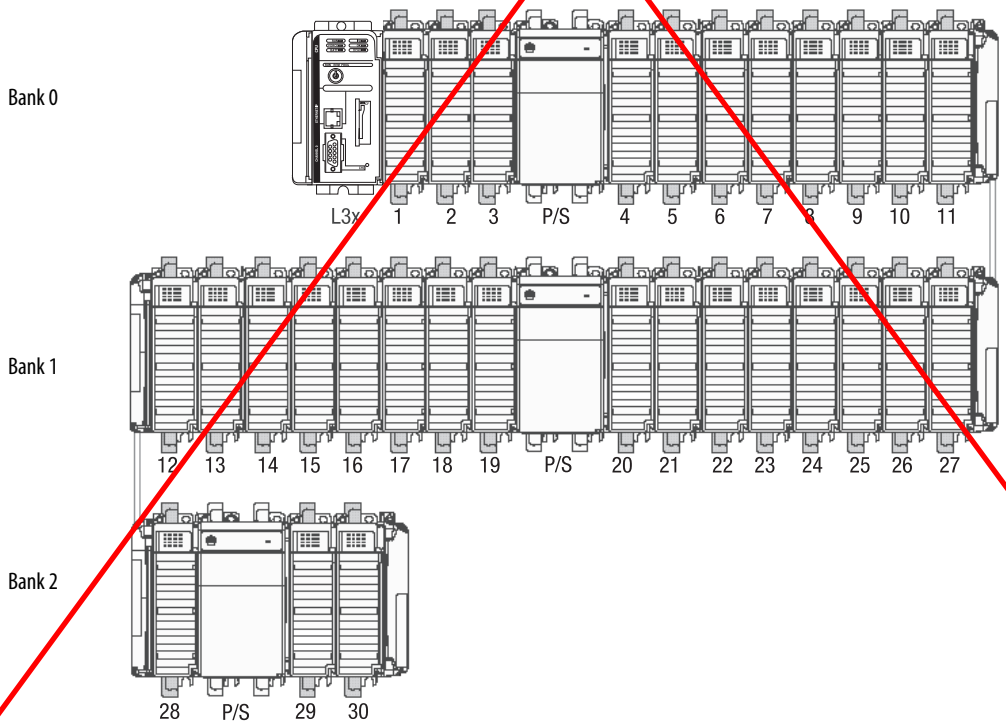


In a 1769-L3*x* controller system, the 1769 I/O modules can be placed to the left and the right of the power supply. As many as eight modules can be placed on each side of the power supply.

Table 30 - Features - 1769 Modular CompactLogix Controllers

Characteristic	1769-L31	1769-L32C	1769-L32E	1769-L35CR	1769-L35E
Available user memory	512 KB	750 KB	750 KB	1.5 MB	1.5 MB
CompactFlash card	1784-CF128	1784-CF128	1784-CF128	1784-CF128	1784-CF128
Communication ports	2 RS-232 ports (isolated DF1 or ASCII; nonisolated DF1 only)	1 ControlNet port 1 RS-232 serial port (DF1 or ASCII)	1 EtherNet/IP port 1 RS-232 serial port (DF1 or ASCII)	1 ControlNet port 1 RS-232 serial port (DF1 or ASCII)	1 EtherNet/IP port 1 RS-232 serial port (DF1 or ASCII)
Module expansion capacity	16 1769 modules	16 1769 modules	16 1769 modules	30 1769 modules	30 1769 modules
Power supply distance rating	4 modules	4 modules	4 modules	4 modules	4 modules

The CompactLogix controller has a power supply distance rating of four modules. The controller must be the leftmost module in the first bank of the system. The maximum configuration for the first bank of a CompactLogix controller is the controller and three I/O modules to the left of the power supply and eight I/O modules to the right of the power supply.



1769-L3*x* Local I/O Performance

You can configure an individual RPI for each local 1769 Compact I/O module. The RPI defines the frequency at which the controller sends and receives all I/O data on the backplane.

Type of Module	Guideline
Digital and analog (any mix)	• 1…4 modules can be scanned in 1 ms • 5…30 modules can be scanned in 2 ms • Some input modules have a fixed 8 ms filter, so selecting a faster RPI has no effect
Specialty	• Full-sized 1769-SDN modules add 2 ms per module • 1769-HSC modules add 1 ms per module • Full-sized 1769-ASCII modules add 1 ms per module

You can always select an RPI that is slower than listed above. These considerations show how fast modules can be scanned—not how fast an application can use the data. The RPI is asynchronous to the program scan. Other factors, such as program execution duration, affect I/O throughput.

Table 31 - Technical Specifications - 1769 Modular CompactLogix Controllers

Attribute	1769-L31	1769-L32C	1769-L32E	1769-L35CR	1769-L35E
User memory	512 KB	750 KB	750 KB	1.5 MB	1.5 MB
Optional flash memory	1784-CF128				
Number of I/O modules, max	16	16	16	30	30
Number of I/O banks, max	3				
Number of expansion I/O modules, max	16 1769 modules			30 1769 modules	
Replacement battery	1769-BA				
Current draw @ 5V DC	330 mA	650 mA	660 mA	680 mA	660 mA
Current draw @ 24V DC	40 mA	40 mA	90 mA	40 mA	90 mA
Power dissipation	2.61 W	4.21 W	5.5 W	4.36 W	5.5 W
Isolation voltage	30V (continuous), basic insulation type Type tested at 710V DC for 60 s; RS232 channel 0 to system No isolation between RS232 channel 1 and system	30V (continuous), basic insulation type Type tested at 710V DC for 60 s; RS232 to system, ControlNet to system, RS232 to ControlNet, ControlNet channel A to ControlNet channel B	30V (continuous), basic insulation type Type tested at 710V DC for 60 s; RS232 to system, Ethernet to system, RS232 to Ethernet	30V (continuous), basic insulation type Type tested at 710V DC for 60 s; RS232 to system, ControlNet to system, RS232 to ControlNet, ControlNet channel A to ControlNet channel B	30V (continuous), basic insulation type Type tested at 710V DC for 60 s; RS232 to system, Ethernet to system, RS232 to Ethernet
Communication ports	CH0 - RS-232 DF1, DH-485, ASCII Fully isolated 38.4 Kbps max CH1 - RS-232 DF1, DH-485 Nonisolated 38.4 Kbps max	RS232 Fully isolated 38.4 Kbps max ControlNet port	RS232 Fully isolated 38.4 Kbps max EtherNet/IP port 10/100 BASE-T	RS232 Fully isolated 38.4 Kbps max ControlNet port	RS232 Fully isolated 38.4 Kbps max EtherNet/IP port 10/100 BASE-T
Serial cables	1756-CP3 or 1747-CP3, right angle connector to controller, straight to serial port, 3 m				
Weight, approx	0.30 kg (0.66 lb)	0.32 kg (0.70 lb)	0.30 kg (0.66 lb)	0.32 kg (0.70 lb)	0.30 kg (0.66 lb)
Slot width	1				
Module location	DIN rail or panel mount				

Table 31 - Technical Specifications - 1769 Modular CompactLogix Controllers

Attribute	1769-L31	1769-L32C	1769-L32E	1769-L35CR	1769-L35E
Panel-mounting screw torque	1.1…1.8 N•m (10…16 lb•in) - use M4 or #8 screws				
Power supply distance rating	4 modules				
Power supply	1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4				
Wire category(1)	2 - on communication ports				
North American temperature code	T5	T4A			
IEC temperature code	NA	NA	T4	NA	T4
Enclosure type rating	None (open-style)				

(1) Use this conductor category information for planning conductor routing. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Table 32 - Certifications - 1769 Modular CompactLogix Controllers

Certification(1)	1769-L31	1769-L32C, 1769-L35CR	1769-L32E, 1769-L35E
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E194810.		
CE	European Union 2004/108/EC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)		European Union 2004/108/EC EMC Directive, compliant with: • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions		
EX	—		European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection 'n' • EN 60079-0; General Requirements (Zone 2) • II 3 G Ex nA IIC T4 X
CI	—	ControlNet International conformance tested to ControlNet specifications	—
EtherNet/IP	—	—	ODVA conformance tested to EtherNet/IP specifications.
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: • Article 58-2 of Radio Waves Act, Clause 3		

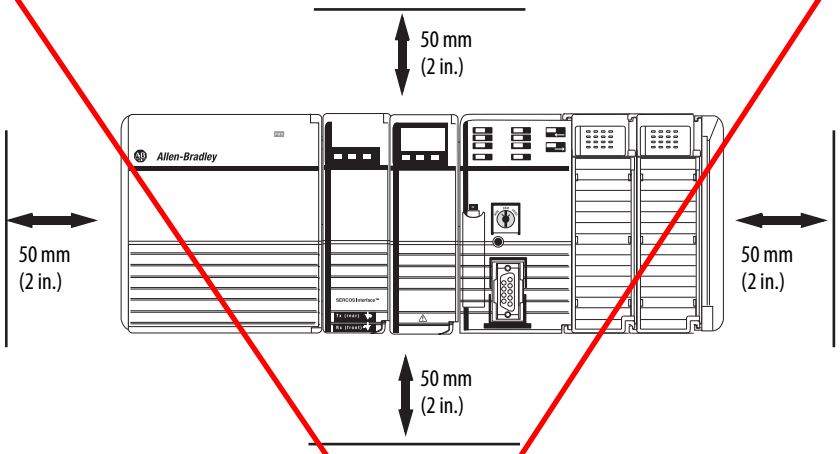
(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

Real-time Clock Accuracy

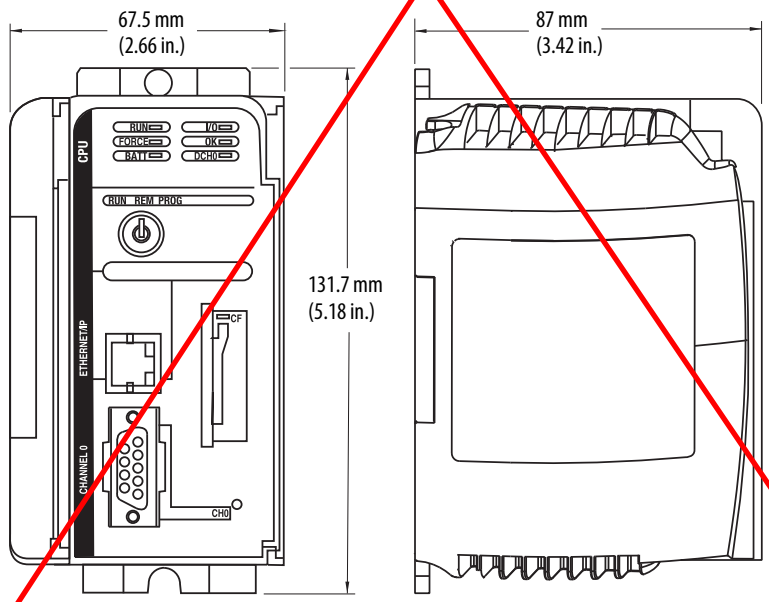
The following table lists the real-time clock accuracy specifications for the 1769 Modular CompactLogix controllers.

Ambient Temperature	Accuracy
0° C (32° F)	54…-56 s/mo
25° C (77° F)	9…-124 s/mo
40° C (104° F)	-84…-234 s/mo
55° C (131° F)	-228…-394 s/mo
60° C (140° F)	-287…-459 s/mo

1769-L3*x* Minimum Spacing Requirements



1769-L3*x* CompactLogix Dimensions



Controller Compatibility

Your controller can control and communicate with other devices, including the following:

- Control Distributed I/O Modules
- Control Safety I/O Modules
- Communicate with Display Devices
- Communicate with Other Controllers
- Communicate with Other Communication Devices

Control Distributed I/O Modules

The controller can control these distributed I/O modules.

I/O Modules	CompactLogix 5370 1768-ENBT 1769-L23Ex 1769-L32E, 1769-L35E EtherNet/IP Network[1]	1768-CNB, 1768-CNBR 1769-L32C, 1769-L35CR ControlNet Network	CompactLogix 5370 L2 and L3 1769-SDN DeviceNet Network[2] [3]
Chassis-based I/O			
1746 SLC™ I/O	Yes	No	No
1756 ControlLogix® I/O	Yes	Yes	Yes
1769 Compact I/O	No	No	Yes
1771 Universal I/O	No	No	No
In-Cabinet I/O			
1734 POINT I/O	Yes	Yes	Yes
1734D POINTBlock I/O	Yes	Yes	Yes
1790, 1790D, 1790P CompactBlock™ LDX I/O	No	No	Yes
1791D, 1791P, 1791R CompactBlock I/O	No	No	Yes
1794 FLEX™ I/O	Yes	Yes	Yes
1797 FLEX Ex™ I/O	Yes	Yes	No
On-Machine I/O			
1732 ArmorBlock® I/O	Yes	No	Yes
1738 ArmorPOINT® I/O	Yes	Yes	No
1792D ArmorBlock MaXum™ I/O	No	No	Yes
1799 Embedded I/O	No	No	Yes

(1) A non-EtherNet/IP CompactLogix controller requires a 1761-NET-ENI interface to connect to an EtherNet/IP network. This interface is only a messaging bridge.

(2) To control I/O, use a 1769-SDN scanner to connect the controller to the DeviceNet network.

(3) The 1769-SDN does not support safety communication to Guard I/O modules on a DeviceNet network.

Control Safety I/O Modules

The Compact GuardLogix controller can control these safety I/O modules in a safety system.

I/O Modules	EtherNet/IP	ControlNet
1791ES CompactBlock Guard I/O	Yes	No
1734 POINT Guard I/O	Yes	No

Communicate with Display Devices

The controller can communicate with these display devices.

Display Devices	EtherNet/IP Network(1)	ControlNet Network	DeviceNet Network(2)	RS-232 (DF1) Network	DH-485 Network
Industrial Computers					
Allen-Bradley® industrial computers (all)(3)	Yes	Yes	Yes	Yes	Yes
Graphic Terminals					
PanelView Plus and PanelView CE terminals	Yes	Yes	Yes	Yes	Yes
PanelView standard terminals	Yes	Yes	Yes	Yes	Yes
PanelView e terminals	No	No	No	No	No
Message Displays					
InView™ message displays	Yes	Yes	Yes	Yes	Yes

(1) A non-EtherNet/IP CompactLogix controller requires a 1761-NET-ENI interface to connect to an EtherNet/IP network. This interface is only a messaging bridge.
(2) For DeviceNet access, use either a 1769-SDN scanner (control I/O and send/receive messages) or a 1761-NET-DNI interface (messaging bridge).
(3) Includes: Allen-Bradley integrated display rotating media (HDD) and solid state (SSD) computers, Allen-Bradley non-display computers, and Allen-Bradley integrated display computers with keypad.

Communicate with Other Controllers

The controller can communicate with these programmable controllers.

Controller	EtherNet/IP Network(1)	ControlNet Network	DeviceNet Network(2)	RS-232 (DF1) Network	DH-485 Network
1756 ControlLogix 1756 GuardLogix	Yes	Yes	Yes	Yes	Yes
CompactLogix 5370	Yes	No	Yes(3)	Yes(4)	Yes(5)
1768-L4*x* CompactLogix	Yes	Yes	Yes	Yes	Yes
1769-L3*x* CompactLogix	Yes	Yes	Yes	Yes	Yes
1769-L23*x* CompactLogix	Yes	No	Yes	Yes	Yes
1789 SoftLogix™ 5800	Yes	Yes	Yes	Yes	No
1794 FlexLogix™	Yes	Yes	Yes	Yes	Yes
PowerFlex® with DriveLogix™	Yes	Yes	Yes	Yes	Yes
1785 PLC-5®	Yes(6) (7)	Yes	Yes(8)	Yes	—
1747 SLC	Yes(9)	Yes	Yes(4)	Yes	Yes
1761 MicroLogix™	Yes	No	Yes(4)	Yes	Yes
1762 MicroLogix	Yes	No	Yes(4)	Yes	Yes

Controller	EtherNet/IP Network[1]	ControlNet Network	DeviceNet Network[2]	RS-232 (DF1) Network	DH-485 Network
1763 MicroLogix	Yes	No	Yes[4]	Yes	Yes
1764 MicroLogix	Yes	No	Yes[4]	Yes	Yes
1772 PLC-2®	—	—	—	Yes	—
1775 PLC-3®	—	—	—	Yes	—
5250 PLC-5/250	—	—	No	Yes	—

(1) A non-EtherNet/IP controller requires a 1761-NET-ENI interface to connect to an EtherNet/IP network. This interface is only a messaging bridge.

(2) In the CompactLogix system, use either a 1769-SDN scanner (control I/O and send/receive messages) or a 1761-NET-DNI interface (messaging bridge).

(3) The CompactLogix 5370 L1 controllers cannot access a DeviceNet network and, therefore, cannot communicate with other controllers on a DeviceNet network.

(4) The CompactLogix 5370 controllers do not have an embedded serial port. You must add external modules to communicate over an RS-232 (DF1) network.

(5) The CompactLogix 5370 controllers do not have an embedded serial port. You must add external modules to communicate over a DH-485 network.

(6) The Ethernet PLC-5 controller must be series C, firmware revision N.1 or later; series D, firmware revision E.1 or later; or series E, firmware revision D.1 or later.

(7) The 1785-ENET Ethernet communication interface module must be series A, firmware revision D or later.

(8) The PLC-5, SLC, and MicroLogix processors appear as I/O points to the Logix controller. Use the appropriate DeviceNet interface for the controller.

(9) Use a 1747-L55*x* controller with OS501 or later.

Communicate with Other Communication Devices

The controller can communicate with these communication devices.

Communication Device	EtherNet/IP Network[1]	ControlNet Network	DeviceNet Network[2]
Linking device (ControlLogix controllers only)	1788-EN2DN	1788-CN2DN 1788-CN2FF	1788-EN2DN[3] 1788-CN2DN
PCMCIA card	—	1784-PCC	1784-PCD
PCI card	—	1784-PCIC 1784-PCICS	1784-PCID 1784-PCIDS 1784-CPCIDS
Drives SCANport™ module	—	1203-FM1 1203-FB1[4]	—
Communication module	—	1203-CN[5] 1770-KFC15 1770-KFCD15 1747-KFC15	1770-KFD 1770-KFG
Communication card	—	1784-PKTCS 1784-KTCS 1784-KTCX15	1784-PKTX 1784-PKTXD
USB communication device	—	1784-U2CN	1784-U2DN

(1) A non-EtherNet/IP controller requires a 1761-NET-ENI interface to connect to an EtherNet/IP network. This interface is only a messaging bridge.

(2) In the CompactLogix system, use either a 1769-SDN scanner (control I/O and send/receive messages) or a 1761-NET-DNI interface (messaging bridge).

(3) The 1788-EN2DN does not support safety communication (CIP Safety).

(4) Use a CIP generic MSG instruction to communicate with the 1203-FM1 SCANport module on a DIN rail that is remote to the controller. The remote DIN rail also requires a 1794-ACN15 or 1794-ACNR15 ControlNet adapter module.

(5) Use the generic module configuration to configure the 1203-CN1 module and a CIP generic MSG instruction to communicate with the module.

Controller Connections

A CompactLogix system uses the connection types to establish communication links between devices:

- Controller-to-local I/O modules or local communication modules
- Controller-to-remote I/O or remote communication modules
- Controller-to-remote I/O (rack-optimized) modules
- Produced and consumed tags
- Messages
- Controller access by the programming software
- Controller access by RSLinx® Classic software for HMI or other applications

You indirectly determine the number of connections the controller uses by configuring the controller to communicate with other devices in the system. The limit of connections may ultimately reside in the communication module you use for the connection. If a message path routes through a communication module, the connection related to the message also counts toward the connection limit of that communication module.

CompactLogix 5370 Controller Ethernet Node Limits and Connections

When designing a CompactLogix 5370 control system, you must consider the following:

- Maximum number of Ethernet nodes available for your controller's project
- Connections

The controller you select determines the number of Ethernet nodes available.

Cat. No.	Ethernet Nodes Supported
1769-L16ER-BB1B	4
1769-L18ER-BB1B	8
1769-L18ERM-BB1B	
1769-L24ER-QB1B	8
1769-L24ER-QBFC1B	
1769-L27ERM-QBFC1B	16
1769-L30ER	16
1769-L30ERM	
1769-L30ER-NSE	
1769-L33ER	32
1769-L33ERM	
1769-L36ERM	48

All CompactLogix 5370 controllers support 256 CIP connections and 120 TCP/IP connections.

1769-L23*x* CompactLogix Connections

The controller you select determines the connections for I/O and messages.

Controller	Supports
1769-L23EQB1B	32 CIP connections 8 TCP/IP connections
1769-L23EQBFC1B	

The total connection requirements for a 1769 CompactLogix system include both local and remote (distributed) connections. The controller supports 100 connections. The available remote connections depend on the network interface.

1769-L3*x* CompactLogix Connections

The controller you select determines the connections for I/O and messages.

Controller	Supports
1769-L32C 1769-L35CR	32 CIP connections
1769-L32E 1769-L35E	32 CIP connections 32 TCP/IP connections

The total connection requirements for a 1769 CompactLogix system include both local and remote (distributed) connections. The controller supports 100 connections. The available remote connections depend on the network interface.

1768-L4*x* CompactLogix Connections

The communication module you select determines the connections for I/O and messages.

Communication Module	Supports
1768-ENBT 1768-EWEB	128 CIP connections 64 TCP/IP connections
1768-CNB 1768-CNBR	48 CIP connections

The total connection requirements for a 1768 CompactLogix system include both local and remote (distributed) connections. The controller supports 250 connections. The available remote connections depend on the network interface.

Determine Total Connection Use

The total connection requirements for a CompactLogix system include both local and remote (distributed) connections. The controllers support these numbers of connections:

- 1769-L23*x* and 1769-L3*x* controllers support 100 connections.
- 1768-L4*x* controllers support 250 connections.
- CompactLogix 5370 controllers support 256 connections.

The available remote connections depends on the network interface.

Connection Type	Device Quantity	Connections per Device	Total Connections
Remote ControlNet communication module Configured as a direct (none) connection Configured as a rack-optimized connection		 0 **or** 1	
Remote I/O module over a ControlNet network (direct connection)		1	
Remote Ethernet communication module Configured as a direct (none) connection Configured as a rack-optimized connection		 0 **or** 1	
Remote I/O module over an EtherNet/IP network (direct connection)		1	
Remote device over a DeviceNet network (accounted for in rack-optimized connection for local 1756-DNB module)		0	
Produced tag and first consumer		2	
Each additional consumer		1	
Consumed tag		1	
Cached message		1	
Message		1	
RSLinx Enterprise subscriber (16 maximum)		1	
Total			

CompactLogix Controller Accessories

Memory Cards

Memory cards offer nonvolatile memory to permanently store a user program and tag data on a controller. Through the programming software, you can manually trigger the controller to save to or load from nonvolatile memory or configure the controller to load from nonvolatile memory on powerup.

IMPORTANT The 1769-L23x packaged CompactLogix controllers do not offer a nonvolatile memory option.

The CompactLogix 5370 controllers come with a 1784-SD1 Secure Digital (SD) card installed. You can order a 1784-SD2 SD card separately for additional nonvolatile memory with the CompactLogix 5370 controllers.

The 1768-L4*x* and 1769-L3*x* modular CompactLogix controllers offer a CompactFlash card as a nonvolatile memory option. You install the CompactFlash card in a socket on the controller. Through the programming software, you can manually trigger the controller to save to or load from nonvolatile memory or configure the controller to load from nonvolatile memory on powerup.

Table 37 - Technical Specifications - 1784-CF128, 1784-SD1, 1784-SD2

Attribute	1784-CF128	1784-SD1	1784-SD2
Memory	128 MB	1 GB	2 GB
Supported controllers	1769 modular controllers 1768 controllers	CompactLogix 5370 controllers	
Weight, approx	14.2 g (0.5 oz)	1.76 g (0.062 oz)	

Table 38 - Environmental Specifications - 1784-CF128, 1784-SD1, 1784-SD2

Attribute	1784-CF128, 1784-SD1, 1784-SD2
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	-25…70 °C (-13…158 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions CISPR 11	Group 1, Class A
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz

Table 39 - Certifications - 1784 Memory Cards

Certification[1]	1784-CF128, 1784-SD1, 1784-SD2
CE	European Union 2004/108/EC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: • Article 58-2 of Radio Waves Act, Clause 3

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1769 CompactLogix Batteries

The 1769-L23*x* and 1769-L3*x* controllers come with one 1769-BA lithium battery.

Neither the 1768 controllers nor the CompactLogix 5370 controllers require a battery. The controller uses internal flash memory to store its program during shutdown. Energy stored in the system maintains controller power long enough to store the program to internal flash memory, but not the external CompactFlash card nor SD card respectively.

Table 40 - Technical Specifications - 1769-BA

Attribute	1769-BA
Description	Lithium battery (0.59 g)
CompactLogix controllers	1769-L23-QBFC1B, 1769-L23E-QB1B, 1769-L23E-QBFC1B 1769-L31 1769-L32C, 1769-L35CR 1769-L32E, 1769-L35E

Removable Terminal Kits

You can order removable terminal kits with the CompactLogix 5370 L1 and L2 controllers separately. The kits are used to connect wiring to the controllers. Table 41 describes the kits.

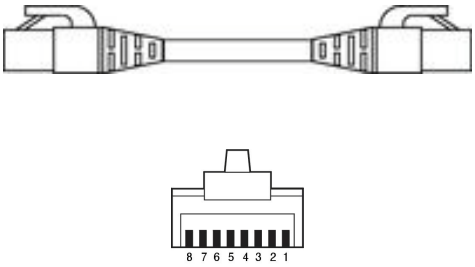
Table 41 - CompactLogix 5370 Controllers Removable Terminal Kits

Cat. No.	Controllers Supported	Description
1769-RTB45	CompactLogix 5370 L1	• Four 10-pin connectors used to connect wiring to the controllers' embedded digital I/O module. • One 5-pin connector used to connect an external 24V DC power source to the controller.
1769-RTB40DIO	CompactLogix 5370 L2	Four 10-pin connectors used to connect wiring to the controllers' embedded digital I/O module.
1769-RTB40AIO	1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B	Four 10-pin connectors used to connect wiring to the controllers' embedded analog I/O module.

Cold Junction Compensation

The CompactLogix 5370 L2 controllers require the use of the 1769-CJC CompactLogix CJC Sensor when the controllers' embedded analog input is configured for Thermocouple mode.

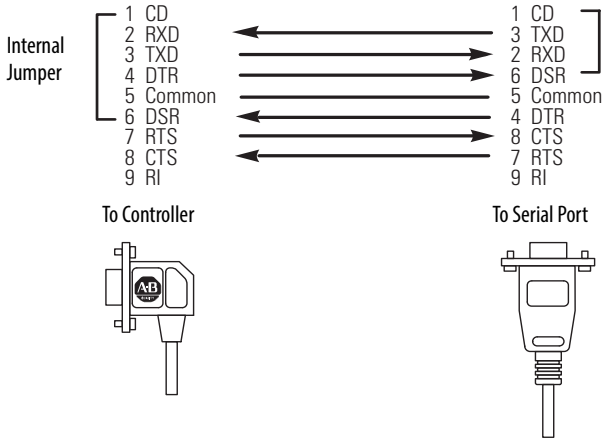
Ethernet Communication Cables



Connector Number	Color	1585J-M8xBJM-2	1585J-M4TBJM-2
1	White/Orange	TxData +	
2	Orange	TxData -	
3	White/Green	Recv Data +	
4	Blue	Unused	-
5	White/Blue	Unused	-
6	Green	Recv Data -	
7	White/Brown	Unused	-
8	Brown	Unused	-

Attribute	Value
Connector type	RJ45 Male to RJ45 Male
Connector angle	Straight-through
Length	Varies by catalog number

Serial Communication Cables



Attribute	1756-CP3	1747-CP3
Connector type	Female 9-pin D-shell	
Connector angle	Right angle connector to controller, straight to serial port	
Length	3 m (118 in.)	

Important User Information

Solid-state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this publication are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.

Rockwell Otomasyon Ticaret A.Ş., Kar Plaza İş Merkezi E Blok Kat:6 34752 İçerenköy, İstanbul, Tel: +90 (216) 5698400

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 1769-TD005G-EN-P - December 2012
Supersedes Publication 1769-TD005F-EN-P - June 2012

SIEMENS

SIMATIC HMI

HMI devices
TP700 Comfort Outdoor, TP1500 Comfort Outdoor

Compact Operating Instructions

03/2016

A5E35956909-AB

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Siemens AG
Division Digital Factory
Postfach 48 48
90026 NÜRNBERG
GERMANY

A5E35956909-AB
℗ 03/2016 Subject to change

Preface

Scope

These compact operating instructions apply to the following HMI devices in conjunction with the WinCC software package:

- TP700 Comfort Outdoor, article number 6AV2124-0GC13-0AX_
- TP1500 Comfort Outdoor, article number 6AV2124-0QC13-0AX_

  "_" stands for the variant key of the article number.

These compact operating instructions describe the technical differences of the Outdoor devices to the corresponding standard devices.

The information in these compact operating instructions take precedence in terms of their binding character over the statements in the following underlying operating instructions, the release notes and the online help.

Operating instructions on the Comfort Panels (http://support.automation.siemens.com/WW/view/en/49313233)

Note

This document belongs to the device and will also be required for repeat commissioning. Keep all supplied and supplementary documentation for the entire service life of the device.

Provide all associated documents to any future owner of the device.

Style conventions

Style Convention	Scope
"Add screen"	• Terminology that appears in the user interface, for example, dialog names, tabs, buttons, menu commands • Required input, for example, limits, tag values. • Path information
"File > Edit"	Operational sequences, for example, menu commands, shortcut menu commands.
<F1>, <Alt+P>	Keyboard operation

Please observe notes labeled as follows:

Note

A note contains important information about the product described in the manual and its use, or a specific section of the manual to which you should pay particular attention.

Naming conventions

Term	Applies to
System	• System • Machining center • One or more machines
HMI device Device	• TP700 Comfort Outdoor • TP1500 Comfort Outdoor
WinCC	WinCC V13 SP1 (TIA Portal)

Figures

This document contains figures of the devices described. The figures can deviate from the particularities of the delivered device.

Table of contents

Overview

1

1.1 Product description

SIMATIC Comfort Outdoor devices with glass touch screen and powder-coated, UV-resistant aluminum front are designed for use in indoor and outdoor areas, for example, in the fields of Oil&Gas, Marine or Refrigeration Technology.

All devices offer the same excellent functionality and are configured exclusively with the innovative HMI software, WinCC. The engineering software is integrated in the engineering framework, "Totally Integrated Automation Portal".

Features

Front	• External dimensions of the front and mounting cutout correspond to the standard product • Durable powder coating • High UV resistance • GFG (Glass-Film-Glass) touch screens, analog resistive • Manual or automatic brightness control with brightness sensor
Display	• High-resolution TFT display in widescreen format with 16 million colors • Suitable for use in daylight • Anti-reflective and bonded for glare-free reading
Touch screen	• Resistive single touch screen • Suitable for operation with gloves, pen and fingers
Interfaces	• 2 PROFINET interfaces • 1 PROFIBUS interface • USB 2.0 ports: – 2 x USB host interface (type A) – 1 x USB device interface (type mini B)

Mechanical differences to the standard product

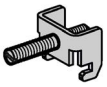
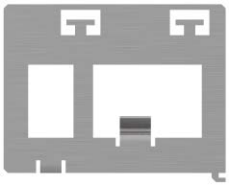
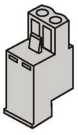
Device depth	The Comfort Outdoor devices are deeper than the corresponding Comfort HMI device. Read the information in the following sections: • Preparing the mounting cutout (Page 17) • Dimension drawings (Page 29)
Slots for SD memory cards	The protection mechanism of the SD memory card for the Comfort Outdoor devices is mechanically differently than that of the corresponding Comfort HMI device. The safety tab is not required with the Comfort Outdoor devices.

1.2 Software requirements

You require the software WinCC V13 SP1 (TIA Portal) Update 6 with the Hardware Support Package "HSP0149 HMI TP700_1500 Comfort Outdoor" or later versions. You can find the software under Technical Support on the Internet.

1.3 Scope of delivery

The following components are included in the scope of delivery of the HMI device.

Name	Figure		Quantity	
HMI device			1	
Installation instructions (Quick Install Guide)			1	
Mounting clips		Aluminum mounting clip	8	TP700 Comfort Outdoor
		Steel mounting clip	12	TP1500 Comfort Outdoor
Strain relief	Example: Strain relief 		1	TP700 Comfort Outdoor
Power supply terminal	Connector, female, 2-pin, type 1 		1	

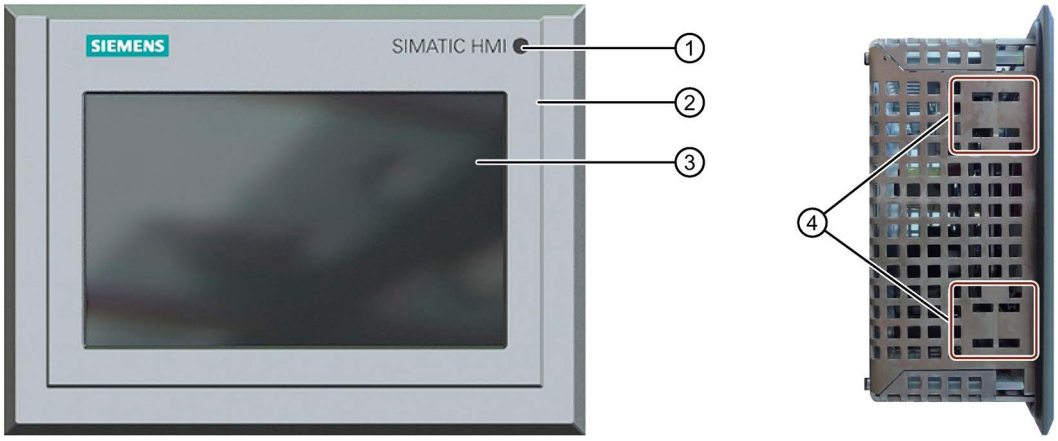
Some components in the scope of delivery are also available as accessories, see "Accessories" section in the Comfort Panels operating instructions or directly in the Industry Mall (https://mall.industry.siemens.com).

1.4 Configuration of the devices

1.4.1 Device views

This section describes the basic design of the device using the example of the TP700 Comfort Outdoor.

Front view and side view



① Light sensor
② Aluminum front, powder coated
③ Glass touch screen / display
④ Cutouts for attaching the mounting clamps

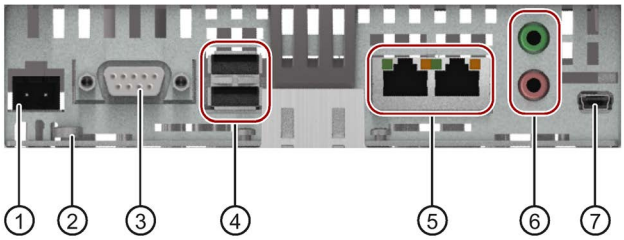
Rear view

① Rating plate
② Slot for data memory card
③ Slot for system memory card
④ Interface inscription

1.4.2 Interfaces

Position of the interfaces

The figure below shows the interfaces of the HMI devices.



① X80 power supply connector
② Connection for equipotential bonding (ground)
③ X2 PROFIBUS (Sub-D RS422/485)
④ X61 / X62 USB type A
⑤ X1 PROFINET (LAN), 10/100 Mb
⑥ X90 Audio Line IN / OUT
⑦ X60 USB type Mini B

Additional information

Use the X1 or X60 interface to connect a configuration PC. Use the X61 / X62 interfaces to connect peripheral devices such as a printer or keyboard. Use the X90 interface to connect a loudspeaker.

You can fasten the USB and PROFINET connecting cables to the rear panel of the HMI device with cable ties.

Secure the cables with a separate strain relief for the TP700 Comfort Outdoor. Install the strain relief on the HMI device.

Safety instructions

2

2.1 General safety instructions

The general safety instructions in the "Comfort Panel" operating instructions apply.

Also note the following for Comfort outdoor devices:

⚠ WARNING

Unintended functions may be triggered with icing

If the operating temperature is below 2 °C, icing may occur on the front of the device. Icing may trigger unintended functions in some circumstances.

To avoid triggering unintended functions, you can take the following measures, for example:

- Install an additional enabling switch in your plant for operator actions that initiate a dangerous operating state.
- Assign a password to operator actions or inputs that initiate a dangerous operating state.

2.2 Notes about usage

Industrial applications

The HMI device is designed for outdoor areas in industrial applications. It conforms to the following standards:

- Requirements of the emission standard for industrial environments, EN 61000-6-4: 2007 + A1:2011
- ESD immunity requirements to DIN EN 61000-6-2:2005

Use in residential areas

Note

The HMI device is not intended for use in residential areas. Operation of an HMI device in residential areas can have a negative influence on radio/TV reception.

If the HMI device is used in a residential area, you must take measures to achieve Limit Class B conforming to EN 55011 for RF interference.

Individual acceptance is required.

Use with additional measures

The HMI device should not be used at the following locations unless additional measures are taken:

- In locations with a high degree of ionizing radiation
- In locations with severe operating conditions, for example, due to:
  - Corrosive vapors, gases, oils or chemicals
  - Electrical or magnetic fields of high intensity
- In systems that require special monitoring, for example, in:
  - Elevators
  - Systems in especially hazardous rooms

Mounting and connecting the HMI device 3

3.1 Preparing for installation

3.1.1 Checking the package contents

Check the package content for visible signs of transport damage and for completeness.

Note

Damaged parts

A damaged part will cause the HMI device to malfunction.

Do not install parts damaged during shipment. In the case of damaged parts, contact your Siemens representative.

Check the scope of supply of the HMI device (see Scope of delivery (Page 9)).

Additional documents may be included in the delivery.

The documentation is part of the HMI device and is required for subsequent commissioning. Keep all enclosed documentation for the entire service life of the HMI device. You must pass along the enclosed documentation to any subsequent owner or user of the HMI device. Make sure that every supplement to the documentation that you receive is stored together with the operating instructions.

3.1.2 Checking the operating conditions

Note the following aspects before installing the HMI device:

1. Familiarize yourself with the technical specifications for operating the HMI device. You can find this information in the section "Technical information (Page 25)".
2. Read the information about local use of the HMI device, see section "Notes about usage (Page 13)".

3.1.3 Selecting a mounting position

The device is suitable for installation in:

- Mounting cabinets
- Control cabinets
- Switchboards
- Consoles

In the following, all of these mounting options are referred to by the general term "cabinet".

The device is self-ventilated and approved for inclined mounting at angles up to +/-35° from the vertical in stationary cabinets.

NOTICE
Damage due to overheating Inclined installation reduces the convection by the device and therefore the maximum permitted ambient temperature for operation. If there is sufficient forced ventilation, the device can also be operated in the inclined mounting position up to the maximum permitted ambient temperature for vertical installation. The device may otherwise be damaged and its certifications and warranty will be rendered null and void. The ambient temperature ranges listed in this section apply to the temperature inside the cabinet.

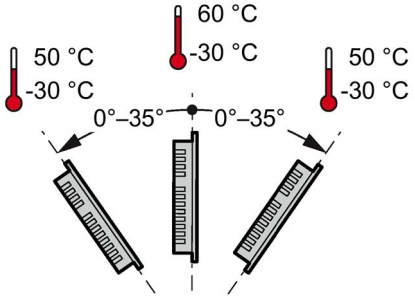
Mounting position

Select one of the approved mounting positions for your device. The approved mounting positions are described in the following sections.

Mounting in horizontal format

Ambient temperature when mounted in horizontal format:

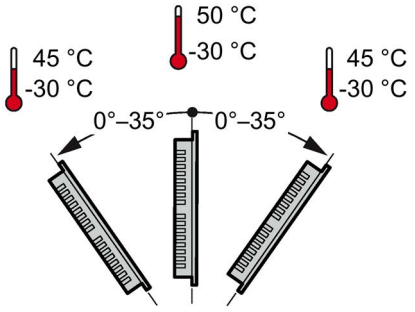
- Vertical mounting (0° inclined): Maximum +60 °C
- Inclined mounting (inclined up to 35°): Maximum +50 °C



Mounting in vertical format

Ambient temperature when mounted in vertical format:

- Vertical mounting (0° inclined): Maximum +50 °C
- Inclined mounting (inclined up to 35°): Maximum +45 °C



See also

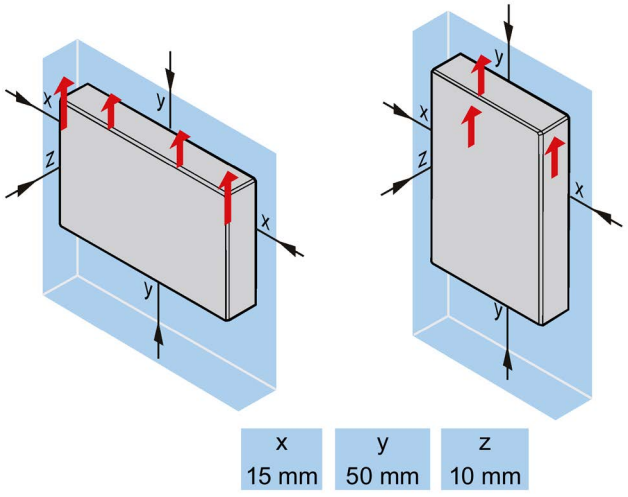
Operating Conditions (Page 27)

3.1.4 Checking clearances

The following clearances are required around the HMI device to ensure sufficient self-ventilation:

- At least 15 mm to both the right and left of the mounting cutout (in x direction) to allow for insertion of the mounting clips during installation
- At least 50 mm above and 50 mm below the mounting cutout (in the y direction) for ventilation
- At least 10 mm behind the rear panel of the HMI device (in the z direction)

The following figure shows the clearances during mounting of the HMI devices in horizontal and vertical formats:



Note

Ensure that the maximum ambient temperature is not exceeded when mounting the device in a cabinet and especially in a closed enclosure.

3.1.5 Preparing the mounting cutout

Note

Stability of the mounting cutout

The material in the area of the mounting cutout must provide sufficient strength to guarantee lasting and safe mounting of the HMI device.

To achieve the degrees of protection described below, it must be ensured that deformation of the material cannot occur due to the force of the mounting clips or operation of the device.

Degrees of protection

The degrees of protection of the HMI device can only be guaranteed if the following requirements are met:

- Material thickness at the mounting cutout for a protection rating of IP66 or Front face only Type 4X/Type 12 (Indoor/Outdoor): 2 mm to 6 mm
- Permitted deviation from plane at the mounting cutout: ≤ 0.5 mm

  This condition must be met for the mounted HMI device.
- Permitted surface roughness in the area of the mounting seal: ≤ 120 µm (R_z 120)

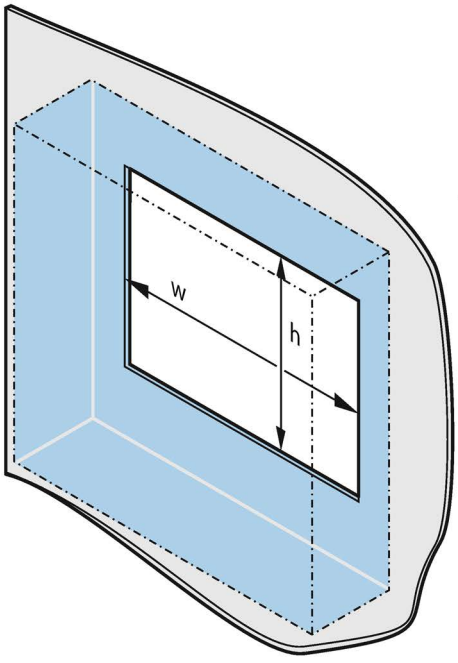
Compatibility of the mounting cutout to other HMI devices

The mounting cutouts of the following HMI devices are compatible with the mounting cutouts of the following predecessor devices:

HMI device	Mounting cutout compatible with
TP700 Comfort Outdoor	TP700 Comfort, TP 177B 6", MP 177 6", TP 277 6"
TP1500 Comfort Outdoor	TP1500 Comfort

Please note that although the dimensions for the mounting cutout are the same, the device depth and/or the enclosure front dimensions may differ from the respective dimensions of the predecessor devices.

Dimensions of the mounting cutout



	w^{+1}_{0}	h^{+1}_{0}
TP700 Comfort Outdoor	197	141
TP1500 Comfort Outdoor	396	291

Width and height should be reversed accordingly when mounting in vertical format.

Mounting depth

The mounting depth of the devices is:

HMI device	Mounting depth
TP700 Comfort Outdoor	67 mm
TP1500 Comfort Outdoor	77 mm

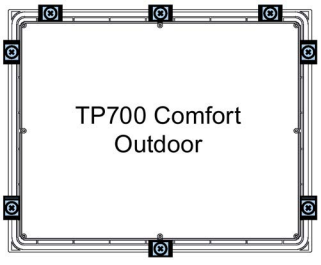
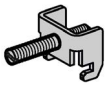
3.2 Mounting the device

Positions of the mounting clips

To achieve the degree of protection for the HMI device, the positions for the mounting clips shown below must be adhered to.

The positions of the mounting clips are marked by stamps on the cutouts. Fit the mounting clips in all the stamped cutouts.

The following table shows the type, number, and position of the mounting clips needed for the respective HMI devices.

HMI device	Mounting clips		
	Type	Number	Position on the HMI device
TP700 Comfort Outdoor	Aluminum mounting clip 	8	
TP1500 Comfort Outdoor	Steel mounting clip 	12	

Requirement

- All packaging components and protective films were removed from the HMI device.
- To install the HMI device, you need the mounting clips from the accessories kit.
- The mounting seal must be installed on the HMI device.

Procedure

Note

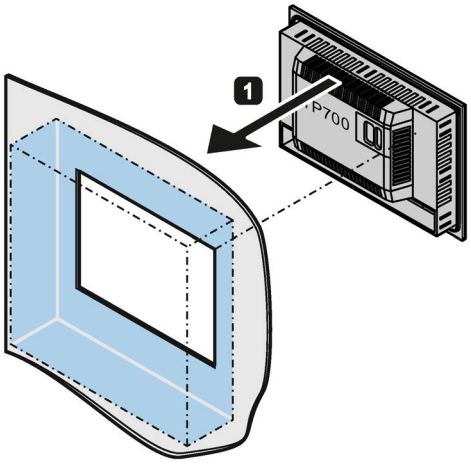
Risk of guaranteed degree of protection not being met

If the mounting seal is damaged, the degree of protection is not guaranteed. Replace the device in this case.

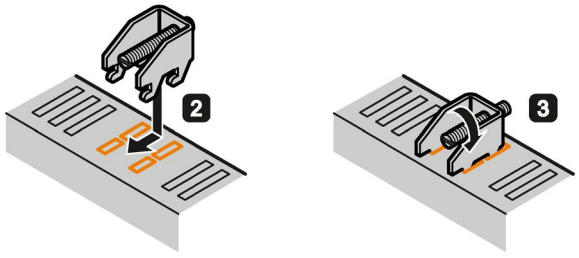
Note

Installation of the HMI device

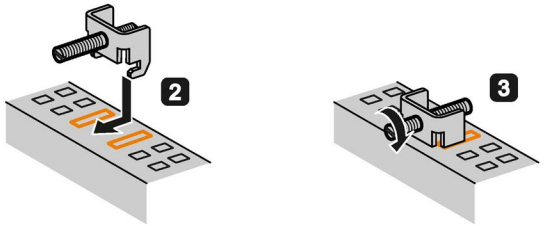
Always mount the HMI device according to the instructions in this manual.



Mounting clips for TP700 Comfort Outdoor:



Mounting clips for TP1500 Comfort Outdoor:



Proceed as follows:

1. Insert the HMI device into the mounting cutout from the front.
2. Insert the mounting clamp into the cutout provided on the HMI device.
3. Tighten the mounting clamp with the setscrew.

   Note

   Adhere to the permitted torque when tightening the setscrew of the mounting clamp: 0.5 Nm

4. Repeat steps 2 and 3 for all mounting clips.
5. Check the fit of the device in the mounting cutout.

3.3 Connecting the device

The specifications in "Comfort Panels" operating instructions apply.

The X3 interface "PROFINET (LAN) 10/100/1000 Mbit" is not featured on the TP700 Comfort Outdoor and TP1500 Comfort Outdoor devices.

Configuring the device

4

4.1 Overview

The specifications in the "Comfort Panel" operating instructions apply for commissioning and parameter assignments.

The enhanced brightness control of the Comfort Panels Outdoor differs from the other Comfort HMI devices and is described in the following section.

4.2 Changing the brightness settings

The Comfort Outdoor Panels feature a manual or automatic brightness control with a brightness sensor. Make the appropriate settings in the Control Panel.

Requirement

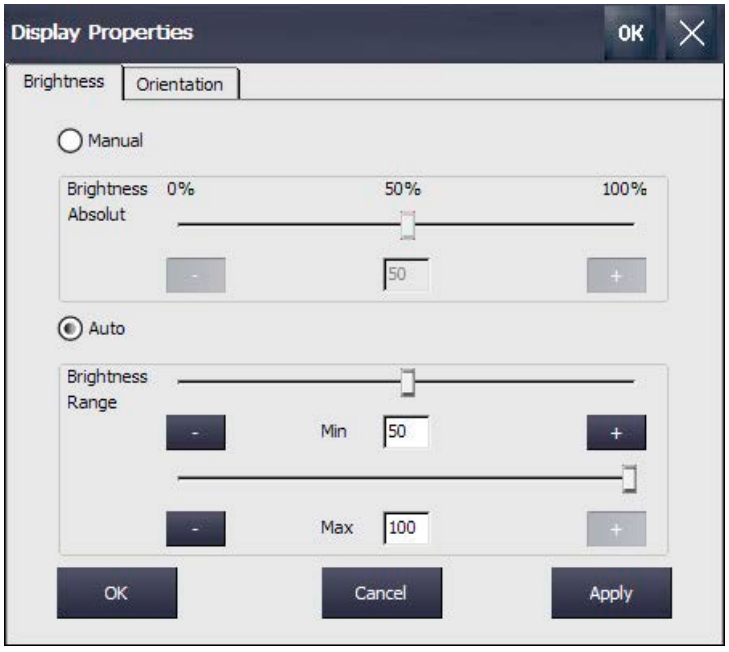
The Control Panel is open.

Set brightness

Proceed as follows:

1. Open the "Display Properties" dialog with the Display icon.

2. Switch to the "Brightness" tab. The figure below shows the factory settings.



Select the "Manual" or "Auto" option.

– In the "Manual" mode, you can adjust the brightness to the desired value using the slider.

Note

"Manual" mode

A change in the brightness value through the configuration takes precedence over the manual setting.

– in the "Auto" mode, you can set the minimum and maximum brightness for the automatic brightness control of the HMI device under "Brightness Range".

NOTICE

"Auto" mode (factory state)

The brightness parameters are controlled by the light sensor in "Auto" mode. The brightness can no longer be changed manually or through the configuration.

The "Screen saver" function is available as usual.

3. If you want to check the settings without closing the dialog, press the "Apply" button.
4. To discard the settings and close the dialog, press the "Cancel".
button. To save the settings and close the dialog, press the "OK" button.

Commissioning a project

5

5.1 Overview

The specifications in "Comfort Panels" operating instructions apply.

5.2 Using existing projects

Proceed as follows to transfer an existing project to the HMI device:

1. Open the existing project in WinCC (TIA Portal).
2. Make sure that the project is dimensioned within the functional scope of the HMI device, see section "Scope of functions with WinCC (Page 33)".

   Note

   The functional scope of the TP1500 Comfort Outdoor corresponds to the functional scope of a TP1200 Comfort.

3. Replace the HMI device in WinCC.
4. Transfer the project to the HMI device as described in the "Comfort Panel" operating instructions.

Note

"Backup, Restore" and "Automatic Backup" only for devices with identical article numbers

The "Backup" and "Restore" function using a data memory card and the "Automatic Backup" function using the system memory card are only available for devices with identical article numbers.

Maintenance and care

6

6.1 Cleaning the device

The specifications in "Comfort Panels" operating instructions apply.

NOTICE
Disable or switch off the device while cleaning Switch off the HMI device or activate the clean screen when you clean the appliance during operation.

Note

Cleaning of the coated glass touch screen

Take care not to damage the glass touch screen and the coating of the touch screen on Comfort Outdoor devices.

Use a cleaning cloth and dishwashing liquid or foaming screen cleaners. Apply as little pressure as possible on the touch screen when cleaning.

6.2 Repair, spare parts, recycling and disposal

The specifications in "Comfort Panels" operating instructions apply.

Technical information

7

7.1 Certificates and approvals

Approvals

The device is certified as shown on the rear of the device.

As soon as additional certificates are available, you can find them in the Industry Mall or Technical Support.

Search for your device and use the link "Support > Approvals / Certificates".

7.2 Electromagnetic compatibility

The device is designed for industrial use.

7.2.1 Emitted interference

The device meets the requirements according to EN 61000-6-4. The device corresponds to limit class A.

Note

The HMI device is not intended for use in residential areas. Operation of an HMI device in residential areas can have a negative influence on radio/TV reception.

7.2.2 Immunity to interferences

The device meets the requirements according to EN 61000-6-2.

7.3 Mechanical ambient conditions

7.3.1 Storage conditions

The following information is for a device that is transported and stored in its original packaging.

The device meets the requirements according to IEC 60721-3-2 Class 2M2 with the following amendments and limitations:

Type of condition	Permitted range
Free fall	≤ 1 m
Vibration to IEC 60068-2-6	5 .. 8.4 Hz, deflection 3.5 mm 8.4 ... 500 Hz, acceleration 1 g
Shock to IEC 60068-2-27	250 m/s², 6 ms, 1000 shocks

7.3.2 Operating Conditions

The following information applies to a device installed according to the specifications in these operating instructions.

The device meets the requirements according to IEC 60721 Class 3M3 with the following amendments and limitations:

Type of condition	Permitted range
Vibration to IEC 60068-2-6	5 ... 8.4 Hz, deflection 3.5 mm 8.4 ... 200 Hz, acceleration 1 g
Shock to IEC 60068-2-27	150 m/s², 11 ms, 3 shocks

7.4 Climatic ambient conditions

7.4.1 Long-term storage

The following information applies to a device that is stored in its original packaging for longer than two weeks.

The device meets the requirements of IEC 60721-3-1 Class 1K2.

7.4.2 Transport and short-term storage

The following information applies to a device that is transported in the original packaging and weather-proof packaging, and stored from some time.

The device meets the requirements according to IEC 60721-3-2 Class 2K4 with the following amendments and limitations:

Type of condition	Permitted range
Temperature	–30 ... 70 °C
Atmospheric pressure	1080 ... 660 hPa, corresponds to an elevation of -1000 to 3500 m
Relative humidity	10 ... 90 %
Pollutant concentration	SO2: < 0.5 ppm; relative humidity < 60 %, no condensation H_2S: < 0.1 ppm; relative humidity < 60 %, no condensation

Note

If dewing has developed, wait approximately 4 hours until the HMI device has dried completely before switching it on.

Do not expose the HMI device to direct radiation from a heater.

7.4.3 Operating Conditions

The following information applies to a device installed according to the specifications in these compact operating instructions.

The HMI device is designed for stationary operation according to IEC 60721.

The device meets the requirements according to IEC 60721-3-3 Class 3K3 with the following amendments and limitations:

Type of condition	Permitted range		
	Mounting position	Elevation -1000 ... 2000 m	Elevation 3000 m *
Temperature, Mounting in horizontal format	Vertical	-30 ... 60 °C	-30 ... 54 °C
	Inclined, maximum inclination 35°	-30 ... 50 °C	-30 ... 45 °C
Temperature, Mounting in vertical format	Vertical	-30 ... 50 °C	-30 ... 45 °C
	Inclined, maximum inclination 35°	-30 ... 45 °C	-30 ... 40 °C
Atmospheric pressure, operation elevation	1080 ... 795 hPa, corresponds to an elevation of -1000 to 2000 m 795 ... 701 hPa, corresponds to an elevation of 2000 ... 3000 m		
Relative humidity	From 10 to 90%, without condensation		
Pollutant concentration	SO2: < 0.5 ppm; relative humidity < 60 %, no condensation H_2S: < 0.1 ppm; relative humidity < 60 %, no condensation		

* Interpolation of the maximum temperature value is permitted in the range of 2000 ... 3000 m.

Note

The system components connected to the HMI device, the power supply for example, must also be suited to the respective operating conditions.

7.5 Protection classes

7.5.1 Insulation test

The device meets the requirements according to EN 61131-2.

Circuits with a nominal voltage of U_e to other circuits or ground	Test voltage
Isolation tested with (Type Test)	707 V DC

7.5.2 Protection against foreign objects and water

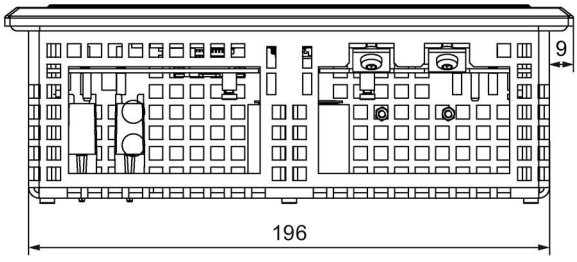
The device meets the requirements according to EN 60529.

Device side	Degree of protection
Front	When mounted: • IP66 • Type 4X/Type 12 (Indoor/Outdoor)
Rear panel	• IP20 protection against contact with standard test probes. There is no protection against ingress by water.

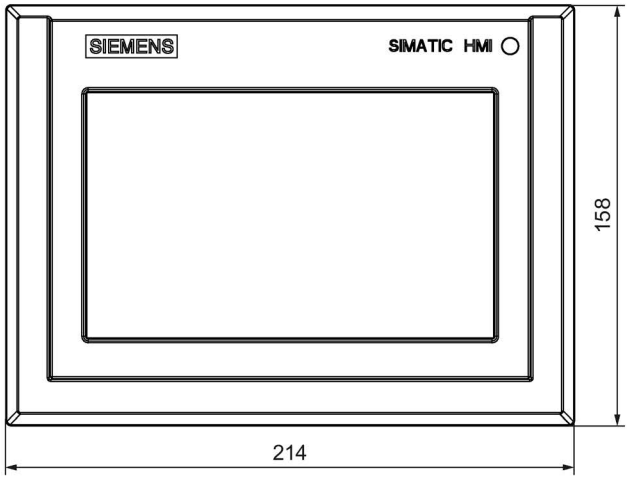
The degree of protection of the device front can only be guaranteed if the mounting seal lies flush against the mounting cutout. Read the corresponding information in section "Preparing the mounting cutout (Page 17)".

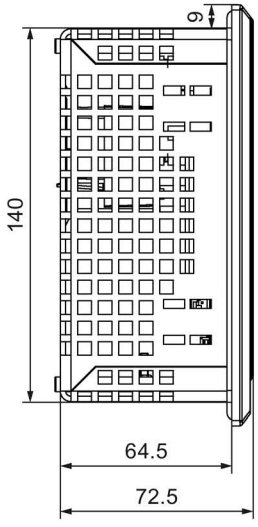
7.6 Dimension drawings

7.6.1 Dimension drawings of the TP700 Comfort Outdoor



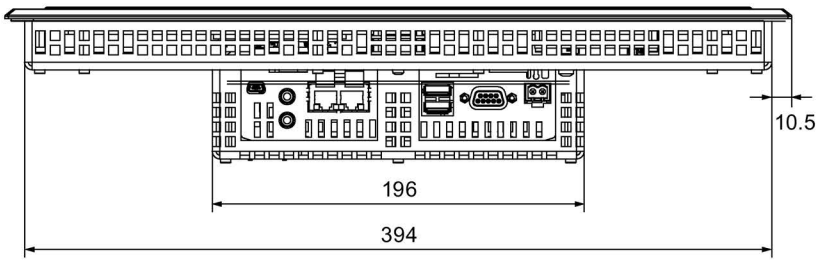
All dimensions in mm.

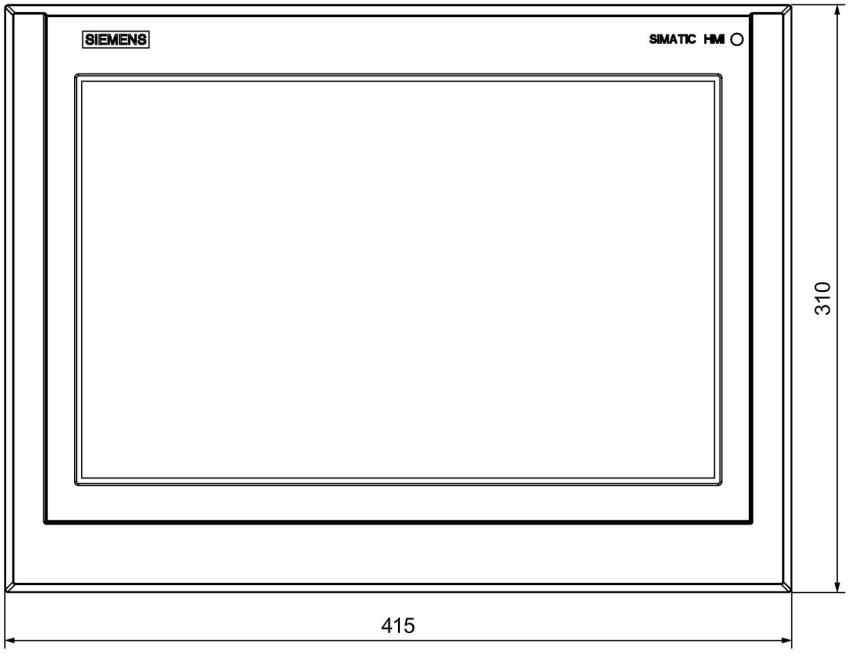


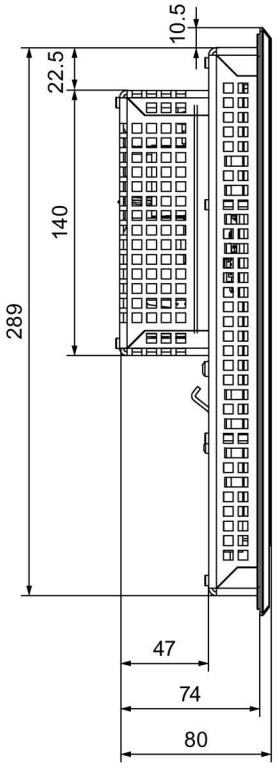


7.6.2 Dimension drawings of the TP1500 Comfort Outdoor

All dimensions in mm.







7.7 Specifications

Weight

	TP700 Comfort Outdoor	TP1500 Comfort Outdoor
Weight without packaging	approx. 1.5 kg	4.0 kg

Display

	TP700 Comfort Outdoor	TP1500 Comfort Outdoor
Type	LCD TFT	
Active display area	7.0" 152 mm x 91 mm	15.4" 331 x 207 mm
Resolution	800 x 480 pixels	1280 x 800 pixels
Possible colors	Up to 16 million	
Brightness control	Manual/automatic, value range 0 to 100 [1], 0 = backlighting off	
Backlighting Half Brightness Life Time (MTBF [2])	LED 50000 h	
Pixel error class in accordance with ISO 9241-307	I	

1 Via WinCC: Complete range, via Control Panel: Manual ("Low limit" to 100) or automatic (0 to 100). The factory setting for "Low limit" is a fixed minimum value.

2 MTBF: Operating hours after which the maximum brightness is reduced by half compared to the original value. MTBF is increased by using the integrated dimming function, for example time-controlled via screen saver or centrally via PROFIenergy.

Input device

	TP700 Comfort Outdoor	TP1500 Comfort Outdoor
Touch screen (analog resistive)	Yes, GFG (glass film glass) touch	

Memory

	TP700 Comfort Outdoor	TP1500 Comfort Outdoor
Usable memory for application data	12 MB	
Usable memory for recipe data [1]	2 MB	
Additional memory for options	12 MB	
Data memory card [2]	1 x MMC/SD combination slot	
System memory card [2]	1 x SD slot	

1 Can be extended via memory card

2 Memory cards are available as SIMATIC HMI accessories

Interfaces

	TP700 Comfort Outdoor	TP1500 Comfort Outdoor
1 x RS 422/485 (PROFIBUS)	Max. 12 Mbps, applies to DP operations	
Ethernet (PROFINET)	2 x RJ45 10/100 Mbps [1]	
Audio	Line In and Line Out	
USB 2.0	2 x Host [2] 1 x Device [3]	

[1] With integrated switch (one IP address only)
[2] USB type A; maximum load 500 mA
[3] USB type mini B (5-pin)

Power supply

	TP700 Comfort Outdoor	TP1500 Comfort Outdoor
Rated voltage Permitted voltage range	24 V DC +19.2 V to +28.8 V	
Rated current range, depends on the load	0.5 ... 1.0 A	0.8 ... 1.4 A
Inrush current I^2t	0.5 A^2s	
Power	17 W	32 W
Maximum permitted transient	35 V (500 ms)	
Minimum time between two transients	50 s	
Internal protection	Electronic	

Miscellaneous

	TP700 Comfort Outdoor	TP1500 Comfort Outdoor
Buffered real-time clock [1]	Yes	
Audio reproduction	Integrated or external via Line OUT	
Magnetic field intensity	50/60 Hz; 100 A/m RMS	

[1] Battery backup typically 6 weeks

7.8 Description of the ports

The specifications in "Comfort Panels" operating instructions apply.

The X3 interface "PROFINET (LAN) 10/100/1000 Mbit" is not featured on the TP700 Comfort Outdoor and TP1500 Comfort Outdoor devices.

7.9 Scope of functions with WinCC

The tables below show the objects which can be integrated in a project for an HMI device.

Note

The specified values are maximum values of the individual objects. Simultaneous use of multiple objects with their maximum value can lead to problems in the active project.

Alarms

Object	Specification	TP700 Comfort Outdoor, TP1500 Comfort Outdoor
Alarms	Number of discrete alarms	4000
	Number of analog alarms	200
	Alarm length	80 characters
	Number of tags / process values in an alarm	Max. 8
	Number of alarm classes	32
	Display	Alarm window, alarm view
	Acknowledge error alarm individually	Yes
	Edit alarm	Yes
	Alarm indicator	Yes
ALARM_S	Display S7 alarms	Yes
Alarm buffer, retentive	Alarm buffer capacity	1024
	Simultaneously queued alarm events	500
	View alarm	Yes
	Delete alarm buffer	Yes
	Print alarms line by line	Yes

Tags, values and lists

Object	Specification	TP700 Comfort Outdoor, TP1500 Comfort Outdoor
Tags	Number	2048
Limit value monitoring	Input/output	Yes
Linear scaling	Input/output	Yes
Text lists	Number	500 [1]
Graphics lists	Number	500 [1]

[1] The maximum total of text and graphics lists is 500.

Screens

Object	Specification	TP700 Comfort Outdoor, TP1500 Comfort Outdoor
Screens	Number	500
	Objects per screen	400
	Tags per screen	400
	Complex objects per screen (for example, bars)	20
	Template	Yes

Recipes

Object	Specification	TP700 Comfort Outdoor, TP1500 Comfort Outdoor
Recipes	Number	300
	Data records per recipe	500
	Entries per data record	1000
	Recipe memory	256 KB
	Storage location [1]	• Memory card (MMC/SD) • USB storage medium • Network drive

[1] The number of recipe data records may be restricted by the capacity of the storage medium.

Logs

Note

The HMI devices are suitable for the logging of relatively small volumes of data.

Manage the data in several adjacent logs in a segmented circular log. The use of a large circular log has a negative effect on performance.

Object	Specification	TP700 Comfort Outdoor, TP1500 Comfort Outdoor
Logs	Number of logs	50
	Number of partial logs in a segmented circular log	400
	Entries per log [1]	20000
	Filing format	CSV with ANSI character set, RDB, TXT
	Storage location	• Memory card • USB storage medium • Network drive

[1] The number of entries in the log may be restricted by the capacity of the storage medium.

Note

Data consistency

If the HMI device is switched off, the consistency of the stored data is only ensured with "SIMATIC HMI Memory Card" type memory cards.

With commercially available memory cards, switching off the device may result in the loss of saved data, for example, due to a power failure.

The consistency of data stored in logs is only guaranteed if you use RDB format.

Only use "SIMATIC HMI Memory Card 2 GB" (SD) or higher.

Safety

Object	Specification	TP700 Comfort Outdoor, TP1500 Comfort Outdoor
User view	Number of user groups	50
	Number of users	50
	Number of authorizations / user permissions	32

Info texts

Object	Specification	TP700 Comfort Outdoor, TP1500 Comfort Outdoor
Info texts	Length (no. of characters)	320 (depending on font)
	For alarms	Yes
	For screens	Yes
	For screen objects (e.g. I/O field, switch, button, invisible button)	Yes

Additional functions

Object	Specification	TP700 Comfort Outdoor, TP1500 Comfort Outdoor
Screen settings	Touch screen calibration	Yes
	Brightness setting	Yes
Language change	Number of languages per project	32
VB Script	User-specific extension of the functionality	Yes
	Number of scripts	100
Graphic objects	Vector and pixel graphics	Yes
Trends	Number	300
Task planner	Number of tasks	48
Text objects	Number	40000
Direct keys	PROFIBUS DP direct keys	Yes
	PROFINET IO direct keys	Yes

Technical Support

A

A.1 Service and support

You can find additional information and support for the products described on the Internet at the following addresses:

- Technical support (http://www.siemens.de/automation/csi_en_WW)
- Support request form (http://www.siemens.com/automation/support-request)
- After Sales Information System SIMATIC IPC/PG (http://www.siemens.com/asis)
- SIMATIC Documentation Collection (http://www.siemens.com/simatic-tech-doku-portal)
- Your local representative (http://www.automation.siemens.com/mcms/aspa-db/en/Pages/default.aspx)
- Training center (http://sitrain.automation.siemens.com/sitrainworld/?AppLang=en)
- Industry Mall (https://mall.industry.siemens.com)

When contacting your local representative or Technical Support, please have the following information at hand:

- MLFB of the device
- BIOS version for industrial PC or image version of the device
- Other installed hardware
- Other installed software

Tools & downloads

Please check regularly if updates and hotfixes are available for download to your device. The download area is available on the Internet at the following link:

After Sales Information System SIMATIC IPC/PG (http://www.siemens.com/asis)

A.2 Troubleshooting and system alarms

The specifications in "Comfort Panels" operating instructions apply.

Index

M

P

R

S

T

U

V

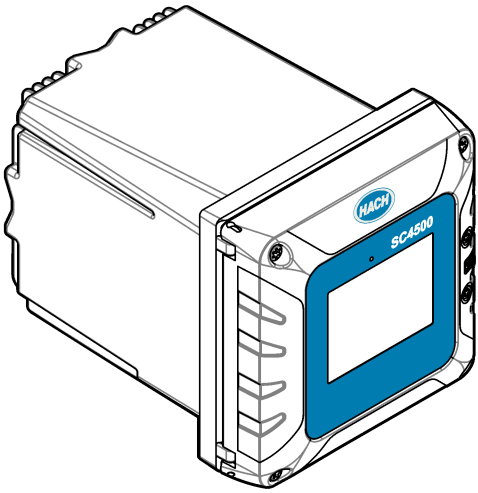
W

DOC343.52.90690

SC4500

11/2022, Edition 4

User Manual



Section 1 Specifications

Specifications are subject to change without notice.

Specification	Details
Dimensions (W x H x D)	½ DIN-144 x 144 x 192 mm (5.7 x 5.7 x 7.6 in.)
Enclosure	UL50E type 4X, IEC/EN 60529–IP 66, NEMA 250 type 4X Metal enclosure with a corrosion-resistant finish
Weight	1.7 kg (3.7 lb) (Controller weight without optional expansion modules)
Pollution degree	Environment: 4; instrument: 2
Overvoltage category	II
Protection class	I, connected to protective earth
Environmental conditions	Indoor and outdoor use
Power requirements	**AC controller:** 100–240 VAC ±10%, 50/60 Hz; 1 A (50 VA with 8W sensor load, 100VA with 28W sensor load) **DC controller:** 18–28 VDC; 2.5 A (12W with 9W sensor load, 36W with 20 W sensor load)
Operating temperature	–20 to 60 °C (–4 to 140 °F) (8 W (AC)/9 W (DC) sensor load) –20 to 45 °C (–4 to 113 °F) (28 W (AC)/20 W (DC) sensor load) Linear derating between 45 and 60 °C (–1.33 W/°C)
Storage temperature	–20 to 70 °C (–4 to 158 °F)
Relative humidity	0 to 95%, non-condensing
Altitude	3000 m (9842 ft) maximum
Display	3.5-inch TFT color display with capacitive touchpad
Measurement	Two device, digital SC connectors
Relays (high voltage)	Two relays (SPDT); Wire gauge: 0.75 to 1.5 mm^2 (18 to 16 AWG) **AC controller** Maximum switching voltage: 100–240 VAC Maximum switching current: 5 A Resistive/1 A Pilot Duty Maximum switching power: 1200 VA Resistive/360 VA Pilot Duty **DC controller** Maximum switching voltage: 30 VAC or 42 VDC Maximum switching current: 4 A Resistive/1 A Pilot Duty Maximum switching power: 125 W Resistive/28 W Pilot Duty
Analog inputs (optional)[3]	One 0-20 mA (or 4-20 mA) analog input on each analog input module One analog sensor input on each sensor module Maximum of two analog inputs
Analog outputs (optional)[3]	Five 0–20 mA (or 4-20 mA) analog outputs on each analog output module[1]
Digital communication (optional)[3]	Profibus DPV1 module, Modbus TCP, PROFINET module, EtherNet/IP™[2] module

[1] Refer to the module documentation for additional information.
Note: *Install only one module in one of the available slots.*

[2] EtherNet/IP is a trademark of OVDA Inc.

Specification	Details
RTC module (optional)	Contact sales or technical support for information. ***Note:*** *Only one RTC module can be installed on a controller at the same time.*
Network connection[3]	**LAN version** (optional): Two Ethernet connectors (10/100 Mbps), M12 female D-coding connector; **Cellular version** and **WiFi version** (optional)[4]
USB port	Used for data download and software upload. The controller records approximately 20,000 data points for each connected sensor.
Compliance information	CE. ETL certified to UL and CSA safety standards (with all sensor types), FCC, ISED, KC, RCM, EAC, UKCA, SABS, CMIM, Morocco
Warranty	1 year (EU: 2 years)

Section 2 General information

In no event will the manufacturer be liable for damages resulting from any improper use of product or failure to comply with the instructions in the manual. The manufacturer reserves the right to make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions are found on the manufacturer's website.

2.1 Safety information

The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is soley responsible to identify critical application risks and install appropriate mechanisms to protect processes during a possible equipment malfunction.

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than that specified in this manual.

2.1.1 Use of hazard information

⚠ DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

2.1.2 Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol on the instrument is referenced in the manual with a precautionary statement.

[3] Dependent on controller configuration.

[4] An external USB box WiFi is necessary for network connection on WiFi versions. An external USB box cellular is necessary for network connection on cellular versions.

	This is the safety alert symbol. Obey all safety messages that follow this symbol to avoid potential injury. If on the instrument, refer to the instruction manual for operation or safety information.
	This symbol indicates that a risk of electrical shock and/or electrocution exists.
	This symbol indicates the presence of devices sensitive to Electro-static Discharge (ESD) and indicates that care must be taken to prevent damage with the equipment.
	Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems. Return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.

2.1.3 Compliance and certification

⚠ CAUTION

This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

Canadian Radio Interference-Causing Equipment Regulation, ICES-003, Class A:

Supporting test records reside with the manufacturer.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de classe A répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

FCC Part 15, Class "A" Limits

Supporting test records reside with the manufacturer. The device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

1. The equipment may not cause harmful interference.
2. The equipment must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their expense. The following techniques can be used to reduce interference problems:

1. Disconnect the equipment from its power source to verify that it is or is not the source of the interference.
2. If the equipment is connected to the same outlet as the device experiencing interference, connect the equipment to a different outlet.
3. Move the equipment away from the device receiving the interference.
4. Reposition the receiving antenna for the device receiving the interference.
5. Try combinations of the above.

2.2 Product overview

⚠ DANGER

Chemical or biological hazards. If this instrument is used to monitor a treatment process and/or chemical feed system for which there are regulatory limits and monitoring requirements related to public health, public safety, food or beverage manufacture or processing, it is the responsibility of the user of this instrument to know and abide by any applicable regulation and to have sufficient and appropriate mechanisms in place for compliance with applicable regulations in the event of malfunction of the instrument.

NOTICE

Network and access point security is the responsibility of the customer that uses the wireless instrument. The manufacturer will not be liable for any damages, inclusive however not limited to indirect, special, consequential or incidental damages, that have been caused by a gap in, or breach of network security.

NOTICE

Perchlorate Material—Special handling may apply. Refer to www.dtsc.ca.gov/hazardouswaste/perchlorate. This perchlorate warning applies only to primary batteries (provided singly or installed on this equipment) when sold or distributed in California, USA.

NOTICE

The controller is supplied with a protection foil installed on the display. Make sure to remove the protection foil before the controller is used.

The SC4500 is a 2-channel controller for digital analytical devices (e.g., sensors and analyzers). Refer to Figure 1.

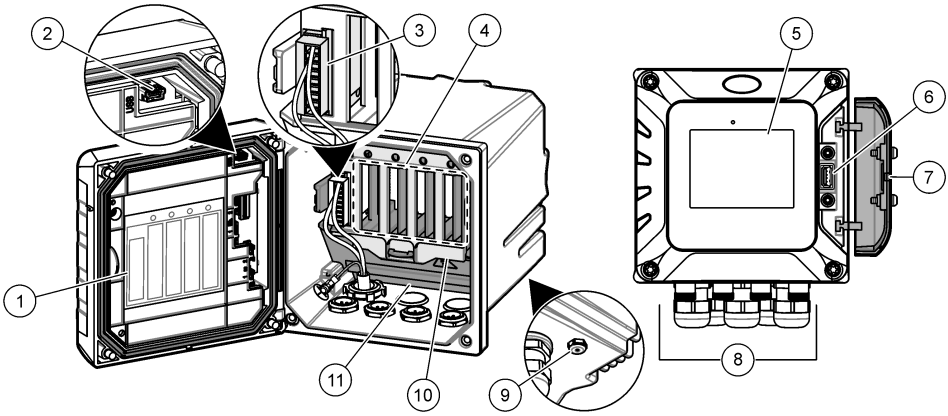
The controller shows sensor measurements and other data on the display, can transmit analog and digital signals, and can interact with and control other devices through outputs and relays. Outputs, relays, sensors and expansion modules are configured and calibrated through the user interface on the front of the controller or remotely for network connected controllers. The controller connects to Claros with a cellular network[5], WiFi network[5] or through LAN connection. The Prognosys diagnostic system[5] shows the status of maintenance tasks and gives the status of the instrument condition.

The instrument display is a touchscreen. The instrument enclosure has a protective vent in the bottom. Do not cover or remove the protective vent. Replace the protective vent if damage is seen.

Note: *Some controller configurations have two Ethernet ports for LAN connectivity or for Modbus TCP/IP based fieldbus communication with PLC/SCADA. Refer to* LAN connection *on page 27.*

The controller is available with optional expansion modules. Refer to Optional expansion modules on page 7.

Figure 1 Product overview



1 Label for module installation and wiring information	**7** USB cover
2 USB connection for external USB box (WiFi or cellular connection)	**8** Electrical connections and fittings
3 Expansion module (Slot 0)[5]	**9** Protective vent
4 Additional expansion module slots (Slots 1, 2, 3 and 4)	**10** Cover for module installation
5 Touchpad display	**11** High-voltage barrier
6 USB connection for data download and firmware update	

2.2.1 Optional expansion modules

The controller is available with optional expansion modules:

- Profibus DP interface module (Slot 0)—Used to connect the controller to a Profibus DP (decentralized peripherals) network. Profibus DP is used to operate sensors and actuators with a centralized controller in production (factory) automation applications.
- 4–20 mA output module (Slot 1)—Used for analog signaling or to control other external devices. ***Note:*** *Only one 4–20mA output module can be installed.*
- EtherNet/IP module (Slot 2)—The controller can connect to a PLC through Industrial Ethernet Protocol including a EtherNet/IP solution. Line, Star and Ring topologies are available.
- PROFINET module (Slot 2)—The controller can connect to a PLC through the Industrial Ethernet Protocol, which includes a PROFINET solution. Line, Star and Ring topologies are available.
- 4–20 mA input module (Slot 3 or 4)—Lets the controller accept one analog input (0–20 mA or 4–20 mA) from an external device.
- pH/ORP module (Slot 3 or 4)—Lets the controller accept measurements from one pH or ORP analog sensor.

Note: *An expansion module can be installed in only one of Slots 0 ,1 and 2 (4–20 mA output, Profibus DP interface, PROFINET or EtherNet/IP).*

Note: *Only two input devices[6] can be connected to the controller at the same time. If more than two input devices are connected, the controller will only see two of the devices. Refer to the module documentation for additional information.*

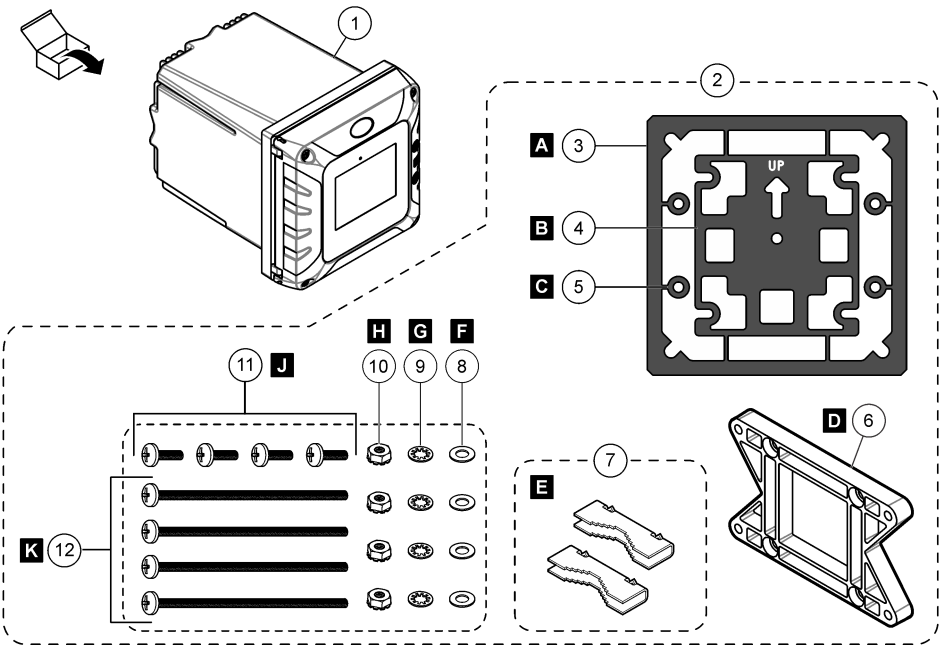
[5] Dependent on controller configuration. The expansion modules are factory-installed based on controller configuration.

[6] *Input devices are analog inputs from external devices, analog sensors and digital sensors.*

2.3 Product components

Make sure that all components have been received. Refer to Figure 2. If any items are missing or damaged, contact the manufacturer or a sales representative immediately.

Figure 2 Product components



1 SC4500 controller	**7** Mounting foot (mounting bracket inserts) (2x)
2 Mounting hardware	**8** Flat washer, ¼-inch ID (4x)
3 Sealing gasket for panel mount, Neoprene	**9** Lock washer, ¼-inch ID (4x)
4 Vibration isolation gasket for pipe mount	**10** Keps hexnut, M5 x 0.8 (4x)
5 Vibration isolation washer for pipe mount (4x)	**11** Pan head screws, M5 x 0.8 x 15 mm (4x)
6 Bracket for wall and pipe mounting [7]	**12** Pan head screws, M5 x 0.8 x 100 mm (4x)[8]

Section 3 Installation

⚠ DANGER

Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

[7] A bracket for panel mounting is available as an optional accessory. Refer to Replacement parts and accessories on page 49.

[8] Used for variable diameter pipe mount installations.

3.1 Installation guidelines

⚠ DANGER

Electrical shock hazard. Externally connected equipment must have an applicable country safety standard assessment.

⚠ WARNING

Explosion hazard. This manual is only for installation of the unit in a non-hazardous location. For installation of the unit in hazardous locations, use only the instructions and approved control drawing provided in the hazardous location installation manual.

NOTICE

Do not install the controller in an environment with a caustic atmosphere without a protective enclosure. A caustic atmosphere will cause damage to electronic circuitry and components.

NOTICE

Do not install the controller outdoors in an environment that receives direct sunlight or UV radiation or damage to the controller can occur. Install the optional UV protection screen with sunroof to prevent damage from UV exposure when installed outdoors in direct sunlight.

Note: *(Network and Claros version only) Make sure that your IT department has approval for the installation and commissioning of the device. Administrator rights are not necessary. The email address "No-reply@hach.com" sends the setup email and "donotreply@hach.com" sends the system notifications that are necessary for the installation. Add the two email addresses to the safe senders list to make sure to receive mails from these senders. Hach does not send a request to confirm that the sender is not a robot.*

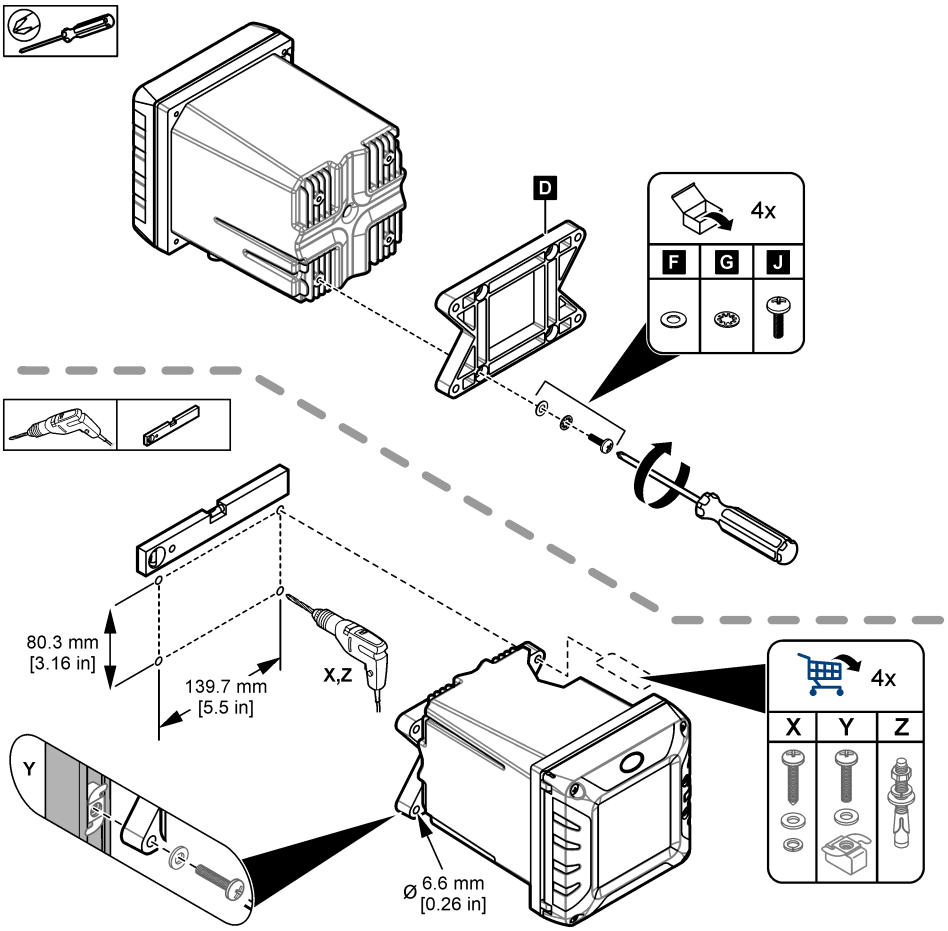
- Install the controller in a location where the power disconnect device for the controller is easily operated.
- Attach the controller upright and level on a flat, vertical surface.
- As an alternative, attach the instrument to a panel, vertical pole or horizontal pole.
- Make sure that the device is in a location where there is sufficient clearance around it to make connections and to do maintenance tasks.
- Make sure that there is a minimum of 16 cm (6.30 in.) of clearance for the controller door to open.
- Install the instrument in a location with minimum vibration.
- The optional holder for mobile phones is recommended for all installations.
- The optional sunroof or the optional UV protection screen with sunroof is recommended for all outdoor installations.
- Give protection to computers or other connected equipment that may not have equivalent environmental ratings based on the enclosure rating of the equipment.
- Obey specified ambient ratings on the internal side of panels for panel mount installations.
- Make sure that the maximum power rating is correct for the ambient temperature.

3.2 Mechanical installation

3.2.1 Attach the instrument to a wall

Attach the controller upright and level on a flat, vertical surface. Make sure that the wall mounting is able to hold 4 times the weight of the equipment. Refer to the illustrated steps in Figure 3 and Product components on page 8 for the necessary mounting hardware.

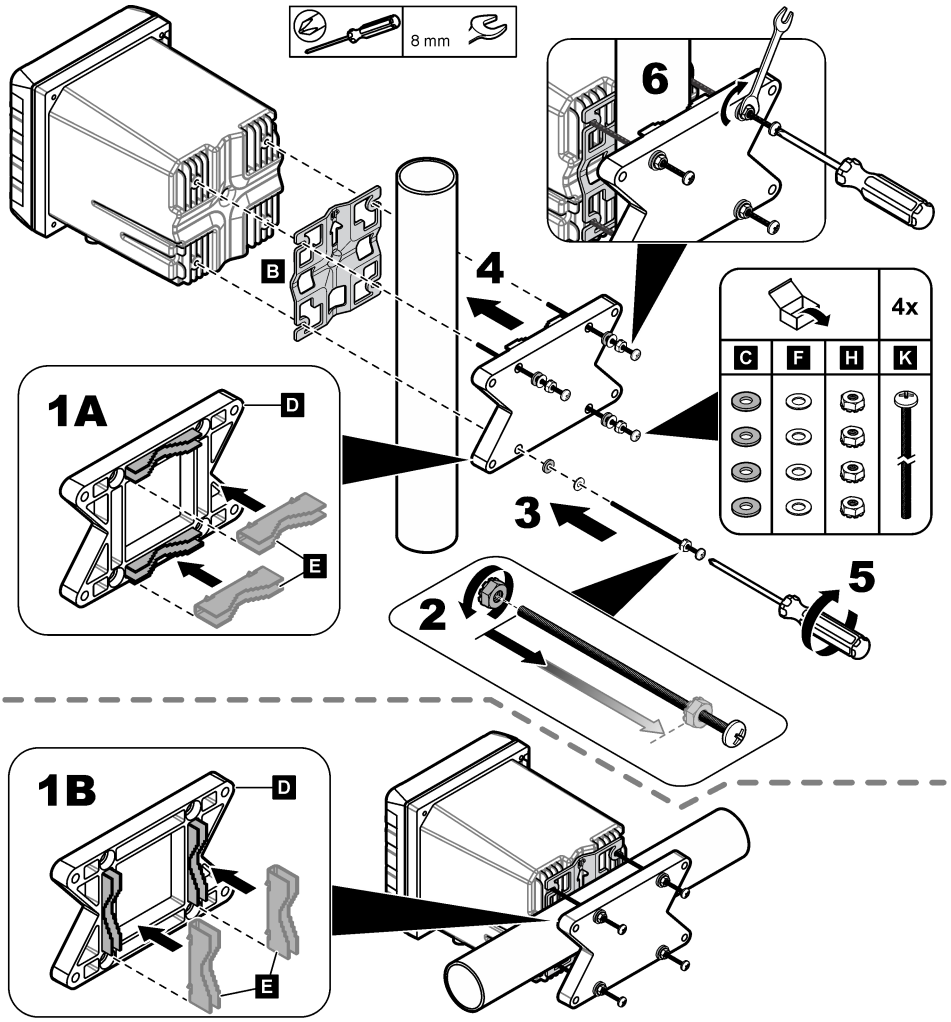
Figure 3 Wall mounting



3.2.2 Attach the instrument to a pole

Attach the controller upright to a pole or pipe (horizontal or vertical). Make sure that the pipe diameter is 19 to 65 mm (0.75 to 2.5 in.) Refer to the illustrated steps in Figure 4 and Product components on page 8 for the necessary mounting hardware.

Figure 4 Pole mounting

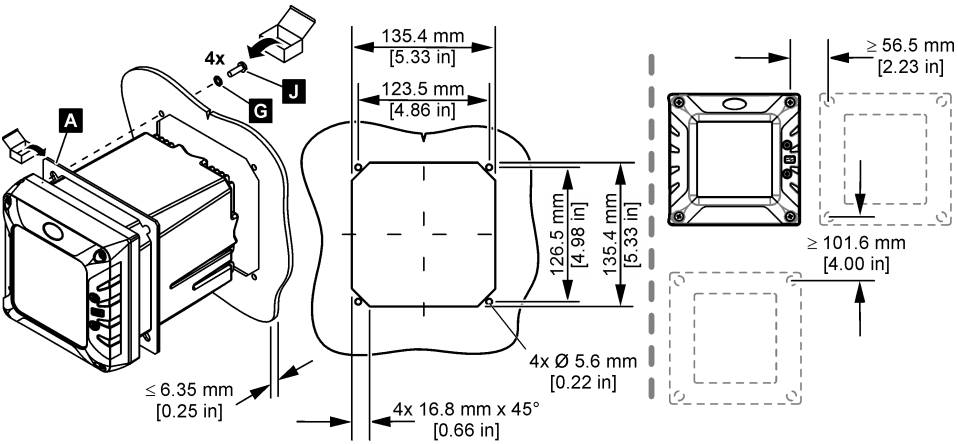


3.2.3 Install the instrument in a panel

A rectangular hole is necessary for panel installation. Use the supplied sealing gasket for panel mount as a template to cut the hole in the panel. Make sure to use the template in the up position to install the controller vertical. Refer to Figure 5.

Note: *If using the bracket (optional) for panel mounting, push the controller through the hole in the panel and then slide the bracket over the controller on the back side of the panel. Use the four 15 mm pan head screws (supplied) to attach the bracket to the controller and secure the controller to the panel.*

Figure 5 Panel mounting dimensions



3.3 Electrical installation

3.3.1 Electrical connectors and fittings

Figure 6 shows the electrical connectors and fittings on the instrument. To keep the environmental rating of the enclosure, make sure that there is a plug in the strain relief fittings that are not used and a connector cap on the unused connectors.

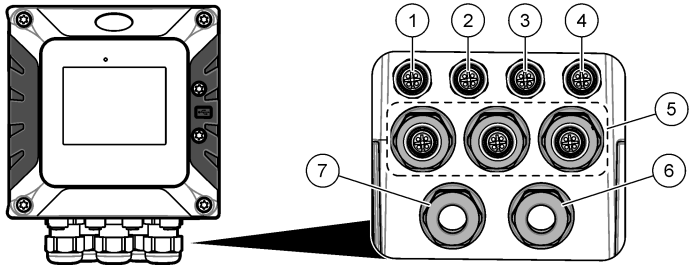
Based on the controller configuration, the controller has:

- Ethernet connectors (LAN) to give internet access to the controller through a customer network.
- Ethernet connectors for Industrial Ethernet Protocols: EtherNet/IP or PROFINET.
- Digital SC connectors for sc digital sensors, sc digital gateways and analyzers.

A color code identifies the connectors. The LAN connectors are green. The EtherNet/IP or PROFINET connectors are yellow. The sc digital sensor connectors are black. Refer to Table 1 for the applicable options for each connector and fitting.

Note: *The controller is supplied without strain relief fittings installed. The user must supply the necessary strain reliefs. Refer to* Replacement parts and accessories *on page 49.*

Figure 6 Electrical connectors and fittings



1 Ethernet connector (optional) for LAN port 1 or EtherNet/IP or PROFINET connector	**5** Strain relief fitting for USB box and expansion modules: Analog inputs/outputs, Profibus DP
2 Ethernet connector (optional) for LAN port 2 or EtherNet/IP or PROFINET connector	**6** Power cord (or conduit hub)[10]
3 Digital SC connector: Channel 1. Optional: Analog sensor connection to sensor module or analog input connection to 4-20 mA input module[9]	**7** Strain relief fitting for high voltage relay
4 Digital SC connector: Channel 2. Optional: Analog sensor connection to sensor module or analog input connection to 4-20 mA input module	

Table 1 Options for each connector and fitting

Device	1[11]	2	Option[12]	3	4	5	6	7
sc digital sensor, sc digital gateway or analyzer				X	X			
Analog sensor				X	X			
4-20 mA input				X	X			
4-40 mA output						X		
Profibus DP module						X		
USB Box						X		
LAN + LAN	●	●	Split / Chaining					
LAN + Modbus TCP	●	●	Split / Chaining					
EtherNet/IP	●	●	IEP only					
LAN + EtherNet/IP	●	●	Mix IEP					
PROFINET	●	●	IEP only					
LAN + PROFINET	●	●	Mix IEP					

9 To connect an analog sensor or 4-20 mA input to the controller, install the applicable expansion module, if not already installed. Refer to the documentation supplied with the expansion module for additional information.

10 The power cord is factory-installed based on the controller configuration.

11 A color code identifies the connectors. The LAN connectors are green. The EtherNet/IP or PROFINET connectors are yellow.

12 Refer to LAN connection on page 27 for Ethernet port configuration options.

Table 1 Options for each connector and fitting (continued)

Device	1[11]	2	Option[12]	3	4	5	6	7
High voltage relay								X
Power supply							X	

3.3.2 Electrostatic discharge (ESD) considerations

NOTICE

Potential Instrument Damage. Delicate internal electronic components can be damaged by static electricity, resulting in degraded performance or eventual failure.

Refer to the steps in this procedure to prevent ESD damage to the instrument:

- Touch an earth-grounded metal surface such as the chassis of an instrument, a metal conduit or pipe to discharge static electricity from the body.
- Avoid excessive movement. Transport static-sensitive components in anti-static containers or packages.
- Wear a wrist strap connected by a wire to earth ground.
- Work in a static-safe area with anti-static floor pads and work bench pads.

3.3.3 Power connections

⚠ DANGER

Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

⚠ DANGER

Electrocution hazard. Always remove power to the instrument before making electrical connections.

If the controller does not have an installed power cord, connect power with conduit or a power cord. Refer to the sections that follow to connect power with conduit or a power cord.

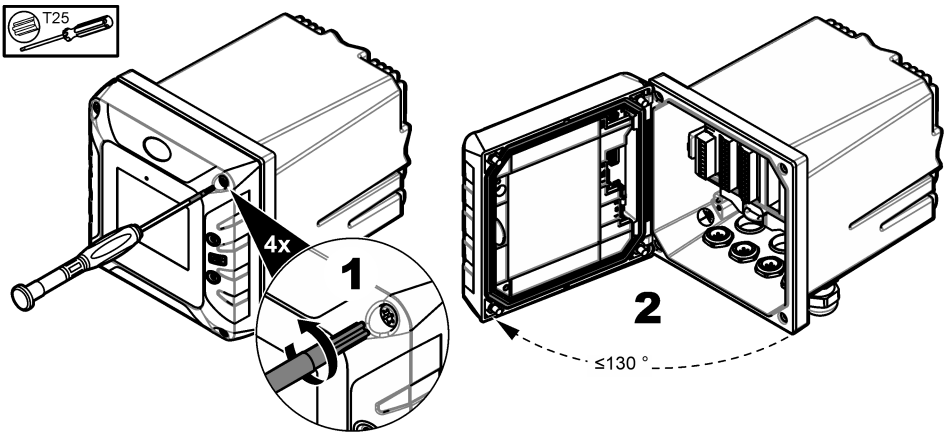
3.3.3.1 Open the controller cover

Open the controller cover to get access to the wiring connections. Refer to Figure 7.

[11] A color code identifies the connectors. The LAN connectors are green. The EtherNet/IP or PROFINET connectors are yellow.

[12] Refer to LAN connection on page 27 for Ethernet port configuration options.

Figure 7 Open the controller

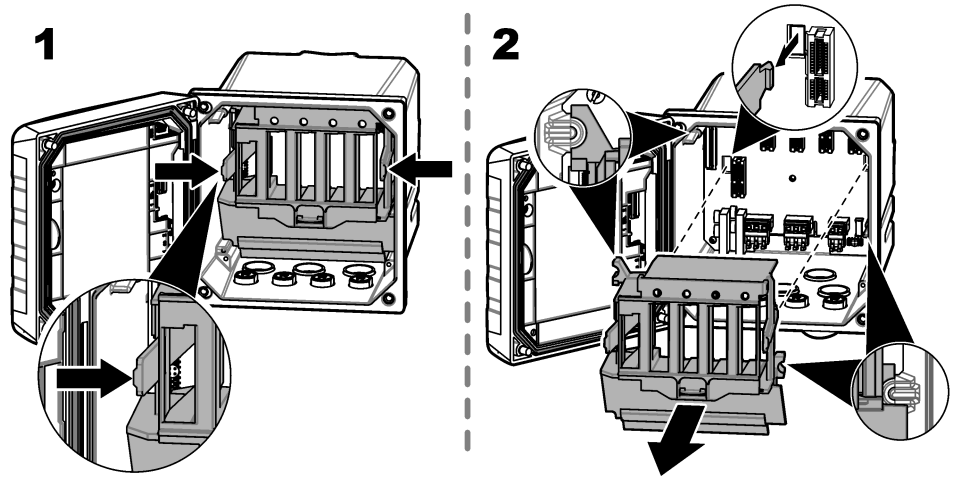


3.3.3.2 Remove the high-voltage barrier

High-voltage wiring for the controller is located behind a high-voltage barrier in the controller enclosure. Do not remove the barrier while power is supplied to the controller. Make sure that the barrier is installed before power is supplied to the controller.

Remove the high-voltage barrier to get access to the high-voltage wiring. Refer to Figure 8.

Figure 8 High-voltage barrier



3.3.3.3 Wiring for power

⚠ DANGER

Electrocution hazard. Protective Earth Ground (PE) connection is required.

⚠ DANGER

Electrical shock and fire hazards. Make sure to identify the local disconnect clearly for the conduit installation.

⚠ WARNING

Potential Electrocution Hazard. If this equipment is used outdoors or in potentially wet locations, a **Ground Fault Interrupt** device must be used for connecting the equipment to its mains power source.

⚠ WARNING

Electrocution hazard. The local disconnection means must disconnect all the electrical current-carrying conductors. Mains connection must keep supply polarity. The separable plug is the disconnect means for cord connected equipment.

⚠ WARNING

Electrical shock and fire hazards. Make sure that the user-supplied power cord and non-locking plug meet the applicable country code requirements.

⚠ WARNING

Explosion hazard. This manual is only for installation of the unit in a non-hazardous location. For installation of the unit in hazardous locations, use only the instructions and approved control drawing provided in the hazardous location installation manual.

NOTICE

Install the device in a location and position that gives easy access to the disconnect device and its operation.

The controller can be purchased as either a 100-240 VAC powered model or a 18-28 VDC powered model. Follow the appropriate wiring instructions for the purchased model.

Supply power to the instrument with conduit or a power cable. Make sure that a circuit breaker with sufficient current capacity is installed in the power line. The circuit breaker size is based on the wire gauge used for installation.

For installation with conduit:

- Install a local disconnect for the instrument within 3 m (10 ft) of the instrument. Put a label on the disconnect that identifies it as the main disconnect device for the instrument.
- Rated for at least 90 °C (194 °F) and applicable to the installation environment
- For permanent connections use only solid wires. Use cable dimensions between 0.75 to 1.5 mm^2 (18 to 16 AWG). Flexible wires must have a crimped ferrule or pin type terminal on the end.
- Connect equipment in accordance with local, state or national electrical codes.
- Connect the conduit through a conduit hub that holds the conduit securely and seals the enclosure when tightened.
- If metal conduit is used, make sure that the conduit hub is tightened so that the conduit hub connects the metal conduit to safety ground.
- The DC power source that supplies power to the DC controller must maintain voltage regulation within the specified 18-28 VDC voltage limits. The DC power source must also provide adequate protection against surges and line transients.

For installation with a power cable, make sure that the power cable is:

- Less than 3 m (10 ft) in length
- Rated sufficient for the supply voltage and current.
- Rated for at least 90 °C (194 °F) and applicable to the installation environment

- Not less than 0.75 mm^2 (18 AWG) with applicable insulation colors for local code requirements. Flexible wires must have a crimped ferrule or pin type terminal on the end.
- A power cable with a three-prong plug (with ground connection) that is applicable to the supply connection
- Connected through a cable gland (strain relief) that holds the power cable securely and seals the enclosure when tightened
- Does not have a locking type device on the plug

3.3.3.4 Connect conduit or a power cord

NOTICE

The manufacturer recommends the use of manufacturer-supplied electrical components, such as power cord, connectors and strain relief fittings.

NOTICE

Make sure that the cable sheath goes through the inner side of the enclosure to keep the environmental rating of the enclosure.

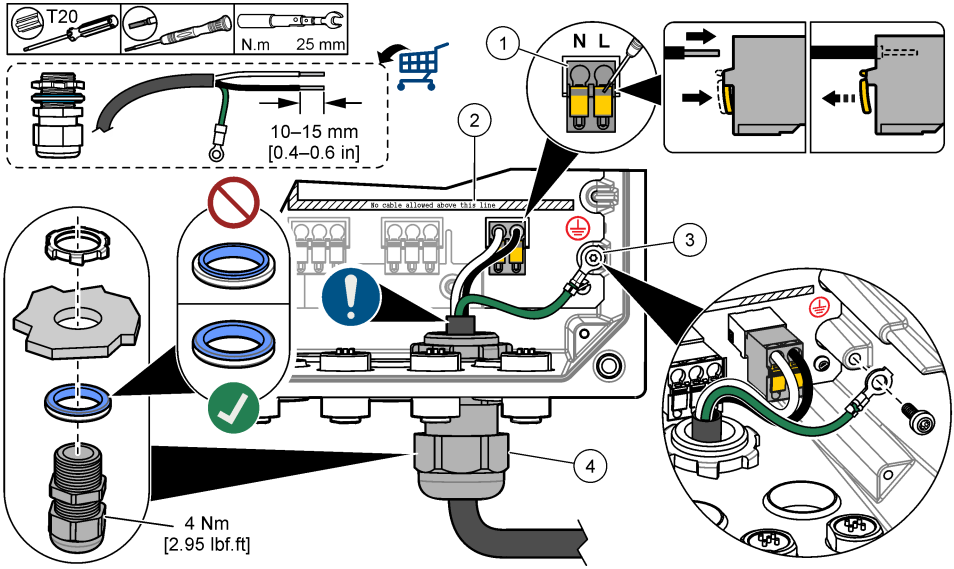
The controller can be wired for line power by hard-wiring in conduit or wiring to a power cord. Regardless of the wire used, the connections are made at the same terminals.

The power cable plug is used to connect and disconnect power to the controller. For installation in conduit, the installed local disconnect is used to connect and disconnect power to the controller.

Refer to Figure 9 and Table 2 or Table 3 to connect conduit or a power cord. Insert each wire into the appropriate terminal until the insulation is seated against the connector with no bare wire exposed. Tug gently after insertion to make sure that there is a secure connection. If necessary, remove the connector from the PCBA for easier wiring of the terminals.

Note: *Make sure that all of the cables stay below the cable limit line printed on the PCBA to prevent interferences with the high-voltage barrier. Refer to Figure 9.*

Figure 9 Connect conduit or a power cord



1 AC and DC power terminal	**3** Protective earth ground
2 Cables limit: do not put cables above the line.	**4** Conduit hub (or strain relief fitting for power cord)

Table 2 Wiring information—AC power

Terminal	Description	Color—North America	Color—EU
L	Hot (Line 1)	Black	Brown
N	Neutral (N)	White	Blue
⏚	Protective earth ground	Green	Green with yellow stripe

Table 3 Wiring information—DC power

Terminal	Description	Color—North America	Color—EU
L	+24 VDC	Red	Red
N	24 VDC return	Black	Black
⏚	Protective earth ground	Green	Green with yellow stripe

3.3.4 Connect the high-voltage relays

⚠ DANGER

Electrocution hazard. Always remove power to the instrument before making electrical connections.

⚠ WARNING

Potential Electrocution Hazard. Power and relay terminals are designed for only single wire termination. Do not use more than one wire in each terminal.

⚠ WARNING

Potential fire hazard. Do not daisy-chain the common relay connections or jumper wire from the mains power connection inside the instrument.

⚠ WARNING

Explosion hazard. This manual is only for installation of the unit in a non-hazardous location. For installation of the unit in hazardous locations, use only the instructions and approved control drawing provided in the hazardous location installation manual.

⚠ CAUTION

Fire hazard. Relay loads must be resistive. Always limit current to the relays with an external fuse or breaker. Obey the relay ratings in the Specifications section.

NOTICE

Make sure that the cable sheath goes through the inner side of the enclosure to keep the environmental rating of the enclosure.

The instrument has two non-powered relays, each with a single-pole change-over contact. For AC controllers, the wiring compartment is not made for voltage connections more than 264 VAC.

The relay terminals are located behind a high-voltage barrier in the controller enclosure. Do not remove the barrier while power is supplied to the relay terminals. Do not supply power to the relay terminals when the barrier is not installed.

Connect each relay to a control device or an alarm device as necessary. Refer to Figure 10 and Table 4 to connect the relays. Refer to Configure the high voltage relays on page 33 to configure the trigger condition for each relay.

Refer to Specifications on page 3 for the relay specifications. The relays are isolated from each other and the low-voltage input/output circuitry.

The largest gauge wire the power and relay plugs are rated for 1.5 mm^2 (16 AWG). The relay terminals accept 0.75 to 1.5 mm^2 (18 to 16 AWG) wire (as determined by load application). Use wire with an insulation rating of 300 VAC or higher. Insert each wire into the appropriate terminal until the insulation is seated against the connector with no bare wire exposed. Tug gently after insertion to make sure that there is a secure connection. If necessary, remove the connector from the PCBA for easier wiring of the terminals. Flexible wires must have a crimped ferrule or a pin type terminal on the end.

Note: *Make sure that all of the cables stay below the cable limit line printed on the PCBA to prevent interferences with the high-voltage barrier.*

The current to the relay contacts must be 5 A (resistive only load), 1250 VA 125 W (resistive only load) or less. Make sure to have a second switch available to remove power from the relays locally in case of an emergency or for maintenance.

For AC controllers, use the relays at high voltage. For DC controllers, use the relays at low voltage. Refer to Specifications on page 3 for the relay specifications. Do not configure a combination of both high and low voltage.

Relay terminal connections to the mains circuit in permanent connection applications must have insulation rated for a minimum of 300 V, 90 °C (194 °F). Terminals connected to the mains circuit with a power cord connection must be double insulated and rated 300 V, 90 °C (194 °F) at both the inner and outer insulation levels.

Figure 10 Connect the relays

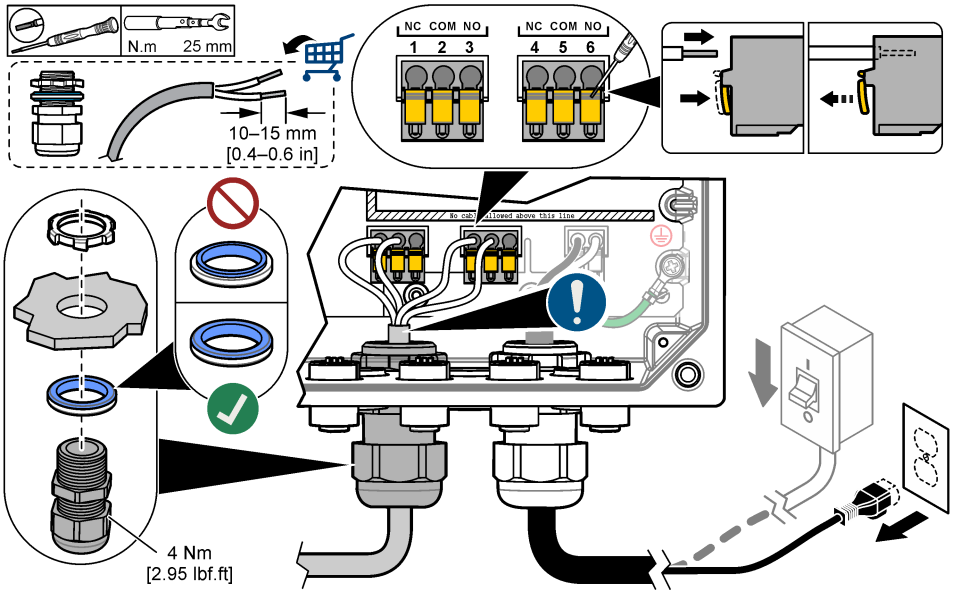


Table 4 Wiring information—relays

Terminal	Description	Terminal	Description
1	Relay 2, NC	4	Relay 1, NC
2	Relay 2, common	5	Relay 1, common

Table 4 Wiring information—relays (continued)

Terminal	Description	Terminal	Description
3	Relay 2, NO	6	Relay 1, NO
NC = normally closed; NO = normally open			

3.3.5 Install an expansion module

⚠ WARNING

Explosion hazard. This manual is only for installation of the unit in a non-hazardous location. For installation of the unit in hazardous locations, use only the instructions and approved control drawing provided in the hazardous location installation manual.

Expansion modules for analog outputs, analog inputs, analog sensors and Profibus communication are available for the controller. Refer to the documentation supplied with the expansion module for additional information.

3.4 Close the cover

⚠ DANGER

Electrocution hazard. High voltage wiring for the controller is connected behind the high voltage barrier in the controller enclosure. The barrier must remain in place except when installing modules, or when a qualified installation technician is wiring for power, relays or analog and network cards.

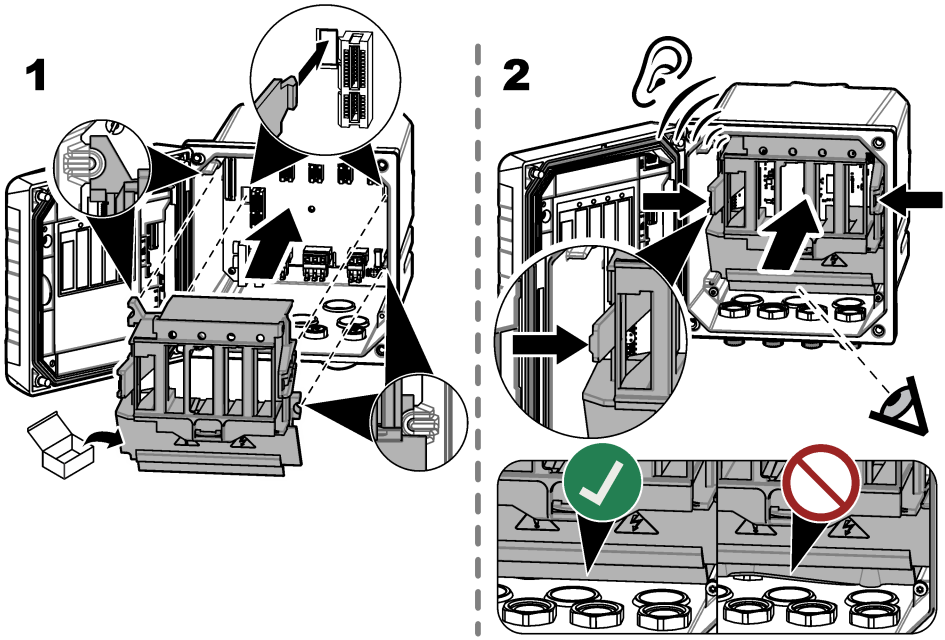
NOTICE

Close the controller cover and make sure that the cover screws are tight to keep the environmental rating of the enclosure.

After the power connections are made, install the high-voltage barrier. Make sure that the high-voltage barrier is correctly put on the enclosure guides and fixed to the main PCBA. Make sure that the lower part of the high-voltage barrier (soft rubber lip) is correctly installed and has no deformation. Refer to Figure 11.

Close the controller cover. Tighten the cover screws with 2 Nm (17.70 lbf-in) torque. Refer to Figure 7 on page 15.

Figure 11 Install the high voltage barrier

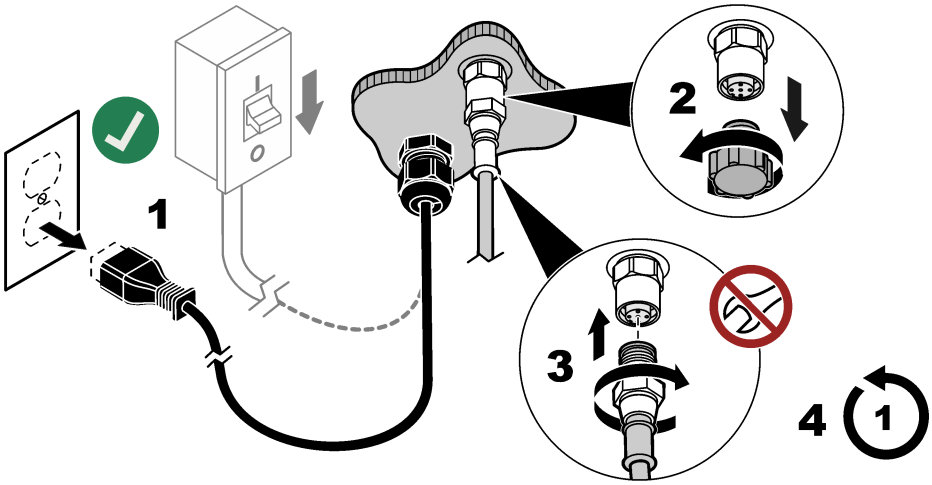


3.5 Connect measurement devices

Connect digital devices (e.g., sensors and analyzers) to the device connectors on the instrument. Refer to Figure 12. Keep the device connector caps for future use.

Make sure that the device cables do not cause a trip hazard and do not have sharp bends.

Figure 12 Connect a device



Section 4 User interface and navigation

NOTICE

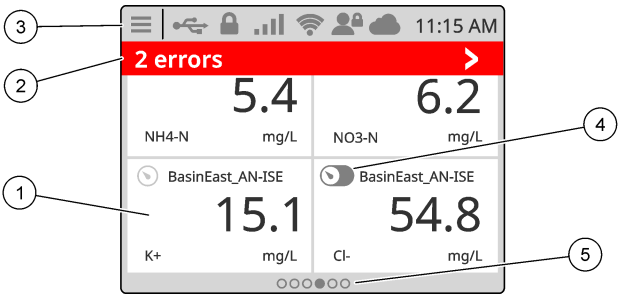
Do not use writing tips of pens or pencils or other sharp objects to make selections on the screen or damage to the screen will occur.

Figure 13 shows an overview of the home screen. Refer to Table 5 for the descriptions of the icons in the display.

The instrument display is a touchscreen. Only use a clean, dry finger tip to navigate the functions of the touchscreen. To prevent unwanted touchs, the screen is automatically lock after a period of inactivity. Touch the screen and swipe up to set the screen back to operation again.

Note: *Go to the General configuration menu to disable the Screen lock setting or to set the Waiting time for the inactivity period.*

Figure 13 Main screen



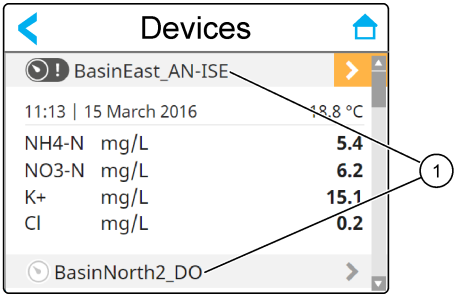
1 Measurement window: shows a device data, push on the tile to show the device detail window.	**4** Prognosys icon (optional)
2 Diagnostic bar: shows system messages and alarm conditions, push on the bar to see the system errors and warnings. Shows pending tasks and information about the system	**5** Carousel icon: swipe on the screen to left or right to show other screen views.
3 Status bar	

Table 5 Icon descriptions

Icon	Description	Icon	Description
	Push to show the Main menu.		3G/4G signal strength. Shows when a USB box with a cellular modem is connected to the controller.
	Claros connection		USB connection. Shows when a USB flash drive is connected to the controller. Blinks when there is data transmission.
	WiFi connection. Shows when a USB box with a WiFi adapter is connected to the controller.		Remote user. Shows when a remote user is connected to the controller.
	Screen lock. Shows when the screen is locked.[13] Swipe up to unlock the screen.		Push to enter a submenu or go back to the previous menu.
	When in a sub menu, push to go to the main screen.		

[13] The Screen lock option is enabled by default.

Figure 14 Devices screen



1	Device name: Push to show the device detail window.

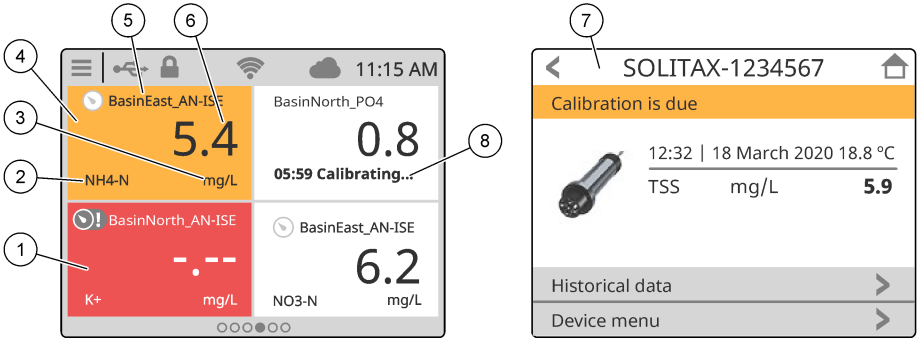
4.1 Measurement window

The main screen shows the measurement window. The carousel icon shows at the bottom of the main screen when there are other screen views available. Each screen view has one, two or four measurement windows, based on the connected sensors and the parameters of each sensor. If an RTC module is installed on the controller and the license key is activated, the last screen of the carousel shows four measurement windows (maximum) for the RTC module.

The controller automatically fills the measurement windows to show all of the information for the connected devices. The measurement window shows the data that follows:

- Name, value, parameter and unit of the measurement device and RTC module output, if installed
  Note: *Measurement devices are the connected digital sensors, analog sensors connected with analog modules or digital gateways, and external devices that supply 4-20 mA inputs.*
- Sensor errors and warnings. If the measurement window background color is amber, there is a warning for the sensor. If the measurement window background color is red, there is an error for the sensor.
- RTC module warnings. If the measurement window background color of the RTC module screen (last screen of the carousel) is amber, there is a warning for the RTC module.
- Prognosys (if available). The Prognosys icon shows when there is no issue or maintenance planned, or if maintenance is due or scheduled. Go to the device detail window to see more Prognosys information.
- The task in operation (maintenance or calibration task)

Figure 15 Measurement window and device detail screen



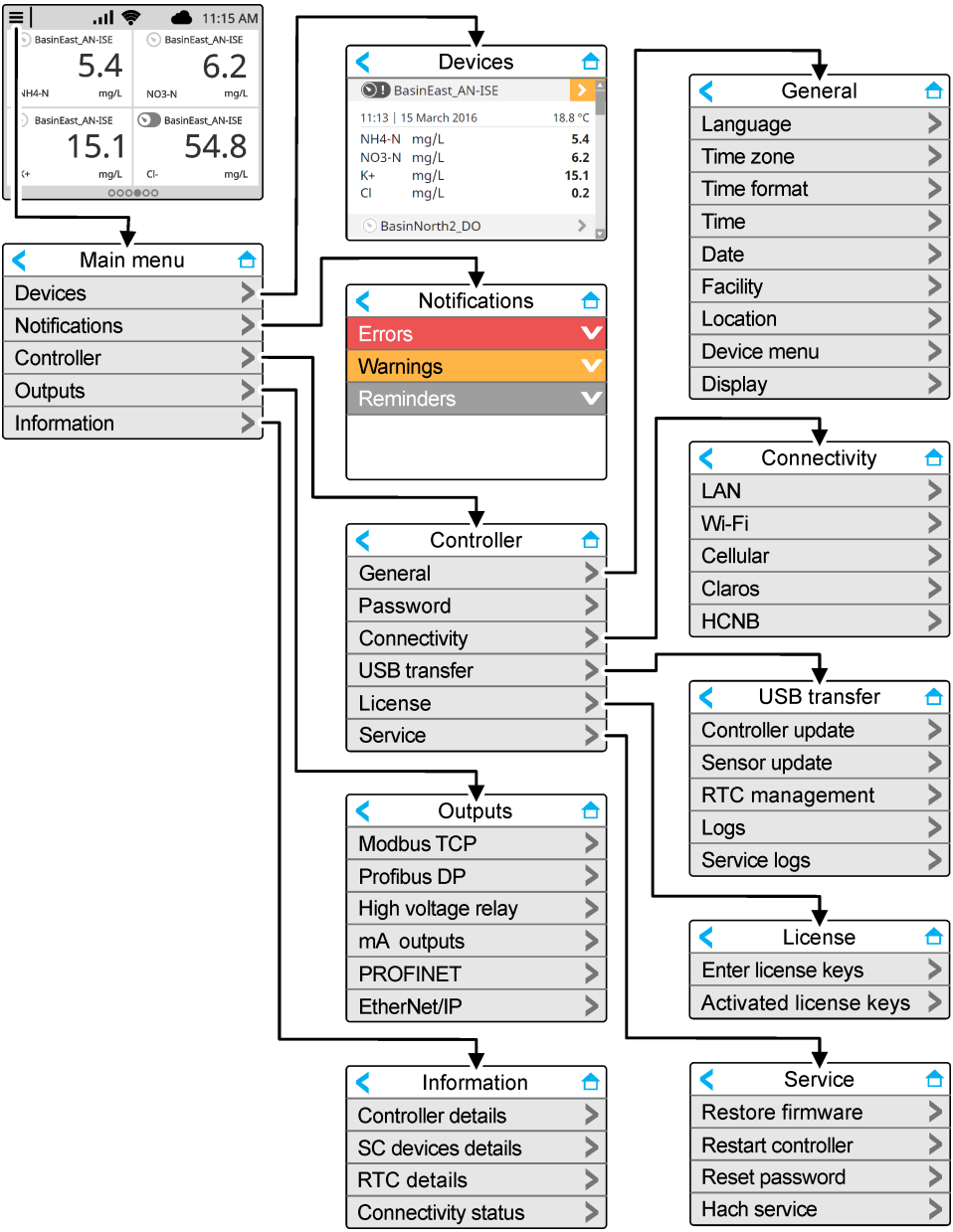
1	Device error	**5**	Device name
2	Device parameter	**6**	Measured value
3	Units	**7**	Device detail screen
4	Device warning	**8**	Task

Section 5 Startup

Connect the power cord to an electrical outlet with protective earth ground or set the circuit breaker for the controller to on.

5.1 Menu structure

The menu options available depend on the controller accessories that are installed.



5.2 Enter initial settings

At initial startup, follow the prompts on the display to set up the language, the date, the time and network information. Refer to Configure the controller settings on page 26 to change the settings.

Section 6 Operation

6.1 Configure the controller settings

Set the controller language, time, date, facility, location and display options.

1. Push the main menu icon, then select Controller > General.
2. Select and configure each option.

Option	Description
Language	Sets the language that shows on the controller display and in the log files.
Time zone	Sets the time zone. Select the Region and City for the time zone. ***Note:*** *The Time zone option is not available when the controller is connected to Claros.*
Time format	Sets the time format: 12 h (default) or 24 h.
Time	Sets the time. ***Note:*** *The Time option is not available when the controller is connected to Claros.*
Date	Sets the date. ***Note:*** *The Date option is not available when the controller is connected to Claros.*
Facility	Sets the name of the facility (32 characters maximum). Default: not selected
Location	Sets the name of the location (32 characters maximum). Default: controller serial number
Device menu	Shows the controller name and serial number . Change the Name setting as necessary.
Display	Sets the display options: • Screen lock—When set to on (default), the screen automatically locks after the inactivity period. When the screen is locked, the touchscreen is disabled and there are no active areas in the display. Touch the screen and swipe up to set the screen back to on. ***Note:*** *The manufacturer strongly recommends not to disable the Screen lock setting. The Screen lock setting prevents unwanted touches on the screen (especially in outdoor installations).* • Waiting time—Sets the inactivity period, after which the controller locks the screen. Options: 1, 3, 5, 10 or 15 minutes

6.2 Configure menu access

Set the password protection to on to prevent unwanted changes to specific controller settings and some of the device menus (e.g., sensor and RTC menus).

When password protection is set to on, a prompt to enter the password shows when a menu is protected. After the password is entered, access to the protected menus is available for 30 minutes.

1. To set password protection to on, do the steps that follow:
   a. Push the main menu icon, then select Controller > Password.
   b. Select Password protection, then select ON.
      The default password is "SC4500". There is only one password for each controller.
2. To change the password, do the steps that follow:
   a. Push the main menu icon, then select Controller > Password.
   b. Select Change password, then enter the old password.
   c. Enter the new password. The password must be 4 to 8 characters. The password is case sensitive and can include alphanumeric and special characters.
3. If the password is forgotten, set the password back to the default as follows:
   a. Push the main menu icon, then select Controller > Service.

b. Select Reset password. The password is set to "SC4500".

4. To set password protection to off, do the steps that follow:

   a. Push the main menu icon, then select Controller > Password.
   b. Select Password protection, then enter the password.
   c. Select OFF.

   The password is saved.

6.3 Connect the instrument to a network

Based on instrument configuration, the instrument can connect to a network with internet connectivity for configuration and operation. Based on the version, the controller connects to the internet with a cellular network, WiFi network or a LAN connection.

6.3.1 LAN connection

The controller is supplied with two Ethernet connectors based on the controller configuration. Regardless of the supplied controller, the user must configure the Ethernet ports to the applicable option.

Note: *An Ethernet port upgrade may be necessary based on the controller configuration. Refer to the documentation supplied with the upgrade kit.*

1. Use a user-supplied Ethernet cable (M12 to RJ45)[14] to connect the controller to a device with internet connection. Refer to Electrical connectors and fittings on page 12.
2. Push the main menu icon, then select Controller > Connectivity > LAN > Ethernet ports.
3. Enter the settings.

Option	Description
None 	The controller does not have Ethernet ports or the Ethernet ports are not configured. The controller is supplied with the option None by default. ***Note:*** *When the controller configuration is set back to the factory settings, all of the LAN connection settings are lost and the Ethernet ports are set back to None.*
Chaining 	The two Ethernet ports are configured for LAN connectivity. When selected, the LAN port configuration setting shows on the LAN menu. The two Ethernet ports have the same port configuration. Select this option to share the internet connection with other controllers (daisy chain topology) or to connect the controller to Claros and HCNB through the Ethernet cable.
Split 	One Ethernet port is configured for LAN connectivity and the other Ethernet port is configured for a separate LAN or Modbus TCP. When selected, the Lan port 1 configuration and Lan port 2 configuration settings show on the LAN menu. The two Ethernet ports have different port configurations. Select the Split option to have different controller connections to Claros and fieldbus (Modbus TCP or HCNB).
Mix IEP 	One Ethernet port is configured for LAN connectivity and the other Ethernet port is configured for IEP[15]. When selected, the LAN port configuration setting shows on the LAN menu. Select this option to use port 1 for LAN connectivity and port 2 for IEP (compatible with EtherNet/IP or PROFINET star topology).
IEP only 	The two Ethernet ports are configured for IEP. The two ports are used for EtherNet/IP or PROFINET with chain, ring or star topology.

4. Push SAVE.
5. When applicable, select LAN port configuration. Enter the settings as follows:

   a. If the customer network supports Dynamic Host Configuration Protocol (DHCP), set the option to on (default) to get an IP address automatically. The display shows the MAC address of the selected port.

[14] Refer to Replacement parts and accessories on page 49.
[15] Based on the controller configuration. Make sure that a PROFINET or EtherNet/IP module is installed in the controller.

b. If the customer network does not support DHCP, set the option to off and complete the settings with IP addresses supplied by the network administrator. Enter the correct settings based on the network topology: IP address, Netmask, Default gateway and DNS address.

c. When Chaining is selected, the LAN server option shows on the LAN port configuration menu. Set the LAN server to on to share the internet connection with other controllers through LAN connectivity.

6. Select APPLY.

6.3.2 WiFi network connection

An external USB box WiFi with a WiFi adapter is necessary to connect the controller to a WiFi network. Refer to the documentation supplied with the USB box WiFi for more information about the WiFi installation. Follow all WiFi module manufacturer recommendations and guidance.

If the controller connects to the internet with a WiFi network, do the steps that follow:

1. Push the main menu icon, then select Controller > Connectivity > Wi-Fi.

2. Set the Wi-Fi connectivity button to on. A list of available access points shows.

3. Select Network to set the applicable WiFi access point. If necessary, enter the correct credentials. The WiFi connectivity currently accepts the authentication methods that follows: User name and Wi-Fi password.

a. WEP: Not recommended. The WEP authentication method has low security.

b. WPA2 Personal / PSK: Standard authentication. Enter the Wi-Fi password to access the network.

c. WPA2 Enterprise: Authentication for enterprise networks. Enter the enterprise credentials, User name andWi-Fi password, to access the network.

4. Select APPLY.

6.3.3 Cellular network connection

Note: *Only for Claros connection.*

The external USB box cellular is necessary to connect the controller to a mobile network. Refer to the documentation supplied with the USB box cellular for installation instructions.

6.3.3.1 Configuration with Hach Cellular (Telenor) SIM

If the controller connects to the internet with the factory installed SIM card and the default Hach data plan (Telenor), do the steps that follow:

1. Push the main menu icon, then select Controller > Connectivity > Cellular.

2. Set the Cellular connectivity button to on.

3. Select APPLY.

Note: *Make sure that the SIM card is not locked. If necessary, use the SIM PIN setting to enter the SIM card PIN.*

4. After a maximum of 5 minutes, examine the signal strength that shows on the display. The cloud icon shows a correct connection.

6.3.3.2 Configuration with customer supplied SIM

To change the SIM card and connect the controller to the internet with a cellular network through a customer supplied data plan, do the steps that follow:

1. Install a user-supplied Micro SIM card. Refer to the documentation supplied with the USB box cellular for more information about the cellular network installation.

Note: *Follow all the cellular manufacturer recommendations and guidance.*

2. Push the main menu icon, then select Controller > Connectivity > Cellular.

3. Make sure that the Cellular connectivity button is set to on.

4. Enter the settings.

Option	Description
Provider	Sets the Provider name (Access Point Name). Select Telenor (NA/Verizon network) for the default settings or Other to set a provider.
APN	Shows the provider name. When Other is selected on the Provider setting, enters the name of the provider.
SIM PIN	SIM card PIN
User name	User name
Password	User password
Internet sharing	Set to on to share the internet connection with other controllers

5. Select APPLY and wait until a confirmation message shows on the display.
6. After a maximum of 5 minutes, examine the signal strength that shows on the display. The cloud icon shows a correct connection.

6.4 Configure the sensors or analog inputs

The controller is supplied with two digital SC connectors based on the controller configuration. Refer to Figure 6 on page 13. Use the digital SC connectors to connect digital sensors to the controller.

To connect an analog sensor or analog input to the controller, remove one of the digital SC connectors and install the applicable expansion module. Refer to the documentation supplied with the expansion module.

Note: *To upgrade a one-channel controller to a two-channel controller, install a new digital SC connector or an analog module. Refer to the documentation supplied with the connector upgrade kit or the analog upgrade kit.*

The connected devices show on the main screen and in the Devices menu. When the controller connects to a network or Claros, the devices of the network also show. Configure the connected devices as follows:

1. On the main screen, select one measurement window to go to the device detail screen. As an alternative, push the main menu icon, then select Devices. A list of all of the available devices shows.
2. Select one device and select Device menu.
3. If the device is a sensor or instrument, refer to the documentation supplied with the device to configure the device.
4. If the device is a 4-20 mA input module, select mA input and configure the settings that follow:

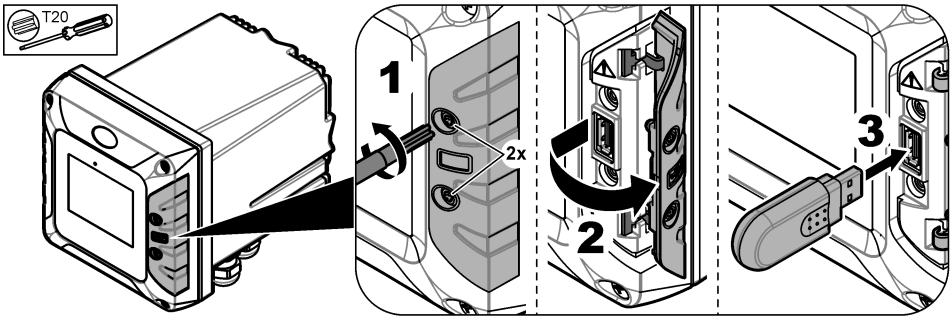
Option	Description
Calibration	Sets the calibration options for the 4-20 mA input module. • 1-point value correction • 2-point value correction • Calibration options • Reset to default calibration

Option	Description
Settings	• Name—Sets the name that identifies the mA input card. • Edit parameter—Selects the parameter type and unit. • Display range—Sets the value that shows on the display for the 0-20 mA or 4-20 mA. • Signal average—Sets a time in seconds that the controller records the measured input currents. The input current value is the average value of the recorded input currents during the configured time. • Display resolution—Sets the resolution of the values shown. Options: XXXX, XXX.X, XX.XX or X.XXX. • Select scale—Sets the input current range. Options: 0-20 mA or 4-20 mA. • Data log interval—Sets the data log interval. Options: 5 seconds, 30 seconds, 1 minute, 2 minutes, 5 minutes, 10 minutes, 15 minutes, 30 minutes or 60 minutes. • Reset—Sets the configuration back to the factory settings.
Maintenance	Shows maintenance tasks for the connected device.

6.5 Connect a USB flash drive (optional)

If necessary for data download or firmware update, connect a USB flash drive to the front panel in the controller. Make sure that the USB flash drive is formatted with FAT32 and has a minimum of 350 Mb capacity. Refer to Figure 16. After the USB flash drive is removed, close the slot cover and tighten the cover screws. Tighten the cover screws with a maximum torque of 1.4 Nm (12.4 in./lb).

Figure 16 USB flash drive connection



6.5.1 Data download

The controller records in an internal memory the data that follows:

- Approximately 20,000 data points, diagnostics data and an event log of all of the connected sensors and expansion modules
- Diagnostic data

Use a USB flash drive to download data from the controller. As an alternative, use the Claros user interface to download the data from the controller[16].

1. Connect a USB flash drive to the controller. Refer to Connect a USB flash drive (optional) on page 30.
2. Make sure that the USB icon shows on the main screen.

   Note: *If the controller does not find a connected USB flash drive or the icon shows grey, refer to* Troubleshooting *on page 46*.
3. Push the main menu icon, then select Controller > USB transfer.

[16] Based on the controller model. Service logs are not available from Claros user interface.

4. Select an option.

Option	Description
Logs	Downloads the data and event logs (.csv files) for all of the connected devices. If an RTC module is installed on the controller and the license key is activated, a .csv file that includes the settings export for RTC is downloaded to the USB flash drive.
Service logs	Downloads diagnostic data.

5. If Logs is selected, the controller downloads the data for all of the devices to the "HACH_Logs" folder on the USB flash drive.
6. When the download is complete, remove the USB flash drive.

   Note: *The USB icon in the front panel flashes to show data transmission. Wait until the icon stays on to remove the USB flash drive.*
7. Close the USB cover.
8. Open the csv file in Excel as follows:

   a. Connect the USB flash drive to a PC.
   b. Open a new, blank workbook in Excel.
   c. Select the **Data** at the top of the window.
   d. Select **From Text/CSV**. A window opens.
   e. Select the csv file that is in the "HACH_Logs" folder on the USB flash drive, then select **Import**. Another window opens.
   f. In the File Origin box, select **65001: Unicode (UTF-8)**.
   g. In the Delimiter box, select **Semicolon**, then select **Load**.

6.5.2 Install controller firmware updates

Make sure that the controller has the latest firmware. Use a USB flash drive to update the controller firmware. As an alternative, use the Claros user interface to update the controller firmware[17].
Note: *When a controller firmware update is done, the firmware for the controller, MODBUS TCP and PROGNOSYS are updated, if installed. In addition, the firmware for the 4-20 mA output module, PROFINET module and EtherNet/IP module are updated, if installed.*

1. Visit www.hach.com and download the .zip file for the latest software version.

   Note: *To identify the software version installed, push the main menu icon, then select Information > Controller details.*
2. Unpack the .zip file.
3. Copy the .swu file to the root folder of a USB flash drive.
4. Connect the USB flash drive to the controller. Refer to Connect a USB flash drive (optional) on page 30.
5. Make sure that the USB icon shows on the main screen.

   Note: *If the controller does not find a connected USB flash drive or the USB icon is grey, refer to* Troubleshooting *on page 46.*
6. Push the main menu icon, then select Controller > USB transfer > Controller update.
7. Follow the instructions on the screen to install the firmware update.
8. When the update is complete, a message shows on the display. Remove the USB flash drive.

   Note: *If there is an error during the firmware update, a message shows on the display. Refer to* Troubleshooting *on page 46.*
9. Close the USB cover.

[17] Based on the controller model

6.5.3 Install sensor firmware updates

Make sure that the connected sensors have the latest firmware. Use a USB flash drive to update the sensor firmware. As an alternative, use the Claros user interface to update the sensor firmware[18].
Note: *When a sensor firmware update is done, the firmware for the digital sensors, 4-20 mA input module, analog sensor module, sc digital gateway and Profibus DP interface are updated, if installed.*

Note: *There is no firmware installed on the analog sensors. The analog sensor firmware is installed on the analog sensor modules and sc digital gateways.*

1. Visit www.hach.com and download the latest software version for the connected SC sensors.

   Note: *To identify the software version installed, push the main menu icon, then select Information > SC Devices details.*
2. Copy the file to the root folder of the USB flash drive.

   Make sure that the files are in the correct folder. Installation files must be in:

   D [USB drive unit]:\HACH\Firmware\[sensor name with MID and IID]\installation file name with code [MID/IID], package number [P] identification file [AC/BC/DD] and version number.

   For example:

   - D:\HACH\Firmware\LDO2_0_42\LDO2_0_42_P03_AC_V1_24_A.bin

   Where,

   - MID—Manufacturer ID
   - IID—Instrument ID.
   - AC—Application code file.
   - BC—Boot code file.
   - DD—Device driver file.

   One or more installation files can be in the installation folder.
3. Connect the USB flash drive to the controller. Refer to Connect a USB flash drive (optional) on page 30.
4. Make sure that the USB icon shows on the main screen.

   Note: *If the controller does not find a connected USB flash drive or the USB icon is grey, refer to* Troubleshooting *on page 46*.
5. Push the main menu icon, then select Controller > USB transfer > Sensor update.
6. Follow the instructions on the screen to install the firmware update.
7. When the update is complete, a message shows on the display. Remove the USB flash drive.

   Note: *If there is an error during the firmware update, a message shows on the display. Refer to* Troubleshooting *on page 46*.
8. Close the USB cover.

If the sensor update was successful and the controller does not shows the measurement for the sensor, disconnect and connect the sensor again. If the problem continues, restart the controller.

6.5.4 Restore the controller firmware

If necessary, use the Restore firmware option to go back to the software version installed on the controller before a firmware update.
Note: *The user cannot downgrade the controller software, only go back to the software version installed on the controller before a firmware update.*

Note: *The user can only restore the controller firmware one time after a firmware update.*

1. On the display push the main menu icon, then select Controller > Service > Restore firmware.

[18] Based on the controller model

A confirmation message with the current software version and the restore software version shows.

2. Select Continue.
3. When the procedure is complete, a message with the current controller software version shows on the display.

After a firmware restore, make sure to examine the controller configuration and change it as necessary. A firmware restore procedure can have an effect on the controller configuration, connectivity configuration and other software options (outputs, installed expansion modules, data log).

Note: *If the restored software is a very old version, the controller compatibility may be not guaranteed.*

6.5.5 Install a firmware update for an RTC module

A firmware update for an RTC module can only be installed by service support. Please contact service support.

6.6 Configure the outputs

6.6.1 Configure the high voltage relays

The instrument has two non-powered relays, each with a single-pole change-over contact. Make sure that the wiring of the relays is complete before this procedure is started. Refer to Connect the high-voltage relays on page 18.

1. On the display push the main menu icon, then select Outputs > High voltage relay > System setup.
2. Enter the settings for each relay.

Option	Description
Source	Sets the source device for the relay output. ***Note:*** *The source device is a sensor connected to the controller or analog inputs (if connected).*
Parameter	Sets the parameter for the relay output based on the selected source.
Data view	Sets the value that will be displayed and stored in the data logger as the measured value. Options: Input configuration (default) or Relay contact status.
Function	Sets the function value. Setup options change based on the selected function. • Alarm—Operates the relays in response to the measured parameter. • Feeder control—Operates the relays in response to the measured parameter. • 2 point control—Operates the relays in response to the measured parameter with two setpoints. • Warning—Operates the relays when the controller finds a SC device warning. Shows the warning and error condition of the selected devices. • Pulse width control—Lets the relays give a pulse width modulated output. • Frequency control—Lets the relays operate in a cyclic manner at a frequency between the minimum pulses for each minute and maximum pulses for each minute. • Timer—Lets the relays to operate at set times independently of the process value. • System error—Shows if a device has an internal error or warning.
Transfer	Sets the transfer value. Options: Relay is energized or Relay is de-energized. (default).
Input value	Shows the process value read from the selected source after the internal formula parser sends the process value (if prompted).
Data logger interval	Sets the interval at which the controller saves the shown value to the data logger. Options: OFF (default), 5 minutes, 10 minutes, 15 minutes, 20 minutes or 30 minutes.

3. Complete the settings based on the Function setting.

Alarm function

Option	Description
Phase	Sets the relay condition when the process value is out of the controlled band. Options: Direct control or Reverse
High alarm	Sets the maximum value of the controlled band in the selected parameter unit.
Low alarm	Sets the minimum value of the controlled band in the selected parameter unit.
High deadband	Sets the hysteresis value used at the upper limit.
Low deadband	Sets the hysteresis value used at the lower limit.
Timer on delay	Sets a delay time for the relay to stay on.
Timer off delay	Sets a delay time for the relay to stay off.
Relay contact status	Displays and logs the status of the relay contact (ON or OFF).

Feeder control function

Option	Description
Phase	Sets the relay condition if the process value is more than the setpoint. Options: Value above the limit or Value below the limit.
Relay setpoint	Set the process value at which the relay condition changes.
Deadband	Sets a hysteresis so the relay will not swing unregulated when the process value converges to the setpoint.
OnMax TIMER	Sets a maximum period of time. During this period the relay stays on when passing the setpoint. When the time expires, the relay changes to OFF regardless of the process value.
Timer on delay	Sets a delay time for the relay to stay on.
Timer off delay	Sets a delay time for the relay to stay off.
Maximum timer expiration	Indicates a period of time (in seconds) for the expiration of the OnMax TIMER and the OffMax TIMER. Relay set to ON, OnMax TIMER set to ON: The time left is displayed before the relay is set to OFF automatically. Relay set to OFF, OffMax TIMER set to ON: The time left is displayed before the relay is set ON again.
Relay contact status	Displays and logs the status of the relay contact (ON or OFF).

2 point control function

Option	Description
Phase	Sets the status of the relay. When the process value enters the band between high and low alarm, the relay condition does not change. Options: Value above the limit or Value below the limit.
High alarm	Sets the upper limit in the unit of the selected parameter of the 2 point control band.
Low alarm	Sets the lower limit in the unit of the selected parameter of the 2 point control band.
Timer on delay	Sets a delay time for the relay to set ON.
Timer off delay	Sets a delay time for the relay to set OFF.
OnMax TIMER	Sets a maximum period of time. During this period the relay is set ON when passing the corresponding limit. As soon as the time expires the relay is set to OFF regardless of the process value.

Option	Description
OffMax TIMER	Sets a maximum period of time (in minutes). During this period the relay is set to OFF when passing the corresponding limit. As soon as the time expires the relay is set ON regardless of the process value.
OnMin TIMER	Sets a minimum period of time. During this period the relay is set ON when passing the corresponding limit. The relay can only be set OFF after the period has expired and after this expiration will be set OFF dependent on the process value.
OffMin TIMER	Sets a minimum period of time. During this period the relay is set to OFF when passing the corresponding limit. The relay can only be set to ON after the period has expired and after this expiration will be set to ON dependent on the process value.
Maximum timer expiration	Shows a period of time (in seconds) for the expiration of the OnMax TIMER and the OffMax TIMER. Options: Relay set to ON, OnMax TIMER set to ON—The time left is displayed before the relay is set to OFF automatically. Relay set to OFF, OffMax TIMER set to ON—The time left is displayed before the relay is set to ON again.
Minimum timer expiration	Shows a period of time (in seconds) for the release of the OnMin TIMERand the OffMin TIMER. Options: Relay set to ON, OnMin TIMER set to ON—Displays the time left before the relay can be set to OFF again. Relay set to OFF, OffMin TIMER set to ON—Displays the time left before the relay can be set ON again.
Relay contact status	Displays and logs the status of the relay contact (ON or OFF).

Warning function

Option	Description
Warning list	Sets the monitoring of the internal warning bits of the selected source. Enabled (default): Monitoring is active. Disabled: Monitoring is not active.
Error list	Sets the monitoring of the internal error bits of the selected source. Enabled: Monitoring is active. Disabled (default): Monitoring is not active.
Process event	Sets the monitoring of the internal process event bits of the selected source. Enabled: Monitoring is active. Disabled (default): Monitoring is not active.
Transfer	Sets the status of the relay. Options: Relay is energized or Relays are de-energized. (default) if some or all conditions (this means warning, error or process event bits) are detected in the selected source or if the source is missing.
Timer on delay	Sets a delay time for the relay to set ON.
Timer off delay	Sets a delay time for the relay to set OFF.
Relay contact status	Displays and logs the status of the relay contact (ON or OFF).

Pulse width control function

Option	Description
Mode	Automatic—The relay output works as a PID (Proportional, Integral, Derivative) controller. Manual—The relay output has got an on/off ratio as set in the Manual output.
High alarm	Sets the process value which leads the PWM ratio to 100% (Duty cycle set to Direct control).
Low alarm	Sets the process value which leads the PWM ratio to 0% (Duty cycle set to Direct control).

Option	Description
Manual output	Additionally the on/off ratio can be set (condition: Mode is set to Manual). Note that this ratio cannot exceed a value beyond the values set in the Minimum and Maximum menus.
Phase	Reverses the leading sign of the control deviation for the PID controller.
Minimum	Sets the minimum pulse ratio.
Maximum	Sets the maximum pulse ratio.
Relay setpoint	Sets the process value which is controlled by the PID controller.
Dead zone	The dead zone is a band around the setpoint. In this band the PID controller does not change the PWM on/off ratio output signal. This band is determined as setpoint +/- dead zone. The dead zone stabilizes the PID controlled system which have a tendency to oscillate.
Periode time	Sets the cycle duration of the pulse output signal.
Minimum	Sets the minimum PWM ratio.
Maximum	Sets the maximum PWM.
Duty cycle	Sets the status of PWM ratio.
Proportional	Sets the proportional part of the PID controller. The proportional part of the controller generates an output signal which is linearly dependent to the control deviation. The proportional part reacts on any changes at the input but starts to oscillate easily if the value is set high. The proportional part cannot completely compensate disturbances.
Integral	Sets the integration part of the PID controller. The integration part of the controller generates an output signal. The output signal increases linearly if the control deviation is constant. The integration part responds slower than the proportional part and can completely compensate disturbances. The higher the integration part, the slower it responds. If the integration part is set to low, it starts to oscillate.
Derivative	Sets the derivative part of the PID controller. The derivative part of the PID controller generates an output signal which depends on the control deviation changes. The faster the control deviation changes, the higher the output signal gets. The derivative part creates an output signal as long as the control deviation changes. If the control deviation is constant, no signal is created. The derivative part is able to smoothen the oscillation caused by the proportional part. The derivative part allows the proportional part to be set higher and the controller responds faster. If there is no knowledge about the controlled process behavior, it is recommended to set this part to “0”, because this part tends to oscillate strongly.

Frequency control function

Option	Description
Mode	Automatic—The relay output works as a PID controller. Manual—The relay output frequency has a cycle duration which is set in the MANUAL OUTPUT menu.
High alarm	Sets the maximum cycle duration which can be set by the PID controller.
Low alarm	Sets the minimum cycle duration which can be set by the PID controller.
Manual output	Indicates the current cycle duration of the output frequency. Additionally the cycle duration can be set (condition: Mode is set to Manual).
Phase	With this menu the leading sign of the control deviation for the PID controller can be reversed.
Relay setpoint	Sets the process value which is controlled by the PID controller.

Option	Description
Dead zone	The dead zone is a band around the setpoint. In this band the PID controller does not change the output frequency. This band is determined as setpoint +/- dead zone. The dead zone stabilizes the PID controlled system which have a tendency to oscillate.
Proportional	Sets the proportional part of the PID controller. The proportional part of the controller generates an output signal which is linearly dependent to the control deviation. The proportional part reacts on any changes at the input but starts to oscillate easily if the value is set to high. The proportional part cannot completely compensate disturbances.
Integral	Sets the integration part of the PID controller. The integration part of the controller generates an output signal. The output signal increases linearly if the control deviation is constant. The integration part responds slower than the proportional part and can completely compensate disturbances. The higher the integration part, the slower it responds. If the integration part is set to low, it starts to oscillate.
Derivative	Sets the derivative part of the PID controller. The derivative part of the PID controller generates an output signal which depends on the control deviation changes. The faster the control deviation changes, the higher the output signal gets. The derivative part creates an output signal as long as the control deviation changes. If the control deviation is constant, no signal is created. The derivative part is able to smoothen the oscillation caused by the proportional part. The derivative part allows the proportional part to be set higher and the controller responds faster. If there is no knowledge about the controlled process behavior, it is recommended to set this part to “0”, because this part tends to oscillate strongly.

Timer function

Option	Description
Outputs on hold	Lets the relay put a mark on the sensor configured in the menu SENSOR at the DURATION time. Other expansion modules such as other relay cards or current output cards which access data of this sensor read this 'mark' and go into hold. To go into hold means the accessing module does not read the latest measurement from the marked sensor but works with the last measurement read before the sensor was marked. To activate this function set this menu to Yes. If the sensor will never let other expansion modules go into hold, set this menu to NO. ***Note:*** *The setting Outputs on hold always adapts to the DURATION time.*
Relay off-time	Sets the period of time to set OFF the relay in one duty cycle (provided the Duty cycle option is set to Direct control).
Duration unit	Sets the units for the DURATION setting.
DURATION	Sets the period of time for setting ON the relay in one duty cycle (provided the Duty cycle option is set to Direct control).
Timer off delay	Delays the check mark of a probe even if DURATION time has expired. The Timer off delay starts immediately after the DURATION time is expired. This setting only takes effect if Outputs on hold is set to Yes.
Duty cycle	Direct control—Sets the relay ON for the time set in the DURATION menu. Sets the relay OFF for the time set in the Relay off-time menu. Reverse—Sets the relay OFF for the time set in the DURATION menu. Sets the relay ON for the time set in the Relay off-time menu.
Relay contact status	Displays and logs the status of the relay contact (ON or OFF).
Next toggle	Shows the seconds until the relay will toggle.

System error function

Option	Description
Warning list	Enabled—Monitors the internal warning bits of every probe. Disabled—Monitoring is disabled.
Error list	Enabled—Monitors the internal error bits of every probe. Disabled—Monitoring is disabled.
Sensor is missing.	Enabled—Monitors the connection of every connected probe. Disabled— Monitoring is not active.
Timer on delay	Sets a delay for the relay to set ON.
Timer off delay	Sets a delay for the relay to set OFF.
Relay contact status	Displays and saves to the log the status of the relay contact (ON or OFF).

4. Push OK to apply the changes.
5. Push the main menu icon, then select Outputs > High voltage relay > Test/Maintenance.
   The Test/Maintenance menu lets the user do a test of the internal high voltage relays.
6. Select an option.

Option	Description
Function test	Does a test on the selected relay. Set the Relay 1, Relay 2 or All to ON or OFF for the test. Output mode does a test on the relay output. Options: Hold (default), Active or Transfer.
Relay status	Shows the condition of the relays.

6.6.2 Configure the analog outputs

Make sure that a 4-20 mA output module is installed in the controller. Refer to the documentation supplied with the module. Make sure that all of the necessary electrical connections are complete before the 4-20 mA output is configured.

1. Identify the relation between input current and calculated concentration as follows:
   - Identify what analog output range uses the connected device (0-20 mA or 4-20 mA).
   - Identify the maximum concentration that is equal to the 20 mA on the analog output.
   - Identify the minimum concentration that is equal to the 0 or 4 mA on the analog output.
2. Push the main menu icon, then select Outputs > mA outputs > System setup
   The available channels based on the installed expansion modules show.
3. Enter the settings for each channel.

Option	Description
Source	Selects the analog output to configure. For the selected device, select the parameter that set the measurement options.
Parameter	Changes the parameter selected on the source option.
Data view	Sets the measured value that shows on the display and saves to the data log. Options: Input value (default) or Current.
Function	Sets the output function. Setup options change based on the selected function. • Linear control—Signal is linearly dependent on the process value. • PID control—Signal works as a PID (Proportional, Integral or Derivative) controller.

Option	Description
Transfer	Sets the transfer value shown on the analog output when the selected source reports an internal error, is disconnected from the system or its output mode is set to Transfer. Default: 10 mA
Current	Shows the calculated output current (in mA). By default, the calculated output current value is not the same as the real output current. The real current output is based on the opposite input resistance and cannot be more than 22 mA.
Data logger interval	Sets the interval at which the shown value is saved to the data logger. Options: OFF (default), 5 minutes, 10 minutes, 15 minutes, 20 minutes or 30 minutes

4. Complete the settings based on the Function setting.

Linear control function

Option	Description
Filter	Sets the record time for the recorded measured values. The average of the recorded values during the record time is shown on the analog output.
Filter unit	Sets the time unit for the Filter setting. Options: seconds (default), minutes, hours or days.
Maximum	Sets the maximum current value on the analog output. Default: 20 mA
Scale	Sets the output current range. Options: 0-20 mA (default) or 4-20 mA
Low value	Sets the selected source value shown as 0 mA (0-20 mA) or 4 mA (4–20 mA) on the analog output. Default: 0
High value	Sets the selected source value shown as 20 mA on the analog output. Default: 20
Error mode	Sets the controller to not change the analog output value (Hold) or show the transfer value on the analog output when an internal error occurs. Options: Hold or Transfer

PID control function

Option	Description
Error mode	Sets the controller to not change the analog output value (Hold) or show the transfer value on the analog output when an internal error occurs. Options: Hold or Transfer
Mode	Sets the output condition when the process value is out of the controlled band. Options: Direct control or Reverse
Mode	Automatic—The output works as a PID controller. Manual—The output has got an on/off ratio as set in Manual output.
Manual output	Additionally the on/off ratio can be set (condition: Mode is set to Manual). Note that this ratio cannot exceed a value beyond the values set in the Minimum and Maximum menus.
Minimum	Sets the lower limit for the output current. Default: 0.1 mA
Maximum	Sets an upper limit for the possible output current value. Default: 20.0 mA
Relay setpoint	Sets the process value which is controlled by the PID controller.
Dead zone	The dead zone is a band around the setpoint. In this band the PID controller does not change the PWM on/off ratio output signal. This band is determined as setpoint +/- dead zone. The dead zone stabilizes the PID controlled system which have a tendency to oscillate.
Proportional	Sets the proportional part of the PID controller. Refer to Configure the high voltage relays on page 33.
Integral	Sets the integration part of the PID controller.
Derivative	Sets the derivative part of the PID controller.
Snap shot	Shows the snap shot value.

5. Push OK to apply the changes.
6. Push the main menu icon, then select Outputs > mA outputs > Test/Maintenance.

   The Test/Maintenance menu lets the user do a test of the internal plug in the expansion cards.
7. Select an option.

Option	Description
Function test	Does a test on the outputs on the selected module.
Output status	Shows the condition of the outputs on the selected module.

6.6.3 Configure the telegram

The industrial communication protocols usually operates with a cyclic transmission of data between main (master) and secondary (slave) devices on a network. The controller uses Telegram for data transmission. The content of the Modbus TCP telegram is the same as the Profibus telegram, the PROFINET telegram and the EtherNet/IP telegram. Configure the telegram settings as follows:

1. Push the main menu icon, then select Outputs > [output source] > Telegram.
2. Select Add device. A list of available devices show.
3. Select the devices to add to the telegram list and push OK.
4. On the Telegram menu, select one device.
5. Select Add tag. A list of available tags for the selected device shows.
6. Select the tags to add to the device and push OK.
7. Push SAVE.
8. To remove a device from the telegram list, do the steps that follow:
   a. Go to Outputs > [output source] > Telegram
   b. Select - Delete device. A list of available devices shows.
   c. Select the devices to remove and push OK. Confirm to remove the selected devices from the telegram list.

Note: *Use the drag and drop function to change the elements on the Telegram list. Push and hold on the element and move the device or tag to the new position. Make sure to update the PLC configuration accordingly after the elements are moved.*

6.6.4 Configure the Modbus TCP

Use the Modbus TCP/IP to connect the controller to measurement and control systems that use the TCP/IP protocol for data transmission.

Make sure that all of the necessary electrical connections are complete. Make sure that the Ethernet port in the controller is configured to Modbus TCP. Refer to LAN connection on page 27.
Note: *To upgrade a controller to have Modbus TCP/IP, refer to* Enter license key *on page 44*.

Configure the controller to use the Modbus TCP communication protocol as follows:

1. Push the main menu icon, then select Outputs > Modbus TCP.
2. Set the Modbus TCP button to on.
3. Select an option.

Option	Description
Modbus TCP	Sets the Modbus TCP to on or off.
IP address	Shows the IP address.
TCP Port	Shows the TCP Port.
Telegram	Manages the Telegram data structure. Select the devices and the device data tags in the Telegram. Refer to Configure the telegram on page 40.

Option	Description
Modbus address	Sets the address (1 to 255) of the Modbus secondary device configured in the Telegram menu.
Virtual modbus slave	Adds virtual secondary devices. The virtual secondary devices are copies of devices configured in the Telegram menu. When set to on, the virtual device is enabled. When set to off (default), the virtual device is disabled.
Data order	Sets the byte sequence for the transmission of floating point values. A floating point value has 4 bytes. The floating point value is only data of the configured slaves. • Normal (default)—The pairs are not changed. • Swapped—Changes the first byte pair with the last byte pair. ***Note:*** *An incorrect setting in the Data order menu can cause small changes in the floating point values (moved in one register).*
Simulation	Simulates two floating point values and errors (or statuses) to replace an instrument. The first floating point value goes through a ramp between limits set in the Minimum and Maximum menus. • Simulation—Enables or disables the simulation. Options: on or off. • Period—Sets the time in minutes (0 to 1000) for the first floating point value to go through the full range between Minimum and Maximum settings. • Maximum—The upper limit for the first floating point value. Range: 0.0 to 1000.0 • Minimum—The lower limit for the first floating point value. Range: 0.0 to 1000.0 • Error—Sets the value in the first simulated register. Range: 0 to 65535 • Status—Sets the value in the second simulated register, Range: 0 to 65535 • Toggle—Changes the direction of the simulated ramp application.
Status	Shows information about the data transfer.
External measurements	Shows when the controller is added to the Telegram menu. For each measurement tag (1 to 32) added in the Telegram menu, select a Parameter and Unit that will show on the tag for external measurements as follows: **1.** Select Parameter and Unit. **2.** Select Search parameter and search for related parameters. For example, enter DO to find all of the parameters related to dissolved oxygen. A message shows the quantity of parameters found. Push OK. **3.** Select Parameter to go to the list of parameters found. **4.** Select one parameter, then push OK. **5.** Select Unit to select one unit based on the selected parameter. **6.** Apply changes to save the configuration. **7.** Do the steps again for the other text parameters or go back to the Modbus TCP menu.

4. Push OK.

6.6.5 Configure the Profibus DP

Use Profibus DP (Decentralised Peripherals) to operate sensors and actuators with a centralised controller in production (factory) automation. Make sure that a digital Fieldbus module is installed in the controller. Refer to the documentation supplied with the module. Make sure that all of the necessary electrical connections are complete before the settings are configured.
Configure the Profibus DP settings as follows:

1. Push the main menu icon, then select Outputs > Profibus DP.

2. Set the Profibus DP button to on.

3. Select an option.

Option	Description
Profibus DP	Selects one of the options that follow: • Fieldbus address—Changes the slave address. • Data order—Sets the byte sequence for the transmission of floating point values. A floating point value has 4 bytes. Options: Normal—IEEE Float Big Endian (default). The pairs are not changed. The Normal Data order mode can be used with all known Profibus master systems. Swapped—IEEE Float word wise swapped. Changes the first byte pair with the last byte pair.
Telegram	Manages the Telegram data structure. Select the devices and the device data tags in the Telegram. Refer to Configure the telegram on page 40.
Simulation	Simulates two floating point values and errors (or statuses) to replace an instrument. The first floating point value goes through a ramp between limits set in the Minimum and Maximum menus. • Simulation—Enables or disables the simulation. • Period—Sets the time in minutes (0 to 65535) for the first floating point value to go through the full range between Minimum and Maximum settings. • Maximum—The upper limit for the first floating point value. Range: –3.402823E to 3.402823E+38 • Minimum—The lower limit for the first floating point value. Range: –3.402823E to 3.402823E+38 • Error—Sets the value in the first simulated register. Range: 0 to 65535 • Status—Sets the value in the second simulated register, Range: 0 to 65535 • Toggle—Changes the direction of the simulated ramp application.
Version	Shows the software version of the Profibus network module.
Location	Sets the location name to identify the Profibus network module. Default: network module serial number
Status	Shows the condition of the Profibus network module. • Status—Options: Please wait—Shows until the network module finds all of the configured secondary devices or shows when the module configuration is new and looks for devices connections. Ready—Shows when the network module is prepared to send data to the Profibus. Online—Shows when the network module is connected to the PLC and cyclic data is sent. ***Note:*** *Based on the number of devices, the duration of a new or initial telegram configuration can take some minutes.* • PLC configuration error—Shows when the network card has received a wrong configuration of a PLC (programmable logic controller), such as write to a read only variable.

Option	Description
Input from PLC	• Datalog Interval—Sets the data log interval. • Unit—For each text parameter (1 to 8), select a Parameter and Unit that will show on the tag that will send the PLC as follows: **1.** Select Parameter and Unit. **2.** Select Search parameter and search for related parameters. For example, enter DO to find all of the parameters related to dissolved oxygen. A message shows the quantity of parameters found. Push OK. **3.** Select Parameter to go to the list of parameters found. **4.** Select one parameter, then push OK. **5.** Select Unit to select one unit based on the selected parameter. **6.** Apply changes to save the configuration. **7.** Do the steps again for the other text parameters or go back to the Profibus DP menu.
Reset configuration	Sets the configuration back to the factory settings.

4. Push OK.

6.6.6 Configure the EtherNet/IP

The controller can connect to a PLC through Industrial Ethernet Protocol including a EtherNet/IP solution. Ring and bus topologies are available.

Pre-requisites:

1. Make sure that a EtherNet/IP module is installed in the controller. Refer to the documentation supplied with the module.
2. Make sure that all of the necessary electrical connections are complete before the module is configured.
3. Make sure to set the Ethernet ports option to IEP only or Mix IEP. Refer to LAN connection on page 27.

For configuration information, refer to the EtherNet/IP documentation, available on the manufacturer's website.

6.6.7 Configure the PROFINET

The controller can connect to a PLC through the Industrial Ethernet Protocol, which includes a PROFINET solution. Ring and bus topologies are available.

Pre-requisites:

1. Make sure that a PROFINET module is installed in the controller. Refer to the documentation supplied with the module.
2. Make sure that all of the necessary electrical connections are complete before the module is configured.
3. Make sure to set the Ethernet ports option to IEP only or Mix IEP. Refer to LAN connection on page 27.

For configuration information, refer to the PROFINET documentation, available on the manufacturer's website.

6.7 Hach Controller Network Bus configuration

The Hach Controller Network Bus (HCNB) is a network used to share the connection to the PLC embedded by one controller and configure the system with remote sensors connected to other controllers (SC4500, SC4200c, SC1500 or RTC). The HCNB is applicable to Claros and non-Claros controllers, but all of the controllers must be connected to the HCNB.

Make sure that the controller connects to the network through LAN or WiFi. Refer to LAN connection on page 27 and WiFi network connection on page 28. To configure the controller to use the HCNB, do the steps that follow:

1. Push the main menu icon, then select Controller > Connectivity > HCNB.
2. Set the HCNB button to on. The controller automatically sets the default parameters for Port, Interface and Auto detection.

   Note: *When the HCNB option is enabled, the controllers in the same network are automatically found.*
3. Push APPLY. The controller is set to off and then on again, and HCNB is enabled.

For additional information, refer to the SC4500 network documentation, available on the manufacturer's website.

6.8 Prognosys diagnostic system

The Prognosys diagnostic system shows the status of maintenance tasks and gives the status of the instrument condition. The measure indicator monitors the instrument components and uses the information to show the condition of the instrument. The service indicator counts the number of days until the maintenance tasks must be completed.

If the controller has Prognosys enabled, the Prognosys icon shows on the measurement window in the main view. The device screen shows the device measurement quality with a percentage of the Health indication. In addition, the device screen shows the maintenance tasks with the number of days that remain until the tasks must be completed. Refer to the sensor documentation for additional information.

To upgrade a controller to have the Prognosys diagnostic system, refer to Enter license key on page 44.

6.9 Claros

Based on the controller configuration, the controller can connect to Claros for data transmission and device configuration.

Configure Claros on the controller as follows:

1. Make sure that the controller is connected to the internet with a cellular network, WiFi network or through LAN. Refer to Connect the instrument to a network on page 27.

   Note: *Push the main menu icon, then select Information > Network status to examine the network connection of the controller.*
2. Push the main menu icon, then select Controller > Connectivity > Claros.
3. Make sure that the Claros button is set to on.
4. Connect to your Claros account and provision the controller. Follow the steps in the Claros interface.

   Note: *Contact Hach to learn more about Claros or to get a Claros account.*

   Note: *Sensor measurements may go out of view until the controller is successfully provisioned to Claros. If the controller is disconnected from Claros, make sure to set the Claros button to off to show sensor measurements on the display.*

When the Claros configuration is complete, the Cloud icon shows on the status bar of the main screen.

6.10 Enter license key

Enter a license key to upgrade the controller software with new functions (e.g., Prognosys, Modbus TCP).

Enter the license key as follows:

1. Push the main menu icon, then select Controller > License.
2. Select one option:

Option	Description
Enter license keys	Enters a license key to upgrade the controller.
Activated license keys	Shows a list with the activated software on the controller.

3. Enter the license key. Push OK.

   Note: *Contact the manufacturer or a sales representative to get a license key.*

   A message shows if the upgrade is correct.

6.11 Show the instrument information

Shows information about the controller and connected SC sensors. Shows the controller connection status.

1. Push the main menu icon, then select **Information**.
2. Select an option.

Option	Description
Controller details	Shows the controller serial number, installed software package, the user-defined facility and location of the controller.
SC Devices details	Shows the data for the connected devices (e.g., 4–20 mA inputs, relays, digital sensors, digital analyzers and expansion modules). Shows the device type, serial number, firmware and Claros status.
RTC details	Shows the type, serial number, firmware version of the RTC module installed on the controller. If Claros is set to on, the Claros status shows.
Connectivity status	Shows the network condition based on the controller connectivity. • Claros—Shows if the controller is successfully connected to the internet and Claros. • Wi-Fi—Shows if the controller is successfully connected to internet using Wi-Fi connectivity. If there is an error, shows possible causes and solutions. • Cellular—Shows if the controller is successfully connected to internet using Cellular connectivity. If there is an error, shows possible causes and solutions. • LAN—Shows the connection condition and the MAC and IP address of each configured Ethernet port.

Section 7 Maintenance

NOTICE

Do not disassemble the instrument for maintenance. If the internal components must be cleaned or repaired, contact the manufacturer.

7.1 Clean the instrument

Clean the exterior of the instrument with a moist cloth and a mild soap solution and then wipe the instrument dry as necessary.

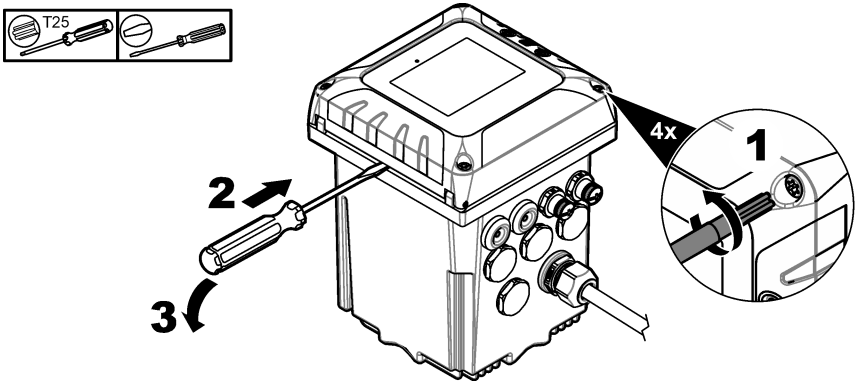
Note: *The manufacturer recommends that the screen is locked during cleaning, or when a waterjet is used near the controller.*

7.2 Unlock the controller cover

Some outdoor conditions can cause a blockage in the controller cover. If necessary, use a flat screwdriver to push at the hinge groove and unlock the controller cover. Refer to Figure 17.

Make sure to install the high-voltage barrier and close the controller cover after maintenance is complete. Refer to Close the cover on page 20.

Figure 17 Unlock the controller cover



7.3 Fuse replacement

Fuses are not user-serviceable items. The need for fuse replacement in controllers indicates severe technical failure and is therefore considered to be a service activity. If a blown fuse is suspected, contact Technical Support.

7.4 Battery replacement

The lithium ion backup battery is not user replaceable. Contact technical support for replacement.

Section 8 Troubleshooting

Problem	Possible cause	Solution
Controller will not power up, or powers up intermittently.	Power is not supplied to the controller.	Make sure that the power cable is connected to the controller. Make sure that the power connections are properly terminated in the controller. Make sure the power strip, line power, wall plug are all properly plugged in. Make sure that the controller is connected to the correct power source: 100-240 VAC for AC controllers and 18-28 VDC for DC controllers. Contact technical support.
The controller shows a sensor warning or error.	The sensor reported a warning message.	Refer to the sensor warning description shown in the device detail screen and to the sensor user manual.
	The measurement is not correct because of a sensor error.	Refer to the sensor warning description shown in the device detail screen and to the sensor user manual.
"Unknown device connected" message	The rotary switch of the sensor module is not set correctly.	Set the rotary switch of the sensor module to the correct position for the sensor type. Refer to the sensor module documentation.

Problem	Possible cause	Solution
Sensor is not recognized.	Too many devices installed	Make sure that only two input devices are connected to the controller. If more than two input devices are connected, the controller will see only two of the devices. Input devices are analog inputs from external devices, analog sensors, digital sensors or analyzers. If a digital sensor and two analog modules are connected, only the two analog modules are seen by the controller. Analog modules are 4–20 mA input modules and sensor modules.
	Two devices are connected to the same channel	Make sure that the analog module and the digital sensor are not connected to the same channel. Refer to items 3 and 4 in Figure 6 on page 13. The analog module slots are internally connected to the channel (Slot 3 = Channel 1, Slot 4 = Channel 2). If a digital sensor and an analog module are connected to the same channel only the analog module is seen by the controller. Analog modules are analog input modules and sensor modules.
	Extension cable damage	If applicable, remove extension cables from the sensors and directly connect the sensor to the controller. Connect the sensor to a different controller to identify if there is sensor damage.
	The communication between the sensor and the controller is defective.	Examine the sensor and the sensor cable for damage. If damage is found, contact technical support.
		If no damage is found, disconnect the sensor, wait 15 seconds, then connect the sensor again. Contact technical support if the communication failure shows again.
	The sensor version is not applicable to the controller.	Make sure that the sensor is applicable to the controller. Contact technical support.
	The sensor firmware is not applicable to the controller.	Make sure to update the sensor firmware to the latest available version. Refer to Install controller firmware updates on page 31.
No relay activation	Incorrect relay connection or configuration	Make sure that the relay connections are secure. Make sure that the relay wiring is correct. Make sure that the relay configuration is correct. The relay should energize and de-energize as selected.
The controller does not recognize the USB flash drive.	Non-compatible USB flash drive	Make sure that the USB flash drive is formatted with FAT32 and has a minimum of 350 Mb capacity. The USB port on the controller is compatible with USB 2.0 devices. ***Note:*** *USB 3.0 devices are also compatible but the device will have a USB 2.0 transfer speed.* Try again with a more recent USB flash drive.
Firmware update failed	The USB flash drive was removed during the update or the update file is corrupted.	Remove the USB flash drive and do the firmware update process again. Download a new firmware update file. Contact technical support if the error shows again.

Problem	Possible cause	Solution
Restore firmware failed	Error code 1: Generic error	Try to restore the firmware again. Contact technical support if the error shows again.
	Error code 2, 3, 5 or 6: The previous update was not successful or there is no previous firmware version. The restore firmware is not compatible. The restore firmware is corrupted or defective.	A firmware restore is not possible. Contact technical support.
	Error code 4: The firmware version is already a restored version.	It is only possible go back to the firmware version installed on the controller before the firmware update. The user can not downgrade the controller firmware.
Download failed: A problem occurred while downloading the log files.	USB flash drive issue	Push Yes to try again. If the error shows again, restart the controller and try the download again. Contact technical support if the error shows again.
Module is not recognized.	Module connection issue	Make sure that the expansion module is correctly installed. Refer to the expansion module documentation. If possible, remove the expansion module and install the expansion module into a different slot. Contact technical support.
There are navigation issues on the controller touchscreen.	There is dirt on the touchscreen.	Clean the screen. The manufacturer recommends a regular cleaning of the touchscreen. ***Note:*** *Make sure that the screen is locked during cleaning to prevent unwanted touches. Refer to* Configure the controller settings on page 26.
The Claros connection icon shows crossed out.	No access to Claros, but access to the internet	If the controller is connected for the first time to Claros, make sure that the controller is provisioned in Claros. If the controller was connected to Claros before, set the controller to off and then on again. Examine the controller connectivity. Refer to Show the instrument information on page 45. Contact technical support if the error shows again.
Time synchronization OFF	The controller cannot access the NPT internet service to get the clock automatically synchronized.	Make sure that there are no restrictions to external access in the controller network. Contact your IT department and make sure that the network has access to the internet NTP service. If the controller does not connect to Claros, go to Controller > Connectivity > Claros and disable Claros. Then, add the date and time manually in the controller settings.
	The controller has Claros enabled but there is no access to internet.	Make sure that the controller connects to the internet. Examine the controller connectivity.
NTP service unreachable	The controller cannot access the NPT internet service to connect to Claros.	Make sure that there are no restrictions to external access in the controller network. Contact your IT department and make sure that the network has access to the internet NTP service. Make sure that UDP port 123 is open and Pool.ntp.org address is approved in the network.

Problem	Possible cause	Solution
The Claros icon stays off. The Claros connection icon shows crossed out.	No access to internet	Cellular internet access: • Examine the controller connectivity. Refer to Show the instrument information on page 45. • Examine the cellular signal strength. Move the USB box to a location with higher signal strength. • Examine the SIM card settings (provider, APN etc.). • Make sure that prepaid SIM card has credit. • Make sure that the SIM card data volume is not exceeded.
		Wi-Fi internet access: • Examine the controller connectivity. Refer to Show the instrument information on page 45. • Examine the Wi-Fi signal strength. Move the USB box to a location with higher signal strength. • Use another device to make sure that WiFi access point is enabled. • Make sure that the correct credentials were used in the WiFi configuration. Refer to WiFi network connection on page 28.
		LAN internet access: • Examine the controller connectivity. Refer to Show the instrument information on page 45.
	No access to Claros	Make sure that the sensors and devices are correctly connected and provisioned in Claros.

Section 9 Replacement parts and accessories

⚠WARNING

Personal injury hazard. Use of non-approved parts may cause personal injury, damage to the instrument or equipment malfunction. The replacement parts in this section are approved by the manufacturer.

Note: *Product and Article numbers may vary for some selling regions. Contact the appropriate distributor or refer to the company website for contact information.*

Replacement parts

Description	Item number
M12/RJ45 connector kit (Ethernet cable)	LXZ524.99.00009
M12/M12 connector kit (Ethernet cable)	LXZ524.99.00010
Ethernet cable M12 to M12, 10 m	LXZ524.99.00011
Ethernet cable M12 to RJ45, 5 m	LXZ524.99.00012
USB to Ethernet Adapter	LZ472-01
Panel mount bracket	8001316
Controller installation kit	8806200
Mounting hardware kit (screws only)	9177800
Mounting bracket inserts	9177900

Description	Item number
SC4500 USB cover replacement, includes screws	LXZ525.99.00012
SC4500 set of front door screws (2x)	LXZ525.99.00023
SC controller M20 Cable Gland Kit	LXZ525.99.00024
SC controller M16 Cable Gland Kit	LXZ525.99.00022
Plug kit for openings	LXZ525.99.00021
M20 Hole Plug	LXZ525.99.00008

Expansion modules

Description	Item number
SC4500 mA output module, five outputs	LXZ525.99.D0002
SC4500 Profibus DP network module	LXZ524.99.00007
SC4500 PROFINET upgrade Kit	LXZ525.99.C0001
SC4500 EtherNet/IP upgrade Kit	LXZ525.99.C0002
SC4500 Modbus TCP upgrade Kit	LXZ525.99.C0003
SC4500 connector upgrade Kit, includes cable nut and cap	LXZ525.99.00001
SC4500 mA input module	LXZ524.97.00042 LXZ524.98.00042
SC4500 pH/ORP module	LXZ525.99.D0003

Accessories

Description	Item number
Power box with power connection cable for AMTAX sc and PHOSPHAX sc	LQV155.99.00012
Power box without power connection cable for AMTAX sc and PHOSPHAX sc	LQV155.99.00002
SC4500 External USB box WiFi (for EU)	LXZ525.99.A0001
SC4500 External USB box WiFi (for North America)	LXZ525.99.A0002
SC4500 External USB box Cellular (for EU)	LXZ525.99.A0011
SC4500 External USB box Cellular (for North America)	LXZ525.99.A0012
SC4500 Wi-Fi USB Box (for Asia and Americas)	LXZ525.99.00018
SC4500 M12/RJ45 cable for USB box, includes nut and cap	LXZ525.99.00004
SC4500 USB flash drive	LXZ525.99.00017
UV protection screen	LXZ524.99.00004
UV protection screen including sunroof	LXZ524.99.00005
Holder for mobiles	LXZ524.99.00013
Sunroof visor	LXZ524.99.00033
Sunroof	LXZ524.99.00037
Mounting hardware for sunroof	LXZ524.99.00036

Appendix A Telegram tag list

Legend:

- **Device**—Shows all of the SC devices that can be selected for the SC4500 controller as source (for mA output or High voltage relay) or as device in Telegram (for Profibus DP, Modbus TCP, PROFINET and EtherNet/IP).
- **Name**—Analog source parameters (used for mA output or High voltage relay) or Telegram tags (Telegram is used for digital and Ethernet protocols.)
- **Type**—Type of data: float (32 bits) or integer (16 bits)
- **mA-O**—Applicable to mA output (source)
- **HVR**—Applicable to high voltage relay (source)
- **P-DP**—Applicable to Profibus DP (Telegram)
- **M-TCP**—Applicable to Modbus TCP (Telegram)
- **PRN**—Applicable to PROFINET (Telegram)
- **E/IP**—Applicable to EtherNet/IP (Telegram)

Notes:

1. The first eight rows in the table that follows are the generic tags. The set of eight generic tags show on all of the SC devices. The tags are applicable in Telegram for Profibus DP, Modbus TCP, PROFINET and EtherNet/IP protocol. The tags are not applicable in source for mA output and High voltage relay.
   - The tags are "classified" because they apply to all of the sensors equally. Each bit of each register has the same meaning on all of the devices.
   - Heartbeat is a lower clock register. The register changes every second to show that read values are refreshed continuously.
2. Device Error condition is float type in AN-ISE sc and TU5x00 sc. Device Warning is float type in AN-ISE sc, AMTAX sc and PHOSPHAX sc.
3. SC4500— Select the controller itself to configure the Modbus TCP to import an external measurement. Refer to Configure the Modbus TCP on page 40.
4. mA output—It is not possible to select the local mA output itself or a remote mA output.

   High voltage relay—It is not possible to select the local High voltage relay itself. If HCNB is ON, it is possible to select a remote High voltage relay.
5. Measurement indicator [%] and Service indicator [days] only shows if the sensor has Prognosys.

Device	Name	Type	mA-O	HVR	P-DP	M-TCP	PRN	E/IP
All SC devices (Set of eight generic tags. Refer to Note 1)	Classified Error	Integer	—	—	✓	✓	✓	✓
	Classified Status 1	Integer	—	—	✓	✓	✓	✓
	Classified Status 2	Integer	—	—	✓	✓	✓	✓
	Classified Status 3	Integer	—	—	✓	✓	✓	✓
	Classified Status 4	Integer	—	—	✓	✓	✓	✓
	Device Error Condition (refer to Note 2)	Integer	—	—	✓	✓	✓	✓
	Device Warning Condition (refer to Note 2)	Integer	—	—	✓	✓	✓	✓
	Heartbeat	Integer	—	—	✓	✓	✓	✓
SC4500 (refer to Note 3)	Measurement 1	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 10	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 11	Float	✓	✓	✓	✓	✓	✓

Device	Name	Type	mA-O	HVR	P-DP	M-TCP	PRN	E/IP
SC4500	Measurement 12	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 13	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 14	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 15	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 16	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 17	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 18	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 19	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 2	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 21	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 22	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 23	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 24	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 25	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 26	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 27	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 28	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 29	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 3	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 30	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 31	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 32	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 4	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 5	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 6	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 7	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 8	Float	✓	✓	✓	✓	✓	✓
SC4500	Measurement 9	Float	✓	✓	✓	✓	✓	✓
High voltage relay (refer to Note 4)	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
High voltage relay	Contact Position ch1	Integer	✓	—	✓	✓	✓	✓
High voltage relay	Contact Position ch2	Integer	✓	—	✓	✓	✓	✓
High voltage relay	Input Value ch1	Float	✓	—	✓	✓	✓	✓
High voltage relay	Input Value ch2	Float	✓	—	✓	✓	✓	✓
MAOUTPUT (refer to Note 4)	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
MAOUTPUT	Current ch1 [mA]	Float	—	✓	✓	✓	✓	✓

Device	Name	Type	mA-O	HVR	P-DP	M-TCP	PRN	E/IP
MAOUTPUT	Current ch2 [mA]	Float	—	✓	✓	✓	✓	✓
MAOUTPUT	Current ch3 [mA]	Float	—	✓	✓	✓	✓	✓
MAOUTPUT	Current ch4 [mA]	Float	—	✓	✓	✓	✓	✓
MAOUTPUT	Current ch5 [mA]	Float	—	✓	✓	✓	✓	✓
MAOUTPUT	Input Value ch1	Float	—	✓	✓	✓	✓	✓
MAOUTPUT	Input Value ch2	Float	—	✓	✓	✓	✓	✓
MAOUTPUT	Input Value ch3	Float	—	✓	✓	✓	✓	✓
MAOUTPUT	Input Value ch4	Float	—	✓	✓	✓	✓	✓
MAOUTPUT	Input Value ch5	Float	—	✓	✓	✓	✓	✓
Profibus DP	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
Profibus DP	External measurement value 1	Float	✓	✓	✓	✓	✓	✓
Profibus DP	External measurement value 2	Float	✓	✓	✓	✓	✓	✓
Profibus DP	External measurement value 3	Float	✓	✓	✓	✓	✓	✓
Profibus DP	External measurement value 4	Float	✓	✓	✓	✓	✓	✓
Profibus DP	External measurement value 5	Float	✓	✓	✓	✓	✓	✓
Profibus DP	External measurement value 6	Float	✓	✓	✓	✓	✓	✓
Profibus DP	External measurement value 7	Float	✓	✓	✓	✓	✓	✓
Profibus DP	External measurement value 8	Float	✓	✓	✓	✓	✓	✓
PROFINET	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
PROFINET	External measurement value 1	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 10	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 11	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 12	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 13	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 14	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 15	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 16	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 17	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 18	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 19	Float	✓	✓	✓	✓	✓	✓

Device	Name	Type	mA-O	HVR	P-DP	M-TCP	PRN	E/IP
PROFINET	External measurement value 20	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 2	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 21	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 22	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 23	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 24	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 25	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 26	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 27	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 28	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 29	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 3	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 30	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 31	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 32	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 4	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 5	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 6	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 7	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 8	Float	✓	✓	✓	✓	✓	✓
PROFINET	External measurement value 9	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
EtherNet/IP	External measurement value 1	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 10	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 11	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 12	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 13	Float	✓	✓	✓	✓	✓	✓

Device	Name	Type	mA-O	HVR	P-DP	M-TCP	PRN	E/IP
EtherNet/IP	External measurement value 14	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 15	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 16	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 17	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 18	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 19	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 20	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 2	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 21	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 22	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 23	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 24	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 25	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 26	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 27	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 28	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 29	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 3	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 30	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 31	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 32	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 4	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 5	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 6	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 7	Float	✓	✓	✓	✓	✓	✓
EtherNet/IP	External measurement value 8	Float	✓	✓	✓	✓	✓	✓

Device	Name	Type	mA-O	HVR	P-DP	M-TCP	PRN	E/IP
EtherNet/IP	External measurement value 9	Float	✓	✓	✓	✓	✓	✓
mA input	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
mA input	Current [mA]	Float	✓	✓	✓	✓	✓	✓
mA input	Input	Float	✓	✓	✓	✓	✓	✓
pH/ORP module	pH [pH]	Float	✓	✓	✓	✓	✓	✓
pH/ORP module	ORP [mV]	Float	✓	✓	✓	✓	✓	✓
pH/ORP module	Temperature NTC300 [°C]	Float	✓	✓	✓	✓	✓	✓
pH/ORP module	Temperature platinium [°C]	Float	✓	✓	✓	✓	✓	✓
pH/ORP module	Temperature NTC300 [°F]	Float	✓	✓	✓	✓	✓	✓
pH/ORP module	Temperature platinium [°F]	Float	✓	✓	✓	✓	✓	✓
pH/ORP module	User temperature [°C]	Float	✓	✓	✓	✓	✓	✓
pH/ORP module	User temperature [°F]	Float	✓	✓	✓	✓	✓	✓
AMTAX sc	Measurement indicator [%] (refer to Note 5)	Integer	—	—	✓	✓	✓	✓
AMTAX sc	Service indicator [days] (refer to Note 5)	Integer	—	—	✓	✓	✓	✓
AMTAX sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
AMTAX sc	Ammonium NH4 ch1 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
AMTAX sc	Ammonium NH4 ch2 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
AMTAX sc	Ammonium NH4-N ch1 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
AMTAX sc	Ammonium NH4-N ch2 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
AMTAX sc	Cleaning solution level [%]	Float	✓	✓	✓	✓	✓	✓
AMTAX sc	Enclosure temperature [°C]	Float	✓	✓	✓	✓	✓	✓
AMTAX sc	Last electrode exchange date	Float	✓	✓	✓	✓	✓	✓
AMTAX sc	Last membrane exchange date	Float	✓	✓	✓	✓	✓	✓
AMTAX sc	mV from active Sample	Float	✓	✓	✓	✓	✓	✓
AMTAX sc	Process state	Float	✓	✓	✓	✓	✓	✓
AMTAX sc	Reagent Level [%]	Float	✓	✓	✓	✓	✓	✓
AMTAX sc	Slope of electrode mV	Float	✓	✓	✓	✓	✓	✓
AMTAX sc	Standards Level [%]	Float	✓	✓	✓	✓	✓	✓
A-ISE sc	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
A-ISE sc	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
A-ISE sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
A-ISE sc	Ammonium NH4 [mg/L]	Float	✓	✓	✓	✓	✓	✓
A-ISE sc	Ammonium NH4-N [mg/L]	Float	✓	✓	✓	✓	✓	✓

Device	Name	Type	mA-O	HVR	P-DP	M-TCP	PRN	E/IP
A-ISE sc	Potassium K [mg/L]	Float	✓	✓	✓	✓	✓	✓
A-ISE sc	Temperature [°C]	Float	✓	✓	✓	✓	✓	✓
A-ISE sc	Temperature [°F]	Float	✓	✓	✓	✓	✓	✓
AN-ISE sc	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
AN-ISE sc	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
AN-ISE sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
AN-ISE sc	Ammonium NH4 [mg/L]	Float	✓	✓	✓	✓	✓	✓
AN-ISE sc	Ammonium NH4-N [mg/L]	Float	✓	✓	✓	✓	✓	✓
AN-ISE sc	Chloride Cl [mg/L]	Float	✓	✓	✓	✓	✓	✓
AN-ISE sc	Nitrate NO3 [mg/L]	Float	✓	✓	✓	✓	✓	✓
AN-ISE sc	Nitrate NO3-N [mg/L]	Float	✓	✓	✓	✓	✓	✓
AN-ISE sc	Potassium K [mg/L]	Float	✓	✓	✓	✓	✓	✓
AN-ISE sc	Temperature [°C]	Float	✓	✓	✓	✓	✓	✓
AN-ISE sc	Temperature [°F]	Float	✓	✓	✓	✓	✓	✓
N-ISE sc	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
N-ISE sc	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
N-ISE sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
N-ISE sc	Chloride Cl [mg/L]	Float	✓	✓	✓	✓	✓	✓
N-ISE sc	Nitrate NO3 [mg/L]	Float	✓	✓	✓	✓	✓	✓
N-ISE sc	Nitrate NO3-N [mg/L]	Float	✓	✓	✓	✓	✓	✓
N-ISE sc	Temperature [°C]	Float	✓	✓	✓	✓	✓	✓
N-ISE sc	Temperature [°F]	Float	✓	✓	✓	✓	✓	✓
CL 17 sc	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
CL 17 sc	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
CL 17 sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
CL 17 sc	Vol [mL/min]	Float	✓	✓	✓	✓	✓	✓
CL 17 sc	Free chlorine [mg/L]	Float	✓	✓	✓	✓	✓	✓
CL 17 sc	Total chlorine [mg/L]	Float	✓	✓	✓	✓	✓	✓
CL 17 sc	LED drive [%]	Float	✓	✓	✓	✓	✓	✓
CL 10 sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
CL 10 sc	Free chlorine	Float	✓	✓	✓	✓	✓	✓
CL 10 sc	pH [pH]	Float	✓	✓	✓	✓	✓	✓
CL 10 sc	Temperature	Float	✓	✓	✓	✓	✓	✓
LDO2 sc	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
LDO2 sc	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
LDO2 sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓

Device	Name	Type	mA-O	HVR	P-DP	M-TCP	PRN	E/IP
LDO2 sc	Dissolved Oxygen [%]	Float	✓	✓	✓	✓	✓	✓
LDO2 sc	Dissolved Oxygen [mg/L]	Float	✓	✓	✓	✓	✓	✓
LDO2 sc	Dissolved Oxygen [ppm]	Float	✓	✓	✓	✓	✓	✓
LDO2 sc	Temperature [°C]	Float	✓	✓	✓	✓	✓	✓
LDO2 sc	Temperature [°F]	Float	✓	✓	✓	✓	✓	✓
Nitratax60 sc	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
Nitratax60 sc	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
Nitratax60 sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
Nitratax60 sc	Nitrate NO3 or NOx-N [mg/L]	Float	✓	✓	✓	✓	✓	✓
Nitratax eco sc	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
Nitratax eco sc	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
Nitratax eco sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
Nitratax eco sc	Nitrate NO3 or NOx-N [mg/L]	Float	✓	✓	✓	✓	✓	✓
Nitratax plus sc	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
Nitratax plus sc	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
Nitratax plus sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
Nitratax plus sc	Nitrate NO3 or NOx-N [mg/L]	Float	✓	✓	✓	✓	✓	✓
Nitratax clear sc	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
Nitratax clear sc	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
Nitratax clear sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
Nitratax clear sc	Nitrate NO3 or NOx-N [mg/L]	Float	✓	✓	✓	✓	✓	✓
Nitratax sc (Germany only)	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
Nitratax sc (Germany only)	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
Nitratax sc (Germany only)	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
Nitratax sc (Germany only)	Nitrate NO3 or NOx-N [mg/L]	Float	✓	✓	✓	✓	✓	✓
NT3100sc	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
NT3100sc	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
NT3100sc	NO3	Float	✓	✓	✓	✓	✓	✓
NT3100sc	NO3-N	Float	✓	✓	✓	✓	✓	✓
NT3100sc	NOx	Float	✓	✓	✓	✓	✓	✓
NT3100sc	NOx-N	Float	✓	✓	✓	✓	✓	✓
NT3200sc	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
NT3200sc	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
NT3200sc	NO2	Float	✓	✓	✓	✓	✓	✓

Device	Name	Type	mA-O	HVR	P-DP	M-TCP	PRN	E/IP
NT3200sc	NO2-N	Float	✓	✓	✓	✓	✓	✓
NT3200sc	NO3	Float	✓	✓	✓	✓	✓	✓
NT3200sc	NO3-N	Float	✓	✓	✓	✓	✓	✓
NT3200sc	NOx	Float	✓	✓	✓	✓	✓	✓
NT3200sc	NOx-N	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc LR	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
PHOSPHAX sc LR	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
PHOSPHAX sc LR	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
PHOSPHAX sc LR	Phosphate-Phosphorus PO4-P [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc LR	Phosphate PO4 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc LR	Phosphorus Pentoxide P2O5 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc MR	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
PHOSPHAX sc MR	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
PHOSPHAX sc MR	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
PHOSPHAX sc MR	Cleaning solution level [%]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc MR	Phosphate-Phosphorus PO4-P ch1 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc MR	Phosphate-Phosphorus PO4-P ch2 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc MR	Phosphate PO4 ch1 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc MR	Phosphate PO4 ch2 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc MR	Phosphorus Pentoxide P2O5 ch1 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc MR	Phosphorus Pentoxide P2O5 ch2 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc MR	Process state	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc MR	Reagent Level [%]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc HR	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
PHOSPHAX sc HR	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
PHOSPHAX sc HR	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
PHOSPHAX sc HR	Cleaning solution level [%]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc HR	Phosphate-Phosphorus PO4-P ch1 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc HR	Phosphate-Phosphorus PO4-P ch2 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc HR	Phosphate PO4 ch1 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓

Device	Name	Type	mA-O	HVR	P-DP	M-TCP	PRN	E/IP
PHOSPHAX sc HR	Phosphate PO4 ch2 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc HR	Phosphorus Pentoxide P2O5 ch1 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc HR	Phosphorus Pentoxide P2O5 ch2 [mg/L or ppm]	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc HR	Process state	Float	✓	✓	✓	✓	✓	✓
PHOSPHAX sc HR	Reagent Level [%]	Float	✓	✓	✓	✓	✓	✓
pHD sc V2	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
pHD sc V2	ORP [mV]	Float	✓	✓	✓	✓	✓	✓
pHD sc V2	Temperature [°C]	Float	✓	✓	✓	✓	✓	✓
pHD sc V2	Temperature [°F]	Float	✓	✓	✓	✓	✓	✓
pHD sc V2	pH [pH]	Float	✓	✓	✓	✓	✓	✓
SOLITAX sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
SOLITAX sc	Measurement indicator [%]	Float	—	—	✓	✓	✓	✓
SOLITAX sc	Service indicator [days]	Float	—	—	✓	✓	✓	✓
SOLITAX sc	Solid [%]	Float	✓	✓	✓	✓	✓	✓
SOLITAX sc	Solid [g/L]	Float	✓	✓	✓	✓	✓	✓
SOLITAX sc	Solid [mg/L]	Float	✓	✓	✓	✓	✓	✓
SOLITAX sc	Solid [ppm]	Float	✓	✓	✓	✓	✓	✓
SOLITAX sc	Turbidity [EBC]	Float	✓	✓	✓	✓	✓	✓
SOLITAX sc	Turbidity [FNU]	Float	✓	✓	✓	✓	✓	✓
SOLITAX sc	Turbidity [FTU]	Float	✓	✓	✓	✓	✓	✓
SOLITAX sc	Turbidity [NTU]	Float	✓	✓	✓	✓	✓	✓
SOLITAX sc	Turbidity [TEF]	Float	✓	✓	✓	✓	✓	✓
SONATAX sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
SONATAX sc	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
SONATAX sc	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
SONATAX sc	Sludge height [ft]	Float	✓	✓	✓	✓	✓	✓
SONATAX sc	Sludge height [m]	Float	✓	✓	✓	✓	✓	✓
SONATAX sc	Sludge level [ft]	Float	✓	✓	✓	✓	✓	✓
SONATAX sc	Sludge level [m]	Float	✓	✓	✓	✓	✓	✓
TSS sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
TSS sc	Solid [%]	Float	✓	✓	✓	✓	✓	✓
TSS sc	Solid [g/L]	Float	✓	✓	✓	✓	✓	✓
TSS sc	Solid [mg/L]	Float	✓	✓	✓	✓	✓	✓
TSS sc	Solid [ppm]	Float	✓	✓	✓	✓	✓	✓

Device	Name	Type	mA-O	HVR	P-DP	M-TCP	PRN	E/IP
TSS sc	Turbidity [EBC]	Float	✓	✓	✓	✓	✓	✓
TSS sc	Turbidity [FNU]	Float	✓	✓	✓	✓	✓	✓
TSS sc	Turbidity [FTU]	Float	✓	✓	✓	✓	✓	✓
TSS sc	Turbidity [NTU]	Float	✓	✓	✓	✓	✓	✓
TSS sc	Turbidity [TEF]	Float	✓	✓	✓	✓	✓	✓
TU5300 sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
TU5300 sc	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
TU5300 sc	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
TU5300 sc	Flow [L/min]	Float	✓	✓	✓	✓	✓	✓
TU5300 sc	Turbidity [DEG]	Float	✓	✓	✓	✓	✓	✓
TU5300 sc	Turbidity [EBC]	Float	✓	✓	✓	✓	✓	✓
TU5300 sc	Turbidity [FTU]	Float	✓	✓	✓	✓	✓	✓
TU5300 sc	Turbidity [FNU]	Float	✓	✓	✓	✓	✓	✓
TU5300 sc	Turbidity [NTU]	Float	✓	✓	✓	✓	✓	✓
TU5300 sc	Turbidity [TEF]	Float	✓	✓	✓	✓	✓	✓
TU5400 sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
TU5400 sc	Measurement indicator [%]	Integer	—	—	✓	✓	✓	✓
TU5400 sc	Service indicator [days]	Integer	—	—	✓	✓	✓	✓
TU5400 sc	Flow [L/min]	Float	✓	✓	✓	✓	✓	✓
TU5400 sc	Relative Standard Deviation [%]	Float	✓	✓	✓	✓	✓	✓
TU5400 sc	Turbidity [DEG]	Float	✓	✓	✓	✓	✓	✓
TU5400 sc	Turbidity [EBC]	Float	✓	✓	✓	✓	✓	✓
TU5400 sc	Turbidity [FTU]	Float	✓	✓	✓	✓	✓	✓
TU5400 sc	Turbidity [FNU]	Float	✓	✓	✓	✓	✓	✓
TU5400 sc	Turbidity [mFNU]	Float	✓	✓	✓	✓	✓	✓
TU5400 sc	Turbidity [mNTU]	Float	✓	✓	✓	✓	✓	✓
TU5400 sc	Turbidity [NTU]	Float	✓	✓	✓	✓	✓	✓
TU5400 sc	Turbidity [TEF]	Float	✓	✓	✓	✓	✓	✓
SS7 sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
SS7 sc	Turbidity	Float	✓	✓	✓	✓	✓	✓
Ultraturb Seawater	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
Ultraturb Seawater	Turbidity	Float	✓	✓	✓	✓	✓	✓
1720E Low Range Turbidimeter	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
1720E Low Range Turbidimeter	Turbidity	Float	✓	✓	✓	✓	✓	✓

Device	Name	Type	mA-O	HVR	P-DP	M-TCP	PRN	E/IP
UVASplus sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
UVASplus sc	Selected Parameter [selected unit]	Float	✓	✓	✓	✓	✓	✓
UVASeco sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
UVASeco sc	Selected Parameter [selected unit]	Float	✓	✓	✓	✓	✓	✓
1200-S sc V2	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
1200-S sc V2	ORP [mV]	Float	✓	✓	✓	✓	✓	✓
1200-S sc V2	pH [pH]	Float	✓	✓	✓	✓	✓	✓
1200-S sc V2	Temperature [°C]	Float	✓	✓	✓	✓	✓	✓
1200-S sc V2	Temperature [°F]	Float	✓	✓	✓	✓	✓	✓
3798-S sc V2	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
3798-S sc V2	Conductivity [S/cm]	Float	✓	✓	✓	✓	✓	✓
3798-S sc V2	Conductivity [S/m]	Float	✓	✓	✓	✓	✓	✓
3798-S sc V2	Conductivity [uS/cm]	Float	✓	✓	✓	✓	✓	✓
3798-S sc V2	Resistivity [Ohm.cm]	Float	✓	✓	✓	✓	✓	✓
3798-S sc V2	Resistivity [Ohm.m]	Float	✓	✓	✓	✓	✓	✓
3798-S sc V2	Temperature [°C]	Float	✓	✓	✓	✓	✓	✓
3798-S sc V2	Temperature [°F]	Float	✓	✓	✓	✓	✓	✓
9184 sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
9184 sc	Concentration [mg/L]	Float	✓	✓	✓	✓	✓	✓
9184 sc	Concentration [ppb]	Float	✓	✓	✓	✓	✓	✓
9184 sc	Concentration [ppm]	Float	✓	✓	✓	✓	✓	✓
9184 sc	Concentration [ug/L]	Float	✓	✓	✓	✓	✓	✓
9184 sc	Current [nA]	Float	✓	✓	✓	✓	✓	✓
9184 sc	Current [uA]	Float	✓	✓	✓	✓	✓	✓
9184 sc	Temperature [°C]	Float	✓	✓	✓	✓	✓	✓
9184 sc	Temperature [°F]	Float	✓	✓	✓	✓	✓	✓
9184 sc	pH [pH]	Float	✓	✓	✓	✓	✓	✓
9185 sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
9185 sc	Concentration [mg/L]	Float	✓	✓	✓	✓	✓	✓
9185 sc	Concentration [ppb]	Float	✓	✓	✓	✓	✓	✓
9185 sc	Concentration [ppm]	Float	✓	✓	✓	✓	✓	✓
9185 sc	Concentration [ug/L]	Float	✓	✓	✓	✓	✓	✓
9185 sc	Current [nA]	Float	✓	✓	✓	✓	✓	✓
9185 sc	Current [uA]	Float	✓	✓	✓	✓	✓	✓
9185 sc	Temperature [°C]	Float	✓	✓	✓	✓	✓	✓

Device	Name	Type	mA-O	HVR	P-DP	M-TCP	PRN	E/IP
9185 sc	Temperature [°F]	Float	✓	✓	✓	✓	✓	✓
9185 sc	pH [pH]	Float	✓	✓	✓	✓	✓	✓
9187 sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
9187 sc	Concentration [mg/L]	Float	✓	✓	✓	✓	✓	✓
9187 sc	Concentration [ppb]	Float	✓	✓	✓	✓	✓	✓
9187 sc	Concentration [ppm]	Float	✓	✓	✓	✓	✓	✓
9187 sc	Concentration [ug/L]	Float	✓	✓	✓	✓	✓	✓
9187 sc	Current [nA]	Float	✓	✓	✓	✓	✓	✓
9187 sc	Current [uA]	Float	✓	✓	✓	✓	✓	✓
9187 sc	Temperature [°C]	Float	✓	✓	✓	✓	✓	✓
9187 sc	Temperature [°F]	Float	✓	✓	✓	✓	✓	✓
9187 sc	pH [pH]	Float	✓	✓	✓	✓	✓	✓
D3422 (digital) - 3400 sc	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
D3422 (digital) - 3400 sc	Conductivity	Float	✓	✓	✓	✓	✓	✓
D3422 (digital) - 3400 sc	Resistivity	Float	✓	✓	✓	✓	✓	✓
D3422 (digital) - 3400 sc	Salinity [ppt]	Float	✓	✓	✓	✓	✓	✓
D3422 (digital) - 3400 sc	Temperature [°C]	Float	✓	✓	✓	✓	✓	✓
D3422 (digital) - 3400 sc	Temperature [°F]	Float	✓	✓	✓	✓	✓	✓
D3422 (digital) - 3400 sc	Total dissolved solids	Float	✓	✓	✓	✓	✓	✓
D3700 sc (analogic) 6120800 (gateway)	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
D3700 sc (analogic) 6120800 (gateway)	Concentration [%]	Float	✓	✓	✓	✓	✓	✓
D3700 sc (analogic) 6120800 (gateway)	Total dissolved solids [ppm]	Float	✓	✓	✓	✓	✓	✓
D3700 sc (analogic) 6120800 (gateway)	Conductivity	Float	✓	✓	✓	✓	✓	✓
D3700 sc (analogic) 6120800 (gateway)	Salinity [ppt]	Float	✓	✓	✓	✓	✓	✓
D3700 sc (analogic) 6120800 (gateway)	Temperature [°C]	Float	✓	✓	✓	✓	✓	✓
D3700 sc (analogic) 6120800 (gateway)	Temperature [°F]	Float	✓	✓	✓	✓	✓	✓
34yyxx (analog) + Gateway (6120700)	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
34yyxx (analog) + Gateway (6120700)	Conductivity	Float	✓	✓	✓	✓	✓	✓
34yyxx (analog) + Gateway (6120700)	Resistivity	Float	✓	✓	✓	✓	✓	✓
34yyxx (analog) + Gateway (6120700)	Salinity [ppt]	Float	✓	✓	✓	✓	✓	✓

Device	Name	Type	mA-O	HVR	P-DP	M-TCP	PRN	E/IP
34yyxx (analog) + Gateway (6120700)	Temperature [°C]	Float	✓	✓	✓	✓	✓	✓
34yyxx (analog) + Gateway (6120700)	Temperature [°F]	Float	✓	✓	✓	✓	✓	✓
34yyxx (analog) + Gateway (6120700)	Total dissolved solids	Float	✓	✓	✓	✓	✓	✓
pHD (analog) + Gateway (6120500)	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
pHD (analog) + Gateway (6120500)	ORP [mV]	Float	✓	✓	✓	✓	✓	✓
pHD (analog) + Gateway (6120500)	Temperature [°C]	Float	✓	✓	✓	✓	✓	✓
pHD (analog) + Gateway (6120500)	Temperature [°F]	Float	✓	✓	✓	✓	✓	✓
pHD (analog) + Gateway (6120500)	pH [pH]	Float	✓	✓	✓	✓	✓	✓
RC and PC (analog) + Gateway (6120600)	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
RC and PC (analog) + Gateway (6120600)	ORP [mV]	Float	✓	✓	✓	✓	✓	✓
RC and PC (analog) + Gateway (6120600)	Temperature [°C]	Float	✓	✓	✓	✓	✓	✓
RC and PC (analog) + Gateway (6120600)	Temperature [°F]	Float	✓	✓	✓	✓	✓	✓
RC and PC (analog) + Gateway (6120600)	pH [pH]	Float	✓	✓	✓	✓	✓	✓
8362 sc panel pH/ORP V5	Set of eight generic tags	Integer	—	—	✓	✓	✓	✓
8362 sc panel pH/ORP V5	ORP [mV]	Float	✓	✓	✓	✓	✓	✓
8362 sc panel pH/ORP V5	pH [pH]	Float	✓	✓	✓	✓	✓	✓
8362 sc panel pH/ORP V5	Temperature [°C]	Float	✓	✓	✓	✓	✓	✓
8362 sc panel pH/ORP V5	Temperature [°F]	Float	✓	✓	✓	✓	✓	✓

HACH COMPANY World Headquarters
P.O. Box 389, Loveland, CO 80539-0389 U.S.A.
Tel. (970) 669-3050
(800) 227-4224 (U.S.A. only)
Fax (970) 669-2932
orders@hach.com
www.hach.com

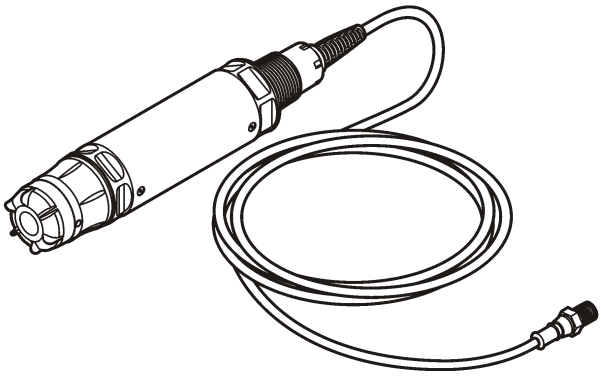
HACH LANGE GMBH
Willstätterstraße 11
D-40549 Düsseldorf, Germany
Tel. +49 (0) 2 11 52 88-320
Fax +49 (0) 2 11 52 88-210
info-de@hach.com
www.de.hach.com

HACH LANGE Sàrl
6, route de Compois
1222 Vésenaz
SWITZERLAND
Tel. +41 22 594 6400
Fax +41 22 594 6499

DOC023.97.80170

LDO Sensor

07/2012, Edition 2



USER MANUAL

Table of Contents

Specifications

Specifications are subject to change without notice.

Specification	Details
Wetted materials (probe body)	CPVC, sensor end and cable end
	Polyurethane, over-molding on cable end and cable jacket
	316 stainless steel body and screws
	Viton, O-ring
	Noryl, nut on the cable end
IP classification	IP68
Wetted materials (sensor cap)	Acrylic
Measurement range (dissolved oxygen)	0 to 20 ppm (0 to 20 mg/L)
	0 to 200% saturation
Measurement accuracy (dissolved oxygen)	Below 5 ppm: ± 0.1 ppm
	Above 5 ppm: ± 0.2 ppm
Repeatability (dissolved oxygen)	0.1 ppm (mg/L)
Response time (dissolved oxygen)	T_{90}<40 seconds
	T_{95}<60 seconds
Resolution, sensor (dissolved oxygen)	0.01 ppm (mg/L); 0.1% saturation.
Measurement range (temperature)	0 to 50 °C (32 to 122 °F)
Measurement accuracy (temperature)	± 0.2 °C (± 0.36 °F)
Interferences	No interferences from the following: H_2S, pH, K^+, Na^+, Mg^{2+}, Ca^{2+}, NH_4^+, Al^{3+}, Pb^{2+}, Cd^{2+}, Zn^{2+}, Cr (total), Fe^{2+}, Fe^{3+}, Mn^{2+}, Cu^{2+}, Ni^{2+}, Co^{2+}, CN^-, NO_3^-, SO_4^{2-}, S^{2-}, PO_4^{3-}, Cl^-, Anion Active Tensides, Crude Oils, Cl_2 < 4 ppm
Storage temperature	–20 to 70 °C (–4 to 158 °F)
Maximum ambient temperature	60 °C (140 °F). Suitable for use in water up to 50 °C (122 °F)
Hazardous location classification (5790001 sensor only)	Class I Division 2, Groups A–D, T4 / Class I, Zone 2 Group 2C, T4 ***Note:*** *This product does not fulfill the requirements of the 94/9/EC Directive (ATEX Directive).*
Certifications (5790001 sensor only)	ETL listed to ANSI/ISA, CSA and FM standards for use in hazardous location. ***Note:*** *This product does not fulfill the requirements of the 94/9/EC Directive (ATEX Directive).*
Minimum flow rate	Not required

Specification	Details
Calibration/verification	Air calibration: One point, 100% water-saturated air
	Sample calibration: Comparison with standard instrument
Probe immersion depth and pressure limits	Pressure Limits at 34 m (112 ft.), 345 kPa (50 psi) maximum; accuracy may not be maintained at this depth
Sensor cable	10 m (30 ft) integral cable with quick disconnect plug (all sensor types) Up to 100 m possible with extension cables (non-Class I, Division 2 sensor types only) Up to 1000 m with junction box (non-Class I, Division 2 sensor types only)
Probe weight	1.0 kg (2 lb, 3 oz)
Probe dimensions	Diameter x length: 49.3 x 255.7 mm (1.9 x 10.1 in.)
Power requirements	12 VDC, 0.25 A, 3 W
Warranty	Probe: 3 years against manufacturing defects
	Sensor cap: 2 years against manufacturing defects

General information

In no event will the manufacturer be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual. The manufacturer reserves the right to make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions are found on the manufacturer's website.

Safety information

NOTICE

The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect processes during a possible equipment malfunction.

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than that specified in this manual.

Use of hazard information

⚠ DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE
Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol on the instrument is referenced in the manual with a precautionary statement.

	This is the safety alert symbol. Obey all safety messages that follow this symbol to avoid potential injury. If on the instrument, refer to the instruction manual for operation or safety information.
	This symbol indicates the presence of a light source that may have the potential to cause minor eye injury. Obey all messages that follow this symbol to avoid potential eye injury.
	This symbol indicates the presence of devices sensitive to Electro-static Discharge (ESD) and indicated that care must be taken to prevent damage with the equipment.
	Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/98/EC), European electrical equipment users must now return old or end-of-life equipment to the Producer for disposal at no charge to the user. ***Note:*** *For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxillary items for proper disposal.*

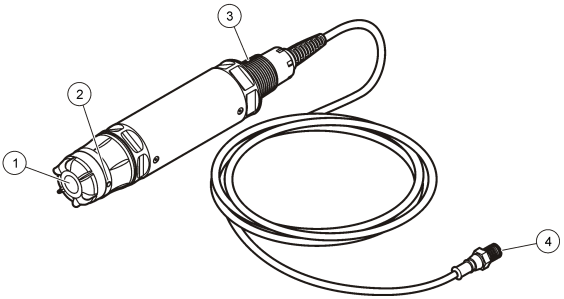
Product overview

⚠ DANGER
 Chemical or biological hazards. If this instrument is used to monitor a treatment process and/or chemical feed system for which there are regulatory limits and monitoring requirements related to public health, public safety, food or beverage manufacture or processing, it is the responsibility of the user of this instrument to know and abide by any applicable regulation and to have sufficient and appropriate mechanisms in place for compliance with applicable regulations in the event of malfunction of the instrument.

This sensor is designed to work with a controller for data collection and operation. The sensor can be used with several controllers. Refer to the controller-specific user manual for more information.

The primary applications for this sensor are municipal and industrial wastewater applications. LDO sensor technology does not consume oxygen, and can measure DO concentration in low or no-flow applications. Refer to Figure 1.

Figure 1 LDO sensor

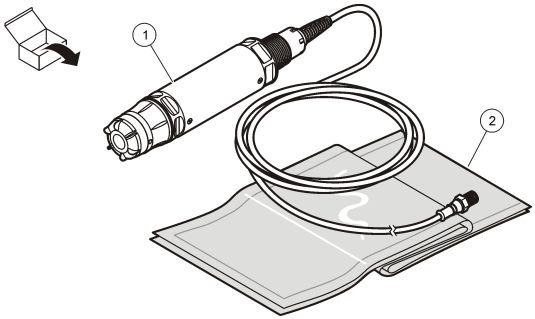


1 Sensor cap	**3** 1-inch NPT
2 Temperature sensor	**4** Connector, quick-connect (standard)

LDO Sensor component list

Make sure that all components shown in Figure 2 have been received. If any items are missing or damaged, contact the manufacturer or a sales representative immediately. Refer to Figure 2.

Figure 2 Sensor component list



1 LDO sensor[1]	**2** Calibration bags (2x)

[1] Included user manual is not shown.

Installation

Validate the sensor type

⚠ DANGER

Explosion hazard. Connect only peripheral components that are clearly marked as certified for Class 1, Division 2 Hazardous Locations.

NOTICE

The hazardous location certified version of this product does not fulfill the requirements of the 94/9/EC Directive (ATEX Directive).

1. Go to the connector end of the cable.
2. Read the label on the connector end of the cable. For hazardous location certified sensors, the label will show "Rated: Class 1 Division 2".

3. Examine the connector.
   - Hazardous location certified sensors have a safety lock connector. Refer to Figure 3 on page 7.
   - Sensors that are not certified for hazardous locations have a quick-connect connector, without a safety lock.

Connect the sensor in a hazardous location

⚠ DANGER

Explosion hazard. This equipment is suitable for use in non-hazardous locations or Class 1, Division 2, Groups A, B, C, D Hazardous Locations with specified sensors and options when installed per the Hazardous Location Installation Control Drawing. Always refer to the Control Drawing and applicable electrical code regulations for proper installation instructions.

⚠ DANGER

Explosion hazard. Do not connect or disconnect electrical components or circuits to the equipment unless power has been removed or the area is known to be non-hazardous.

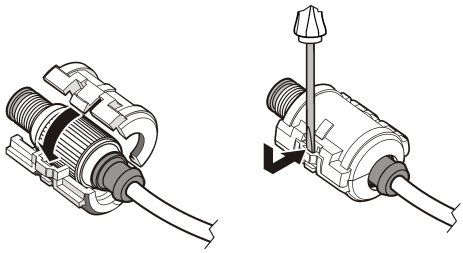
NOTICE

Use only a hazardous location certified sensor and cable lock in hazardous locations. The hazardous location certified version of this product does not fulfill the requirements of the 94/9/EC Directive (ATEX Directive).

For more information, refer to Validate the sensor type on page 6 .

1. Remove the connector cap from the controller. Keep the connector cap to seal the connector opening when the sensor is removed.
2. Connect the sensor to the controller. Refer to the controller manual for more information.
3. Close the safety lock over the connector.
4. To remove the connector safety lock, use a small flat screwdriver. Refer to Figure 3.

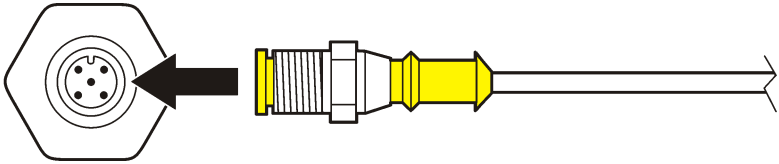
Figure 3 Connector safety lock



Connect the sensor in a non-hazardous location

Refer to Figure 4 to connect an LDO sensor to an sc controller. Refer to the specific sc controller manual for hard-wiring instructions.

Figure 4 Connect the LDO sensor (non-hazardous location sensor shown)



After the sensor is attached, scan for the sensor. Refer to Install the sensor on page 8.

Install the sensor

There are two options to install the sensor:

- Connect the sensor while power to the controller is off. The controller will look for and install new sensors when it is turned on.
- Connect the sensor while power to the controller is on. Use the Scan Devices command to install the new sensor:

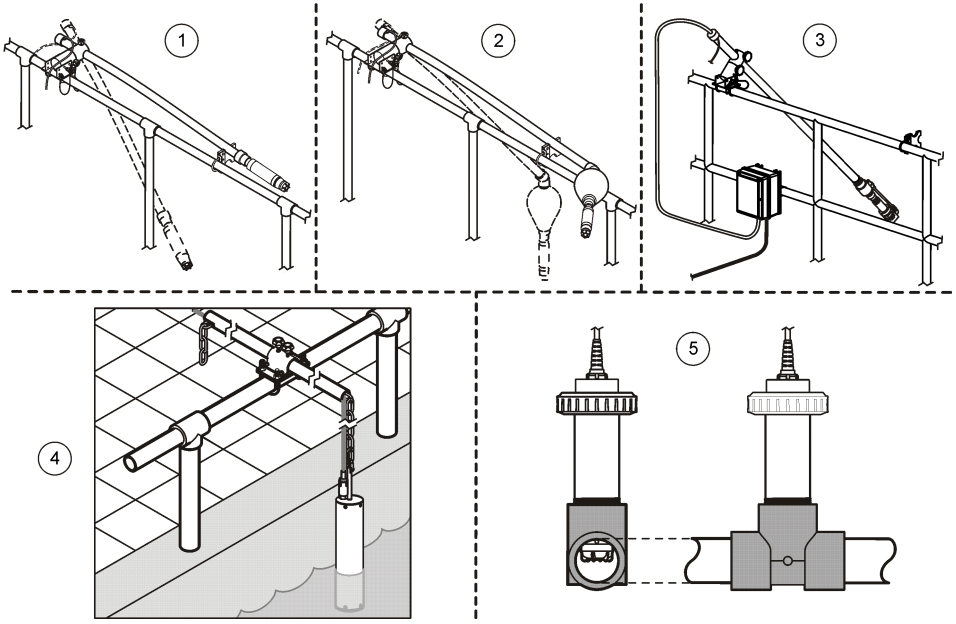
Option	Description
sc200 controller	Go to MENU>TEST/MAINT>SCAN DEVICE
sc100 controller	Go to MENU>TEST/MAINT>SCAN SENSORS
sc1000 controller	Go to MENU>SYSTEM SETUP>DEVICE MANAGEMENT>SCANNING FOR NEW DEVICES

Refer to Connect the sensor in a non-hazardous location on page 7 for digital sensor connection.

Sensor installation options

The installation and accessory options available for the LDO sensor are supplied with installation instructions in the hardware kit. Figure 5 shows several installation options. To order installation hardware, refer to Replacement parts and accessories on page 17.

Figure 5 Installation options



1 Rail mount	**4** Chain mount
2 Float mount	**5** Union mount
3 Air blast system mount	

Operation

User navigation

Refer to the controller documentation for keypad description and navigation information.

Configure the sensor

Use the Configure menu to enter identification information for the sensor and to change options for data handling and storage.

For information about sensor installation, refer to Install the sensor on page 8.

Make sure that all of the Configuration menu values are correct for the application.

1. Go to MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE.
2. Select an option, ENTER. The list of available options is shown in the table below.

Option	Description
EDIT NAME	Changes the name that corresponds to the sensor on the top of the measure screen. The name is limited to 10 characters in any combination of letters, numbers, spaces or punctuation.
SET UNITS	TEMP–Sets the temperature units to °C (default) or °F.
	MEASURE–Set the measurement units in mg/L, ppm or % .
	ALT/PRESS–Set the altitude in m or ft, or set the atmospheric pressure units in mmHg or torr. (Default value = 0 ft)
ALT/PRESS	Enter the value of the altitude or atmospheric pressure. This value must be accurate to complete % saturation measurements and calibration in air. (Default = 0 ft).
SALINITY	Enter the salinity value. Salinity range: 0.00 to 250.00 parts per thousand (‰). Refer to Enter a salinity correction value on page 10 for more information. (Default value = 0)
SIGNAL AVERAGE	Set the time interval to average signal in seconds
CLEAN INTRVL	Set the time interval for manual sensor cleaning in days (Default value = 0 days. A value of 0 days disables the clean interval.)
RESET CLN INTRVL	Set the time interval to the last saved clean interval
LOG SETUP	Sets the time interval for data storage in the data log—0.5, 1, 2, 5, 10, 15 (default), 30, 60 minutes.
SET DEFAULTS	Restores the configurable default values for the sensor. Does not change the setting for slope or offset.

Enter the atmospheric pressure value

The factory setting for atmospheric (air) pressure is 0 ft, or sea level. To change the default value, use the steps in this procedure. The adjustment for air pressure is entered as either elevation or as pressure units (preferred).

Note: *Accurate air pressure is critical for saturated air calibration (Calibration with air on page 11). Use only absolute pressure, not adjusted. If the absolute air pressure is not known, use the correct elevation for the location.*

1. Go to MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE>SET UNITS>AIR PRESS/ALT UNITS.
2. Select **one** of the unit options listed:

Option	Description
ft	Feet—unit of measure for elevation
m	Meters—metric unit of measure for elevation

Option	Description
mmHg	Millimeters of mercury—metric unit of measure for absolute air pressure
torr	Unit of measure for absolute air pressure

3. Confirm the selection. The value entry screen will show the selected units.
4. Enter the value, then confirm.

Enter a salinity correction value

Dissolved oxygen measurements in saline samples can show an apparent DO value that is very different from the actual DO value. To correct for the influence of dissolved salts in a sample, enter a salinity correction factor.

Note: *If the presence or amount of salinity in the process is unknown, consult with the treatment facility engineering staff.*

1. Use a conductivity meter to measure the conductivity of the sample in mS/cm at a reference temperature of 20 °C (68 °F).
2. Use Table 1 to estimate the salinity correction factor in parts per thousand (‰) saturation.

   Note: *The chloride ion concentration, in g/kg is equal to the chlorinity of the sample. Salinity is calculated with the formula: Salinity = 1.80655 × chlorinity.*

   Salinity can be calculated with the relationship in section 2520 B of *Standard Methods for the Examination of Water and Wastewater*.*,
3. Go to MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE>SALINITY.
4. Enter the salinity correction factor and confirm.

Table 1 Salinity saturation (‰) per conductivity value (mS/cm)

mS/cm	‰	mS/cm	‰	mS/cm	‰	mS/cm	‰
5	3	16	10	27	18	38	27
6	4	17	11	28	19	39	28
7	4	18	12	29	20	40	29
8	5	19	13	30	21	42	30
9	6	20	13	31	22	44	32
10	6	21	14	32	22	46	33
11	7	22	15	33	23	48	35
12	8	23	15	34	24	50	37
13	8	24	17	35	25	52	38
14	9	25	17	36	25	54	40
15	10	26	18	37	26		

* *Standard Methods for the Examiniation of Water and Wastewater*, 20th Edition. Editors Lenore S. Clesceri, Arnold E. Greenberg and Andrew D. Eaton, p. 2-48-2-29 (1998). The relationship between Chlorinity and Oxygen Solubitity is provided in the same reference in 4500-O:I p. 4-131.

Configure linear output on the controller

Linear outputs send probe data back to the facility PLC, SCADA or other data collection system.

1. Go to the controller output setup menu.

Option	Description
sc200	Go to MENU>SETTINGS>sc200 SETUP>OUTPUT SETUP>[Select Output]>SET FUNCTION.
sc100	Go to MENU>SYSTEM SETUP>OUTPUT SETUP>[Select Output]>SET FUNCTION.
sc1000	Go to MENU>SYSTEM SETUP>OUTPUT SETUP>[Select Output]>SET FUNCTION.

2. Set the function for the controller.

Option	Description
sc200	LINEAR
sc100	LINEAR CONTROL (Default value)
sc1000	LINEAR CONTROL (Default value)

Modbus registers

A list of Modbus registers is available for network communication. Refer to www.hach.com or www.hach-lange.com for more information.

Calibration for measurements

The sensor is calibrated to specification at the factory. The manufacturer does not recommend calibration unless periodically required by regulatory agencies. If calibration is required, let the sensor come to equilibrium with the process before calibration. Do not calibrate the sensor at setup.

Table 2 shows options for calibration.

Table 2 Calibration options

Option	Description
AIR CAL	Recommended calibration method. This calibration modifies the slope.
SAMPLE CAL	Calibration by comparison with a hand-held DO meter . This calibration modifies the offset.
RESET DFLT CAL	Resets the calibration gain (slope) and offset to the factory default: default gain=1.0; default offset=0.0

Calibration with air

User notes:

- Make sure that calibration bag has water inside.
- Make sure that the seal between the calibration bag and the sensor body is tight.
- Make sure that the sensor is dry when it is calibrated.
- Make sure the air pressure/elevation setting is accurate for the calibration location.
- Allow enough time for the sensor temperature to stabilize to the temperature of the calibration bag location. A large difference in temperature between the process and the calibration location can take up to 15 minutes to stabilize.

1. Remove the sensor from the process. Use a wet cloth to clean the sensor.
2. Put the entire sensor in a calibration bag with 25-50 mL of water. Make sure that the sensor cap is not in contact with the water inside the calibration bag and that no water drops are on the sensor cap (Figure 6).
3. Use a rubber band, tie or hand to create a tight seal around the sensor body.

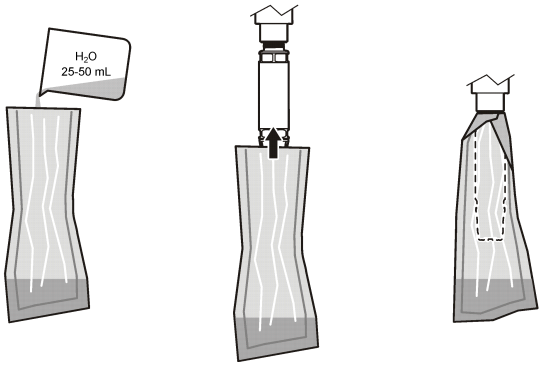
4. Let the instrument stabilize for 15 minutes before calibration. Keep the calibration bag out of direct sunlight during stablization.
5. Make sure that the current absolute air pressure or elevation is configured correctly. Refer to Enter the atmospheric pressure value on page 9.

   Note: *The manufacturer recommends the use of absolute or actual air pressure as a best practice.*
6. Go to MENU>SENSOR SETUP>[Select Sensor]>CALIBRATE>AIR CAL.
7. Select the option for the output signal during calibration:

Option	Description
Active	The instrument sends the current measured output value during the calibration procedure.
Hold	The sensor output value is held at the current measured value during the calibration procedure.
Transfer	A preset value is sent during calibration. Refer to the controller user manual to change the preset value.

8. The controller will show "Move the probe to bag". Allow the value to stabilize. Push ENTER to accept the stable value. Alternately, let the calibration continue until the display shows "Complete".
9. When the sensor is calibrated, put the sensor into the process. Push ENTER.

Figure 6 Air calibration procedure



If the value does not stabilize, the display will show "Unable to Calibrate" followed by an error message. Table 3 shows the error message and resolution for calibration problems.

Table 3 Air calibration error messages

Message	Description	Resolution
Cal fail, gain high	The calculated gain value is too high.	Repeat the calibration.
Cal fail, gain low	The calculated gain value is too low.	Repeat the calibration.
Cal fail, unstable	The value did not stabilize in the maximum allowed calibration time.	Repeat the calibration.

Sample CAL - calibration by comparison

This calibration method uses an alternate sensor attached to a hand-held meter.

1. Put the alternate sensor into the process. Put the second sensor as close as possible to the first sensor.
2. Wait for the DO value to stabilize .
3. On the controller for the first sensor, go to MENU>SENSOR SETUP>[Select Sensor]>CALIBRATE>SAMPLE CAL.

4. Select the option for the output signal during calibration:

Option	Description
Active	The instrument sends the current measured output value during the calibration procedure.
Hold	The sensor output value is held at the current measured value during the calibration procedure.
Transfer	A preset value is sent during calibration. Refer to the controller user manual to change the preset value.

5. The controller will show:
   - "Press ENTER when stabilized"
   - The current dissolved oxygen measurement
   - The current temperature measurement
6. When the measurement is stable, push ENTER. The display will show an entry screen.

   Note: *The measurement will usually stabilize in 2 to 3 minutes.*

If the value does not stabilize, the display will show "Unable to Calibrate" followed by an error message. Table 4 shows the error message and resolution for calibration problems.

Table 4 Sample cal error messages

Message	Description	Resolution
Cal fail, offset high	The calculated offset value is too high.	Repeat the calibration.
Cal fail, offset low	The calculated offset value is too low.	Repeat the calibration.
Cal fail, unstable	The value did not stabilize in the maximum allowed calibration time.	Repeat the calibration.

Exit the calibration procedure

1. During calibration, push the BACK key. Three options are shown:

Option	Description
ABORT	Stop the calibration. A new calibration must start from the beginning.
BACK TO CAL	Return to the current calibration.
LEAVE	Exit the calibration temporarily. Access to other menus is allowed while the calibration continues in the background. A calibration for a second sensor (if present) can be started. To return to the calibration, push the MENU key and select Sensor Setup, [Select Sensor].

2. Select one of the options. Confirm.

Reset calibration defaults

Calibration settings can be reset to the factory defaults. Gain and offset values are set to 1.0 and 0.0, respectively.

1. Go to MENU>SENSOR SETUP>[Select Sensor]>CALIBRATE>RESET CAL DEFLT.
2. The display will show a confirmation message. Confirm to reset the sensor to the factory default calibration curve.

Maintenance

⚠ DANGER

Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

⚠ DANGER

Explosion hazard. Do not connect or disconnect electrical components or circuits to the equipment unless power has been switched off or the area is known to be non-hazardous.

⚠ DANGER

Explosion hazard. Substitution of components may impair suitability for Class 1, Division 2. Do not replace any component unless power has been switched off and the area is known to be non-hazardous.

NOTICE

The hazardous location certified version of this product does not fulfill the requirements of the 94/9/EC Directive (ATEX Directive).

Maintenance schedule

The maintenance schedule shows minimum intervals for regular maintenance tasks. Perform maintenance tasks more frequently for applications that cause electrode fouling.
Note: *Do not disassemble the probe for maintenance or cleaning.*

Maintenance task	Recommended minimum frequency
Clean the sensor	90 days
Inspect the sensor for damage	90 days
Calibrate the sensor	As recommended by regulatory agencies

Clean the sensor

Clean the exterior of the sensor with a soft, wet cloth.
Note: *If the sensor cap must be removed for cleaning, do not expose the interior of the cap to direct sunlight for extended periods of time.*

Set or change the clean interval

Application conditions may need shorter or longer durations between manual sensor cleanings. The default clean interval is 0 days. To change the interval, refer to the steps in this procedure.

1. Go to MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE>CLEAN INTRVL.
2. Change the shown value as needed. Confirm the change.
   - To turn off the clean interval, set the value to '0'.

Change the sensor cap

⚠ WARNING

Potential explosion hazard. The sensor setup cap is not rated for hazardous location use.

Replacement sensor caps and setup caps are shipped with installation instructions. Refer to the included instructions to change the cap.

For best performance and accuracy, replace the sensor cap:

- Every two years
- When routine inspection shows significant erosion of the sensor cap

Troubleshooting

Diagnostic and test menu

The diagnostic and test menu shows current and historical information about the LDO sensor. To access the diagnostic and test menu, go to MENU>SENSOR SETUP>[Select Sensor]>DIAG/TEST.

Refer to Table 5.

Table 5 DIAG/TEST menu

Option	Description
SENSOR INFO	SOFTWARE VERS—Shows the installed software version
	BOOT VERSION—Shows the installed boot version
	DRIVER VERS—Shows the installed software driver version
LOT CODE	Shows the sensor cap manufacturing lot
SERIAL NUMBER	Sensor serial number
GAIN CORR	Adjust the calibration gain value.
	Range: 0.50 to 2.00
OFFSET CORR	Adjust the calibration offset value (mg/L or ppm).
	Range: –3.00 to +3.00
PHASE DIAG	Shows the phase for total, red and blue wavelengths. Updates once per second.
AMPL DIAG	Shows the amplitude for red and blue wavelengths. Updates once per second.
DAYS TO CLEAN	Shows the number of days until the next scheduled manual cleaning.
SENSOR LIFE	Shows the number of days until the next scheduled sensor cap replacement

Error list

If an error occurs, the reading on the measurement screen flashes. Output behavior is determined by controller settings. Refer to the controller manual for details.
To show the current sensor errors, go to MENU>DIAGNOSTICS>[Select Sensor]>ERROR LIST. Refer to Table 6.

Table 6 Error list for the LDO sensor

Error	Possible cause	Resolution
RED AMPL LOW (Value is below 0.01) OR BLUE AMPL LOW (Value is below 0.01)	The sensor cap is not installed, or is not installed correctly.	Remove the sensor cap and install it again.
	The light path is blocked in the sensor cap.	Inspect the inside of the sensor cap and lens.
	The sensor is not operating correctly.	Make sure that the LED is flashing. Contact the manufacturer.

Warning list

When the warning icon flashes (sc100 and sc200) or when the screen turns yellow (sc1000), a message is shown on the bottom of the measurement screen. On the sc1000, the screen turns

yellow to show a warning. To show the current sensor warnings, go to MENU> DIAGNOSTICS>[Select Sensor]>WARNING LIST. Refer to Table 7.

Table 7 Sensor warning list

Warning	Definition	Resolution
EE SETUP ERR	Storage is corrupt. The values have been set to the factory default.	Contact technical support.
EE RSRVD ERR		
TEMP < 0 C	The process temperature is below 0 °C (32 °F)	Increase the process temperature or stop use until the process temperature is in the sensor specification range.
TEMP > 50 C	The process temperature is above 50 °C (120 °F)	Decrease the process temperature or stop use until the process temperature is in the sensor specification range.
RED AMPL LOW	Value falls below 0.03	Refer to Table 6 on page 15 .
RED AMPL HIGH	Value is greater than 0.35	Call technical support.
BLUE AMPL LOW	Value is below 0.03	Refer to Table 6 on page 15.
BLUE AMPL HIGH	Value is greater than 0.35	Call technical support.
CAP CODE FAULT	The sensor cap code has become corrupt. The code has been reset automatically to the default cap and lot codes.	Complete the sensor setup cap procedure. If no setup cap is available for the sensor cap, call technical support.

Event list

The Event list keeps a log of changes to how data is recorded by the sensor. To show sensor events, go to MENU>DIAGNOSTICS>[Select Sensor]>EVENT LIST.
Refer to Table 8.

Table 8 Event list for the sensor

Event	Description
ALT/PRESSURE UNIT CHANGE	Atmospheric pressure or altitude units have changed.
ALT/PRESSURE CHANGE	The value for altitude or atmospheric pressure has changed.
TEMP UNIT CHANGE	The units for temperature have changed.
MEAS UNIT CHANGE	A new unit of measurement has changed.
SALINITY CHANGE	The value for salinity has changed.
SET DEFAULT	Sensor settings have been reset to the default values.
SENSOR SETUP CHANGE	The sensor setup has changed.
CLEAN INTERVAL TIMER CHANGE	The time between sensor cleaning has changed.
SENSOR CAP LIFE TIMER CHANGE	The time between sensor cap replacements has changed.

Replacement parts and accessories

Replacement items

Description	Item no. (US / EU)
LDO Probe, with one sensor cap and 2 calibration bags	9020000 / LXV416.99.20001
LDO Probe for hazardous locations, with one sensor cap and 2 calibration bags	9020300 / —
Sensor cap, replacement (includes the sensor setup cap, which is not rated for use in Class 1, Division 2 hazardous locations)	9021100 / 9021150

Accessories

Description	Item no. (US / EU)
Sensor cable lock for hazardous locations	6139900 / —
High output air blast cleaning system, 115 V (not rated for use in hazardous locations)	6860000 / 6860003.99.0001
High output air blast cleaning system, 230 V (not ATEX rated for use in hazardous locations)	6860100 / 6860103.99.0001
Calibration bag (1x)	5796600 / 5796600
Cable, sensor extension, non-hazardous location, 7.7 m (25 ft)[1]	US: 5796000, 7.7 m (25 ft)
	EU: LZX849, 10 m (33 ft)
Hardware kit for pipe mount (PVC)	9253000 / LZY714.99.21810
Hardware kit for float mount (PVC)	9253100 / LZX914.99.42200
Hardware kit for air blast mount	9253500 / LZY812
Hardware kit for chain mount (stainless steel)	— / LZX914.99.11200
Hardware kit for union mount	9257000 / 9257000
HQd meter with LDO rugged probe (not rated for use in hazardous locations)	8505200 / HQ40D.99.310.000

[1] 15 m (49 ft) and 30 m (98 ft) also available

Catalog Number 6120218

pHD sc Digital Differential pH/ORP Sensors

USER MANUAL

April 2009, Edition 5

eac/te/dp

Table of Contents

Section 1 Specifications

Specifications are subject to change without notice.

Table 1 Differential pH and ORP Sensor Specifications

Specification Category	pH Sensors[1]	Stainless Steel pH Sensor	ORP Sensors[2]
Wetted Materials	PEEK®[3] or Ryton®[4] (PVDF) body, salt bridge of matching material with Kynar®[5] junction, glass process electrode, titanium ground electrode, and Viton®[6] O-ring seals (pH sensor with optional HF-resistant glass process electrode has 316 stainless steel ground electrode, and perfluoroelastomer wetted O-rings; for other wetted O-ring materials consult the manufacturer)	Immersion mounting only, 316 SS Stainless Steel body with Ryton® (PVDF) ends and salt bridge.	PEEK® or Ryton® (PVDF) body, salt bridge of matching material with Kynar® junction, glass and platinum (or glass and gold) process electrode, titanium ground electrode, and Viton® O-ring seals
Operating Temperature Range	–5 to 70 °C (23 to 158 °F) for sensor with integral digital electronics –5 to 105 °C (23 to 221 °F) for analog sensor with digital gateway	0 to 50 °C (32 to 122 °F) for sensor with integral digital electronics	–5 to 70 °C (23 to 158 °F) for sensor with integral digital electronics –5 to 105 °C (23 to 221 °F) for analog sensor with digital gateway
Pressure/Temperature Limits (without mounting hardware)	6.9 bar at 105 °C (100 psi at 221 °F) for analog with gateway 6.9 bar at 70 °C (100 psi at 158 °F)	N/A (immersion only)	6.9 bar at 70 °C (100 psi at 158 °F) 6.9 bar at 105 °C (100 psi at 221 °F) for analog with gateway
Maximum Flow Rate	3 m (10 ft) per second	3 m (10 ft) per second	3 m (10 ft) per second
Built-in Temperature Element	NTC 300 ohm thermistor for automatic temperature compensation and analyzer temperature readout	NTC 300 ohm thermistor for automatic temperature compensation and analyzer temperature readout	NTC 300 ohm thermistor for analyzer temperature readout only — not for automatic temperature compensation
Stability	0.03 pH per 24 hours, non-cumulative	0.03 pH per 24 hours, non-cumulative	2 mV per 24 hours, non-cumulative
Maximum Transmission Distance	1000 m (3280 ft) with termination box	1000 m (3280 ft) with termination box	1000 m (3280 ft) with termination box
Sensor Cable (integral)	Digital: PUR (polyurethane) 4-conductor with one shield, rated to 105 °C (221 °F), 10 m (33 ft) standard length Analog: Five-conductor (plus two isolated shields) cable with XLPE (cross-linked polyethylene) jacket; rated to 150 °C (302 °F); 6 m (20 ft) standard length	Digital: PUR (polyurethane) 4-conductor with one shield, rated to 105 °C (221 °F), 10 m (33 ft) standard length	Digital: PUR (polyurethane) 4-conductor with one shield, rated to 105 °C (221 °F), 10 m (33 ft) standard length Analog: Five-conductor (plus two isolated shields) cable with XLPE (cross-linked polyethylene) jacket; rated to 150 °C (302 °F); 6 m (20 ft) standard length
Components	Corrosion-resistant materials, fully-immersible probe with 10 m (30 ft) cable	Corrosion-resistant materials, fully-immersible probe with 10 m (30 ft) cable	Corrosion-resistant materials, fully-immersible probe with 10 m (30 ft) cable
Measuring Range	–2.0 to 14.0 pH or –2.00 to 14.00 pH	–2.0 to 14.0 pH or –2.00 to 14.00 pH	–1500 to +1500 mV
Probe Storage Temperature	4 to 70 °C (40 to 158 °F); 0 to 95% relative humidity, non-condensing	4 to 70 °C (40 to 158 °F); 0 to 95% relative humidity, non-condensing	4 to 70 °C (40 to 158 °F); 0 to 95% relative humidity, non-condensing

Table 1 Differential pH and ORP Sensor Specifications (continued)

Specification Category	pH Sensors[1]	Stainless Steel pH Sensor	ORP Sensors[2]
Temperature Compensation	Automatic from –10 to 105 °C (14.0 to 221 °F) with selection for NTC 300 ohm thermistor, Pt 1000 ohm RTD, or Pt 100 ohm RTD temperature element, or manually fixed at a user-entered temperature; additional selectable temperature correction factors (ammonia, morpholine, or user-defined pH/°C linear slope) available for pure water automatic compensation from 0.0 to 50 °C (32 to 122 °F)	Automatic from –10 to 105 °C (14.0 to 221 °F) with selection for NTC 300 ohm thermistor, Pt 1000 ohm RTD, or Pt 100 ohm RTD temperature element, or manually fixed at a user-entered temperature; additional selectable temperature correction factors (ammonia, morpholine, or user-defined pH/°C linear slope) available for pure water automatic compensation from 0.0 to 50 °C (32 to 122 °F)	N/A
Measurement Accuracy	±0.02 pH	±0.02 pH	±5 mV
Temperature Accuracy	±0.5 °C (0.9 °F)	±0.5 °C (0.9 °F)	±0.5 °C (0.9 °F)
Repeatability	±0.05 pH	±0.05 pH	±2mV
Sensitivity	±0.01 pH	±0.01 pH	±0.5 mV
Calibration Methods	Two point automatic, one point automatic, two point manual, one point manual.	Two point automatic, one point automatic, two point manual, one point manual.	one point manual
Maximum Probe Immersion Depth/ Pressure	Submersible to 107 m (350 ft)/1050 kPa (150 psi)	Immersion only	Submersible to 107 m (350 ft)/1050 kPa (150 psi)
Sensor Interface	Modbus	Modbus	Modbus
Probe Cable Length	6 m (20 ft) + 7.7 m (25 ft) interconnect cable extension for analog sensor with digital gateway 10 m (31 ft) for sensor with integral digital electronics	6 m (20 ft) + 7.7 m (25 ft) interconnect cable extension for analog sensor with digital gateway 10 m (31 ft) for sensor with integral digital electronics	6 m (20 ft) + 7.7 m (25 ft) interconnect cable extension for analog sensor with digital gateway 10 m (31 ft) for sensor with integral digital electronics
Probe Weight	316 g (11 oz)	870 g (31 oz)	316 g (11 oz)
Probe Dimensions	See Figure 2 on page 9 through Figure 3 on page 9.	See Figure 4 on page 9.	See Figure 2 on page 9 through Figure 3 on page 9.

[1] Most pH applications are in the 2.5 to 12.5 pH range. The pHD™ Differential pH sensor with the wide-range glass process electrode performs exceptionally well in this range. Some industrial applications require accurate measurement and control below 2 or above 12 pH. In these special cases, please contact the manufacturer for further details.

[2] For best ORP measuring results in solutions containing zinc, cyanide, cadmium or nickel, the manufacturer recommends using the pHD™ ORP sensor equipped with a gold electrode.

[3] PEEK® is a registered trademark of ICI Americas, Inc.

[4] Ryton® is a registered trademark of Phillips 66 Co.

[5] Kynar® is a registered trademark of Pennwalt Corp.

[6] Viton® is a registered trademark of E.I. DuPont de Nemours + Co.

Table 2 Digital Gateway Specifications

Weight	145 g (5 oz)
Dimensions	17.5 x 3.4 cm (7 x 1 3/8 in.)
Operating Temperature	–20 to 60 °C (–4 to 140°F)

Section 2 General Information

2.1 Safety Information

Please read this entire manual before unpacking, setting up, or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To ensure that the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that specified in this manual.

This product is acceptable for use in a Hazardous Location when used with an sc100 Controller and installed per Control Drawing 58600-78 as described in the sc100 Controller Manual, Cat. No. 5860018.

2.1.1 Use of Hazard Information

DANGER
Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION
Indicates a potentially hazardous situation that may result in minor or moderate injury.

Important Note: *Information that requires special emphasis.*

Note: *Information that supplements points in the main text.*

2.1.2 Precautionary Labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed.

	This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.
	This symbol, when noted on a product enclosure or barrier, indicates that a risk of electrical shock and/or electrocution exists.
	This symbol, if noted on the product, indicates the need for protective eye wear.
	This symbol, when noted on the product, identifies the location of the connection for Protective Earth (ground).
	This symbol, when noted on the product, identifies the location of a fuse or current limiting device.

2.2 General Sensor Information

Optional equipment, such as mounting hardware for the probe, is supplied with instructions for all user installation tasks. Several mounting options are available, allowing the probe to be adapted for use in many different applications.

The electronics of the sensor are encapsulated in a PEEK® or Ryton® body. The pH sensor has an integral NTC 300 ohm thermistor to automatically compensate pH readings for temperature changes. ORP sensors have a fixed temperature value of 25 °C/300 ohm (the ORP measurement is not temperature dependent).

2.2.1 Sensor Body Styles

pHD™ Differential pH and ORP sensors are available in three body styles:

- **Convertible Body Style** — has 1-inch NPT threads at both ends of the body for mounting in any of the following configurations:
  - into a standard 1-inch NPT pipe tee
  - into a pipe adapter for union mounting with a standard 1-½ inch pipe tee
  - onto the end of a pipe for immersion into a vessel

Note: *The convertible style sensor can also be retrofitted into existing installations for 1-½ inch LCP, Ryton, and epoxy sensors.*

- **Insertion Body Style** — similar to the convertible sensor except that its 1-inch NPT threads are only on the cable end for mounting into a flow cell or the pipe adapter of a ball valve hardware assembly. This hardware enables the sensor to be inserted into or retracted from the process without stopping the process flow.
- **Sanitary Body Style** — features a built-in 2-inch flange for mounting into a 2-inch sanitary tee. Included with the sanitary-style sensor is a special cap and EDPM compound gasket for use with the sanitary hardware.

In addition, all probes are available with or without integral digital electronics. For applications with extreme temperatures, the sensor without integral digital electronics can be combined with the digital gateway.

Figure 1 Convertible Style Sensor Dimensions

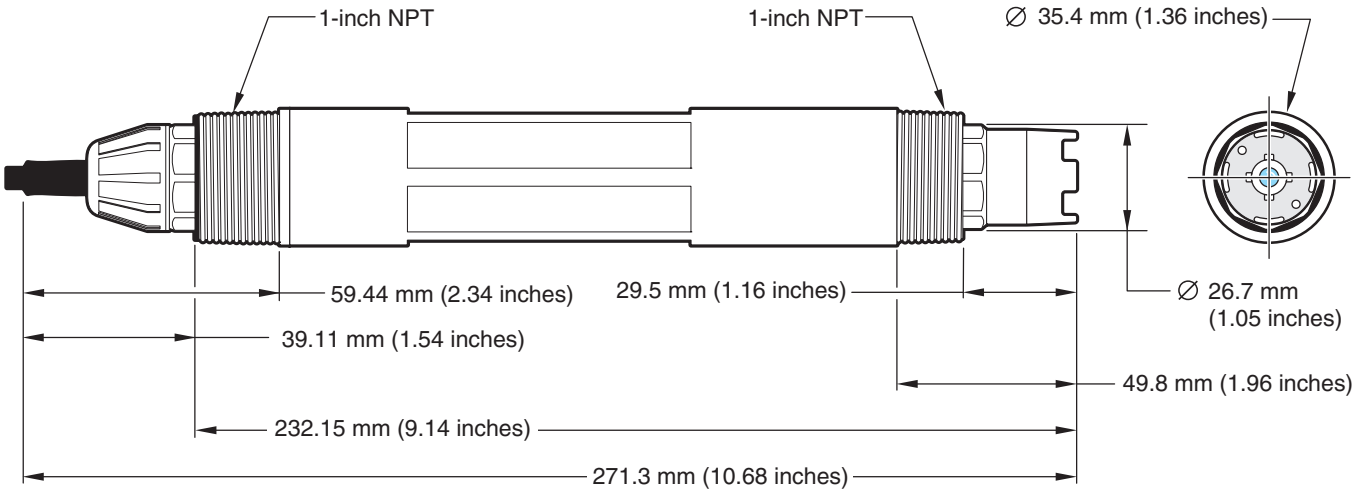


Figure 2 Insertion Style Sensor Dimensions

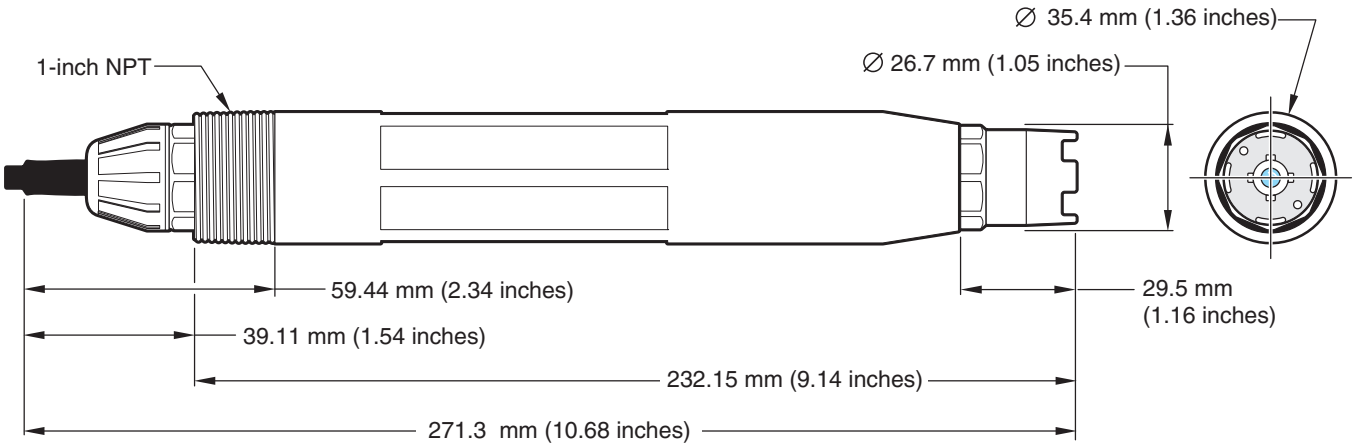


Figure 3 Sanitary Style Sensor Dimensions

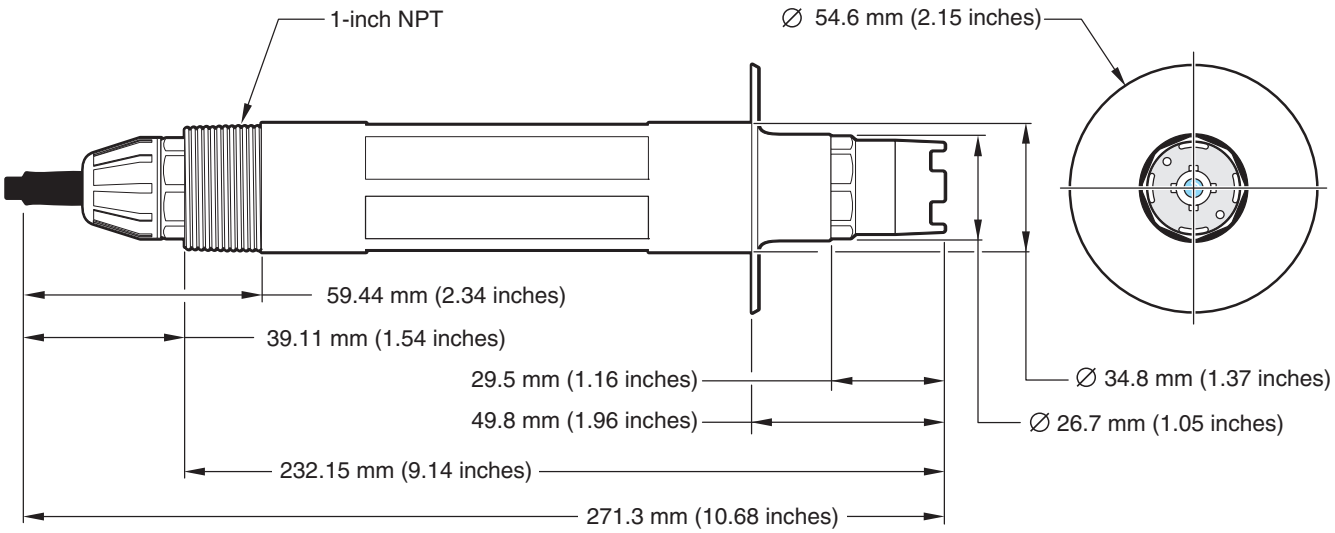
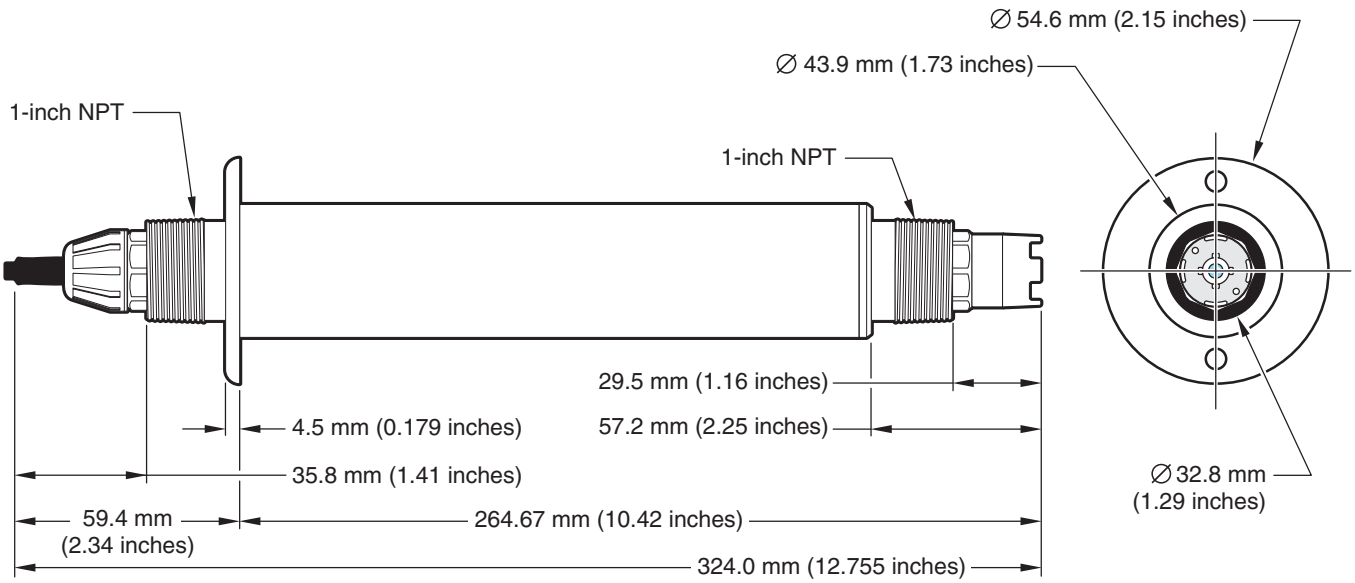


Figure 4 Stainless Steel Style Sensor (DPS1 and DRS5) Dimensions



2.3 The Digital Gateway

The digital gateway was developed to provide a means to use existing analog sensors with the new digital controllers. The gateway contains all the necessary software to interface with the controller and output a digital signal. Extension cables are required for connection from the digital gateway to the digital controller. See Replacement Parts and Accessories on page 41.

2.4 Operating Precaution

CAUTION
If the pH process electrode breaks, handle the sensor very carefully to prevent injury.

Before placing the pH or ORP sensor into operation, remove the protective cap to expose the process electrode and salt bridge. Save the protective cap for future use.

For short-term storage (when sensor is out of the process for more than one hour) fill the protective cap with pH 4 buffer or DI water and place the cap back on the sensor. Keeping the process electrode and salt bridge moist will avoid slow response when the sensor is placed back in operation.

For extended storage, repeat the short-term storage procedure every 2 to 4 weeks, depending on the surrounding environmental conditions. See Specifications on page 5 for temperature storage limits.

The process electrode at the tip of the pH sensor has a glass bulb, which can be broken. Do not subject it to abrupt impact or other mechanical abuse.

The gold or platinum process electrode at the ORP sensor tip has a glass shank (hidden by the salt bridge) which can break. Do not subject this electrode to impact or other mechanical abuse.

DANGER
Only qualified personnel should conduct the tasks described in this section of the manual.

DANGER
Seul un technicien qualifié peut effectuer les tâches d'installation décrites dans cette section du manuel.

3.1 Connecting/Wiring the Sensor to the sc100 Controller

DANGER
The sc100 and certain versions of the sensor are suitable for use in Class 1, Division 2, Groups A, B, C, D Hazardous Locations . See Control Drawing 58600-78 in the sc100 Controller Manual, Cat. No. 58600-18 for acceptable sensor versions and installation requirements.

DANGER
Le sc100 et certaines versions du capteur peuvent être utilisés dans des endroits dangereux de la Classe 1, Division 2, Groupes A, B, C, D. Reportez-vous au schéma de contrôle 58600-78 du Manuel du contrôleur sc100, Réf. 58600-18 pour connaître les versions des capteurs admises et les conditions d'installation.

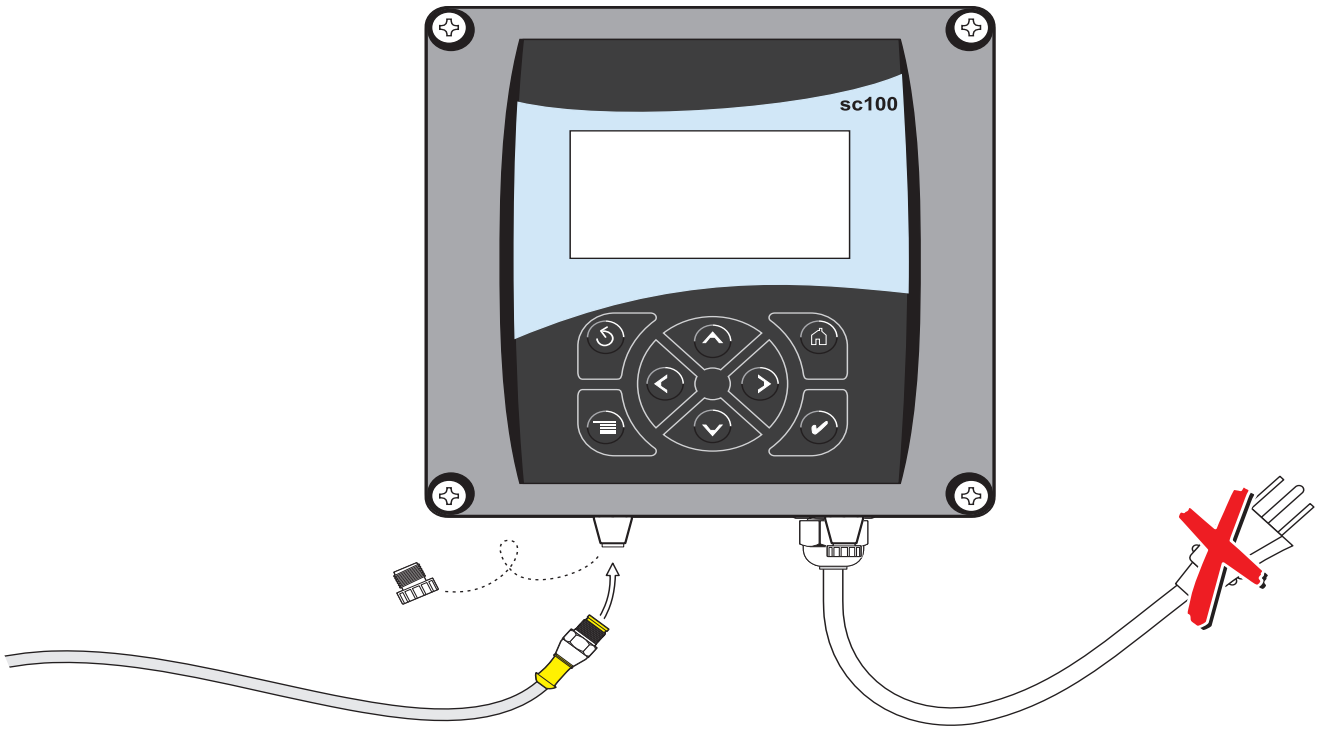
3.1.1 Connecting the sc Sensor to a sc100 Controller in a Non-hazardous Location

3.1.1.1 Attaching a sc Sensor with a Quick-connect Fitting

Important Note: *The standard quick-connect fitting is NOT suitable for Class 1, Division 2 Hazardous Location installations without the connector lock installed, see section 3.1.2 on page 13 for more information.*

The sensor has a keyed quick-connect fitting for easy attachment to the controller (Figure 5). Retain the connector cap to seal the connector opening when the sensor is removed. Extension cables may be purchased to extend the sensor cable length. If the total cable length exceeds 100 m (300 ft), a termination box must be installed. See Replacement Parts and Accessories on page 41.

Figure 5 Attaching the Sensor using the Quick-connect Fitting



3.1.1.2 Hard-wiring a sc Sensor to the Controller

Important Note: *Hard-wiring the sensor to the sc100 is not an approved method for Class I, Division 2 Hazardous Locations.*

1. Disconnect power to the controller if powered.
2. Open the controller cover.
3. Disconnect and remove the existing wires between the quick-connect and terminal strip J5, see Figure 5 on page 12.
4. Remove the quick-connect fitting and wires and install the threaded plug on the opening to maintain the environmental rating.
5. Cut the connector from the sensor cable.
6. Strip the insulation on the cable back 1-inch. Strip ¼-inch of each individual wire end.
7. Pass the cable through conduit and a conduit hub or a strain relief fitting (Cat.No.16664) and an available access hole in the controller enclosure. Tighten the fitting.

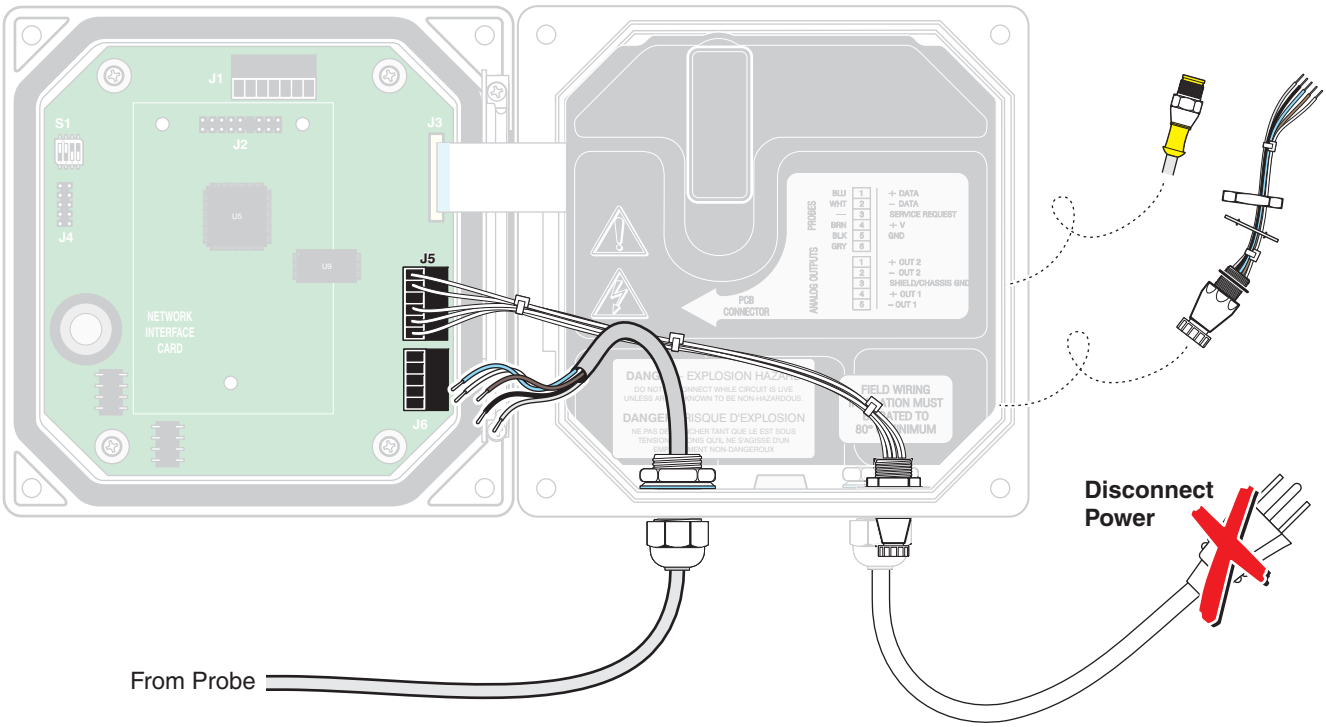
Note: *Use of strain relief fitting other than Cat. No. 16664 may result in a hazard. Use only the recommended strain relief fitting.*

8. Reinstall the plug on the sensor access opening to maintain the environmental rating.
9. Wire as shown in Table 3 and Figure 6.
10. Close and secure the cover.

Table 3 Wiring the Sensor at Terminal Block J5

Terminal Number	Terminal Designation	Wire Color
1	Data (+)	Blue
2	Data (–)	White
3	Service Request	No Connection
4	+12 V dc	Brown
5	Circuit Common	Black
6	Shield	Shield (grey wire in existing quick disconnect fitting)

Figure 6 Hard-wiring the sensor



3.1.2 Connecting the sc Sensor to a sc100 Controller in a Hazardous Location

DANGER
The sc100 and certain versions of the sensor are suitable for use in Class 1, Division 2, Groups A, B, C, D Hazardous Locations. See Control Drawing 58600-78 in the sc100 Controller Manual, Cat. No. 58600-18 for acceptable sensor versions and installation requirements.

DANGER
Le sc100 et certaines versions du capteur peuvent être utilisés dans des endroits dangereux de la Classe 1, Division 2, Groupes A, B, C, D. Reportez-vous au schéma de contrôle 58600-78 du Manuel du contrôleur sc100, Réf. 58600-18 pour connaître les versions des capteurs admises et les conditions d'installation.

DANGER
Explosion hazard. Do not connect or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

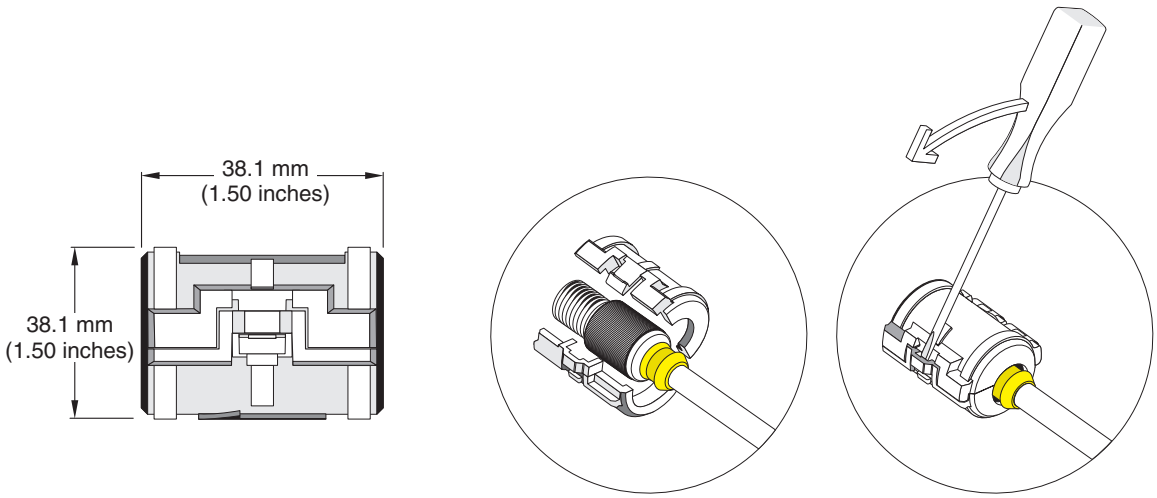
DANGER
Risque d'explosion. Couper le courant ou s'assurer que l'emplacement est designe non dangereux avant de replacer le aucon composant.

3.1.2.1 Attaching a sc Sensor with a Quick-connect Fitting in a Hazardous Location

The sensor cable is supplied with a keyed quick-connect fitting for easy attachment to the controller, see Figure 5. For hazardous locations, a connector safety lock (Cat. No. 6139900) **must** be installed. Retain the connector cap to seal the connector opening in case the sensor must be removed.

1. Remove the connector cap from sc100 controller. Retain the connector cap to seal the connector opening in case the sensor must be removed.
2. Connect the sensor connector to the plug on the sc100.
3. Install a connector safety lock (Figure 7). Align the lock over the connector and squeeze the two halves together to lock. To remove the connector safety lock by inserting a small flat-bladed screwdriver into the locking groove. Pivot the screwdriver away from the groove and separate the two halves (Figure 7).

Figure 7 Installing the Connector Safety Lock



3.2 Connecting the Sensor to the sc1000

3.2.1 Connecting the Sensor using the Quick-connect Fittings

1. Unscrew the connector cap from the controller. Retain the connector cap to seal the connector opening in case the sensor must be removed.
2. Push the connector into the socket.
3. Hand-tighten the union nut.

Note: *Do not use the middle connection for the sensors as this is reserved for the display module.*

3.3 Using the Digital Gateway

The digital gateway is designed to provide a digital interface to the controller. The non-sensor end is wired to the sc100 or sc1000 controller in a non-hazardous location as

shown in section 3.1.1 on page 11. The non-sensor end is wired to the sc100 controller in a hazardous location as shown in section 3.1.2 on page 13.

3.3.1 Wiring the Digital Gateway

DANGER
The sc100 and certain versions of the sensor are suitable for use in Class 1, Division 2, Groups A, B, C, D Hazardous Locations . See Control Drawing 58600-78 in the sc100 Controller Manual, Cat. No. 58600-18 for acceptable sensor versions and installation requirements.

DANGER
Le sc100 et certaines versions du capteur peuvent être utilisés dans des endroits dangereux de la Classe 1, Division 2, Groupes A, B, C, D. Reportez-vous au schéma de contrôle 58600-78 du Manuel du contrôleur sc100, Réf. 58600-18 pour connaître les versions des capteurs admises et les conditions d'installation.

DANGER
Explosion hazard. Do not connect or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

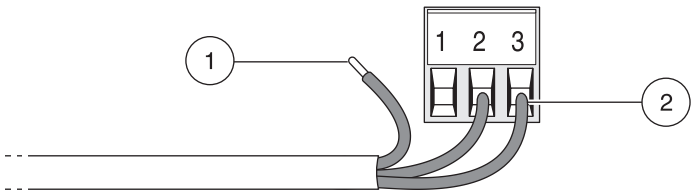
DANGER
Risque d'explosion. Couper le courant ou s'assurer que l'emplacement est designe non dangereux avant de replacer le aucon composant.

1. Route the cable from the sensor through the strain relief in the digital gateway then properly terminate the wire ends (see Figure 8).

Note: *Do not tighten the strain relief until the digital gateway is wired and the two halves are threaded securely together.*

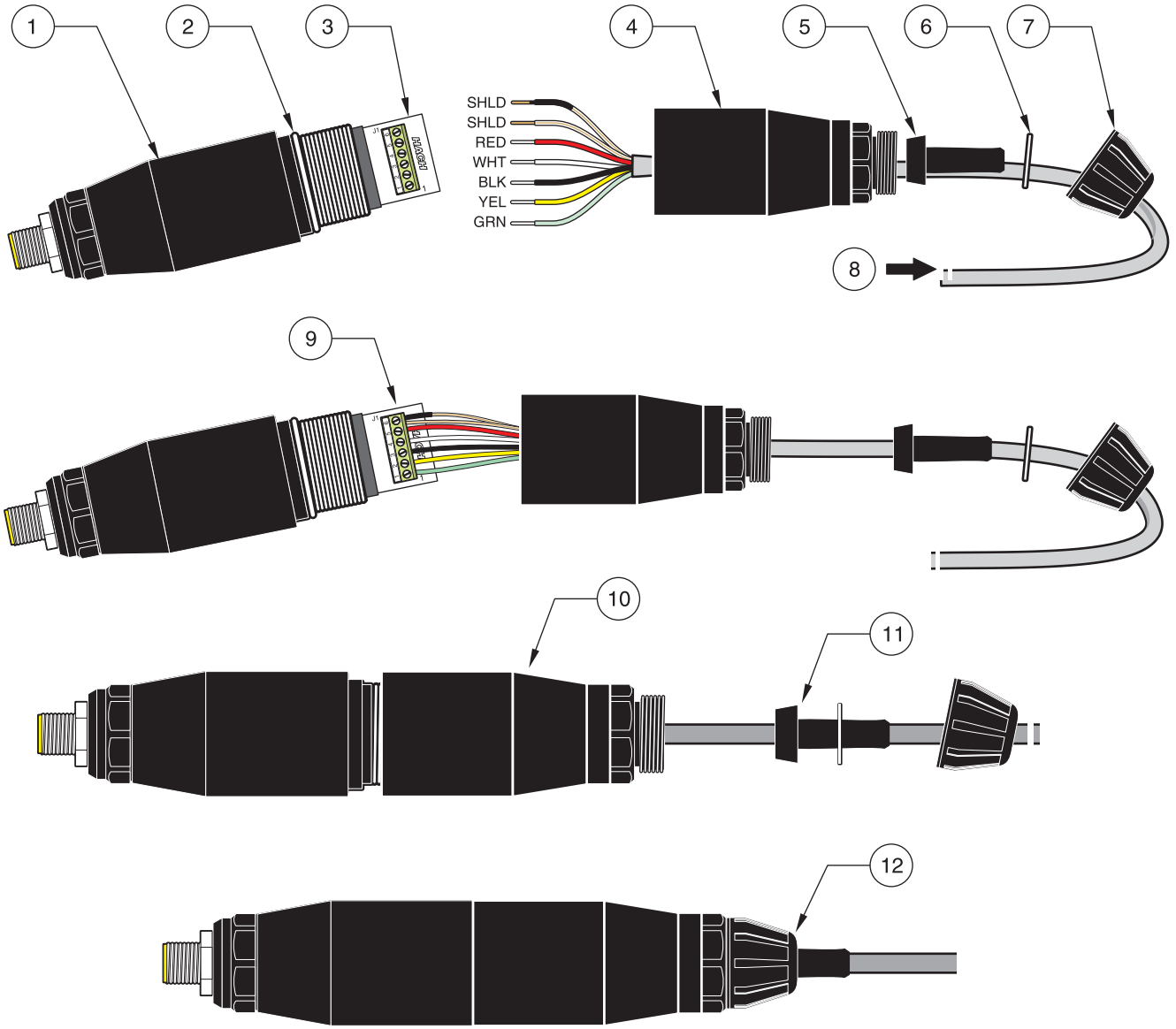
2. Insert the wires as shown in Table 4 and Figure 9.
3. Make sure the O-ring is properly installed between the two halves of the digital gateway and thread the two halves together. Hand tighten.
4. Tighten the strain relief to secure the sensor cable.
5. Connect the digital gateway to the controller.
   - sc100 Non-Hazardous Location Instructions—section 3.1.1 on page 11.
   - sc100 Hazardous Location Instructions—section 3.1.2 on page 13g
   - sc1000 Connection Instructions—Refer to section 3.2 on page 14.

Figure 8 Proper Wire Preparation and Insertion



1. Strip ¼-inch of insulation.	**1.** Seat insulation against connector with no bare wire exposed.

Figure 9 Wiring and Assembling the Digital Gateway



1. Digital gateway front	**7.** Cord grip
2. O-ring	**8.** From sensor
3. Sensor wire connector	**9.** Insert wires into connector according to Table 4. Use the included 2 mm screwdriver (Cat. No. 6134300) to secure connections.
4. Digital gateway back	**10.** Screw back of digital gateway onto front.
5. Cable bushing	**11.** Push cable bushing and anti-rotation washer into back.
6. Anti-rotation washer	**12.** Fasten cord grip securely. Assembly is complete.

Table 4 Wiring the Digital Gateway (Cat. No. 6120500)

Sensor (wire color)	Sensor Signal	Digital Gateway J1
Green	Ref	J1-1
Yellow	Temp +	J1-2
Black	Temp –	J1-3
White	VI	J1-4
Red	Active	J1-5
Clear	Shield	J1-6
Clear w/shrink wrap	Shield	J1-6

3.3.2 Mounting the Digital Gateway

The digital gateway is supplied with a mounting clip for mounting to a wall or other flat surface. See Figure 10 for dimensions. Use an appropriate fastener to secure it to the wall, see Figure 11. After the sensor is wired to the digital gateway and the two halves are threaded together, place the mounting clip over the center of the digital gateway and squeeze the clip together to secure.

Figure 10 Digital Gateway Dimensions

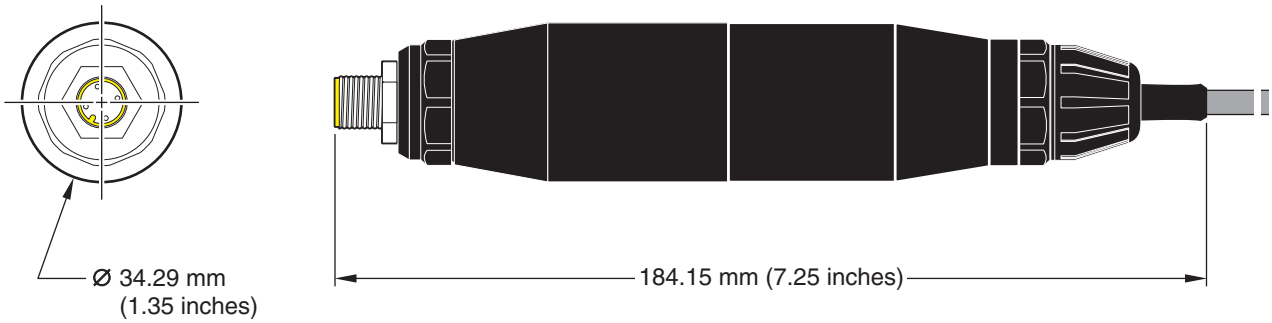
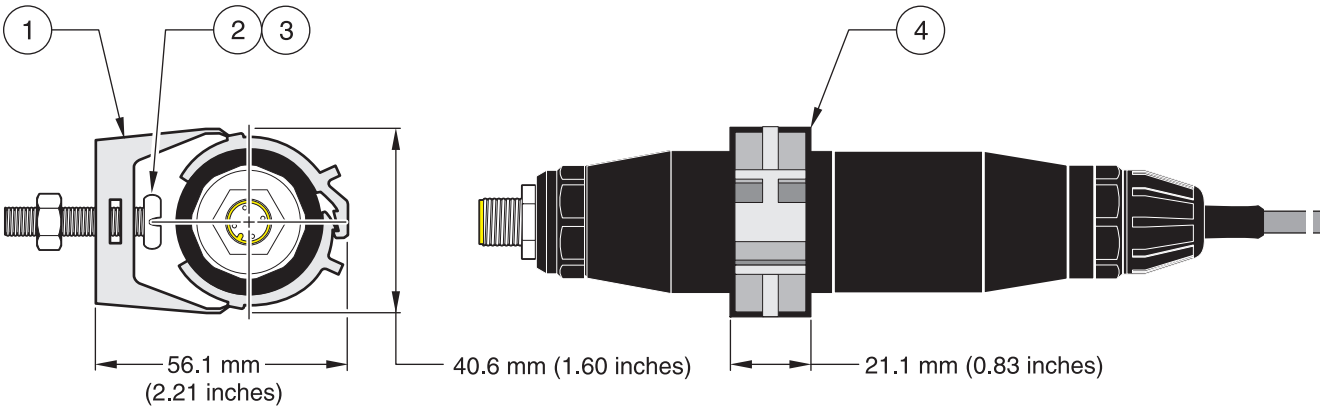


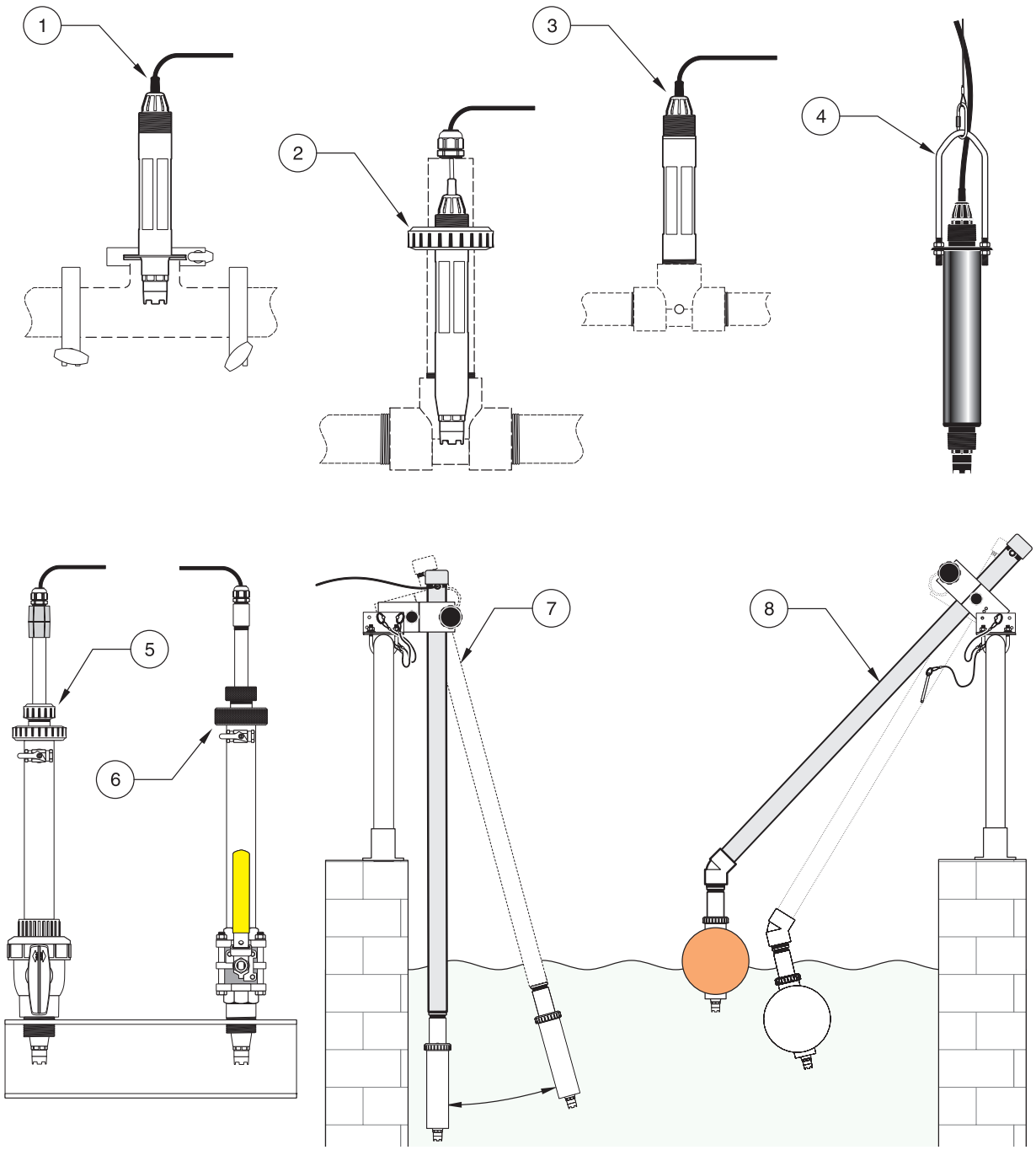
Figure 11 Mounting the Digital Gateway



1. Mounting Clip	**14.** Hex Nut, ¼-28
13. Screw, pan head, ¼-28 x 1.25-in.	**15.** Mount clip, insert digital gateway, squeeze clip closed.

3.4 Installing the Sensor in the Sample Stream

Figure 12 Sensor Installation Examples

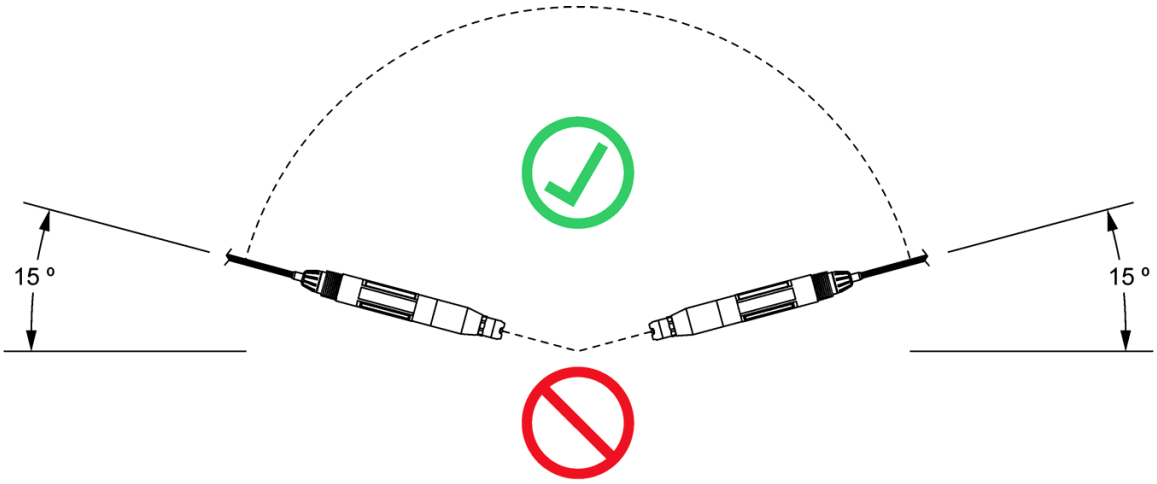


1. Sanitary mount	**19.** PVC Insertion mount
16. Union mount	**20.** Stainless steel insertion mount
17. Flow-through mount	**21.** Immersion mount
18. Hanging stainless steel sensor with the bale	**22.** Immersion mount, ball float

- Install the sensor so the sample contacts is representative of the entire process.
- Mount the sensor at least 508 mm (20 in) from the aeration basin wall, and immerse it at least 508 mm (20 in) into the process.

- Install the sensor using the instructions supplied with the installation apparatus. See Figure 12 for suggested mounting configurations.
- Sensor must be mounted at least 15º above horizontal. See Figure 13.

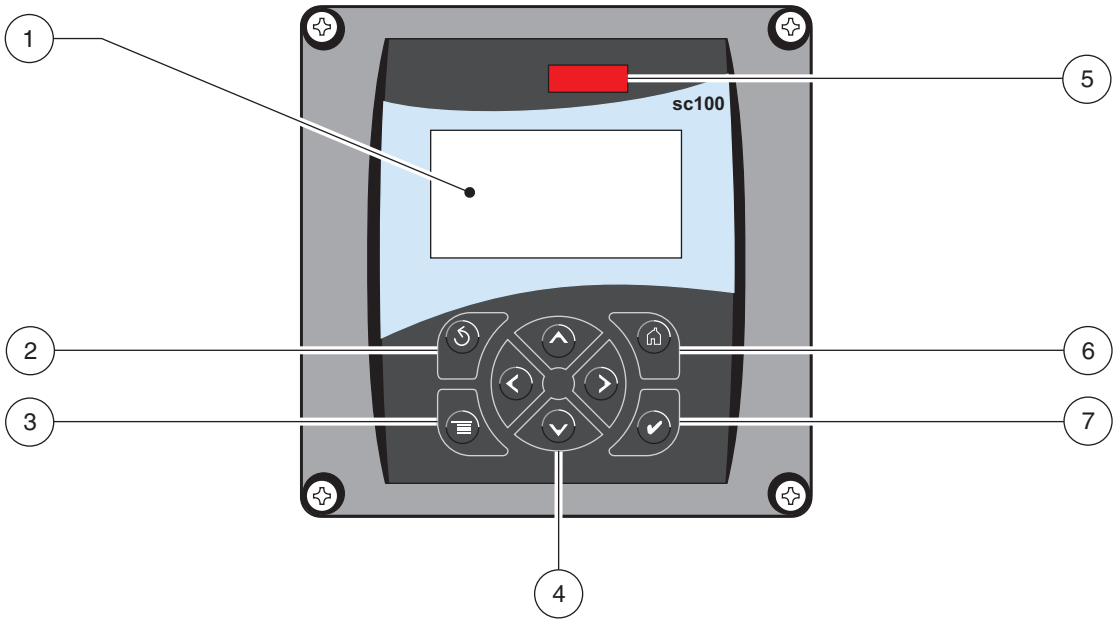
Figure 13 Sensor Mounting Angle



4.1 Using the sc100 Controller

The front of the controller is shown in Figure 14. The keypad consists of the eight keys described in Table 5.

Figure 14 Front of the Controller



1. Instrument display	**26.** IrDA window
23. BACK key	**27. HOME** key
24. MENU key	**28. ENTER** key
25. RIGHT, **LEFT**, **UP**, and **DOWN** keys	

Table 5 Controller Key Functions/Features

Number	Key	Function
2	back	Moves back one level in the menu structure.
3	menu	Moves to the main menu from other menus. This key is not active in menus where a selection or other input must be made.
4		Navigates through the menus, changes settings, and increments and decrements digits.
5	home	Moves to the Main Measurement screen from any other screen. This key is not active in menus where a selection or other input must be made.
6	enter	Accepts an input value, updates, or accepts displayed menu options.

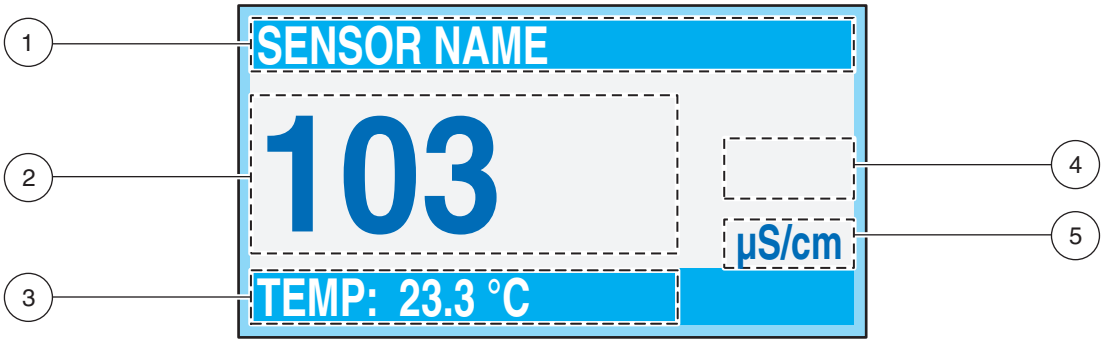
4.1.1 Controller Display Features

When a sensor is connected and the controller is in measurement mode, the controller display will show the current conductivity reading plus the sample temperature.

The display will flash on startup, when a sensor error has occurred, when the hold outputs function has been activated, and when a sensor is being calibrated.

An active system warning will cause the warning icon (a triangle with an exclamation point inside) to be displayed on the right side of the display.

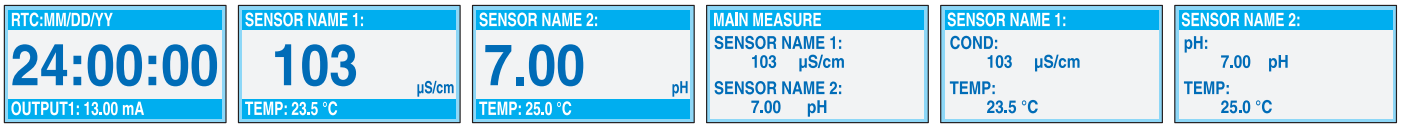
Figure 15 Display



1. Status bar. Indicates the sensor name and status of relays. The relay letter is displayed when the relay is energized.	**30.** Secondary measurement
	31. Warning icon area
29. Main measurement	**32.** Measurement units (µS, mS, S, mohm, TDS)

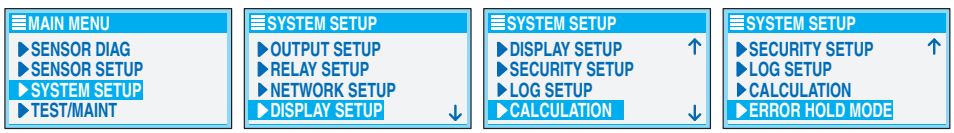
4.1.2 Important Key Presses

- Press the **HOME** key then the **RIGHT** or **LEFT** key to display two readings when two sensors are connected. Continue to press the **RIGHT** or **LEFT** key to toggle through the available display options as shown below.



- Press the **UP** and **DOWN** keys to toggle the status bar at the bottom of the measurement display to display the secondary measurement (temperature) and output information.

- When in Menu mode, an arrow may appear on the right side of the display to indicate that more menus are available. Press the **UP** or **DOWN** key (corresponding to the arrow direction) to display additional menus.



4.2 Using the sc1000 Controller

The sc1000 is a touch screen application. Use your finger to touch keys and menu commands. In normal operation the touch screen displays the measured values for the sensors selected.

4.2.1 Display Features

4.2.1.1 Using the Pop-up Toolbar

The pop-up toolbar provides access to the controller and sensor settings. The toolbar is normally hidden from view. To view the toolbar, touch the bottom-left of the screen.

Figure 16 Pop-up Toolbar Functions

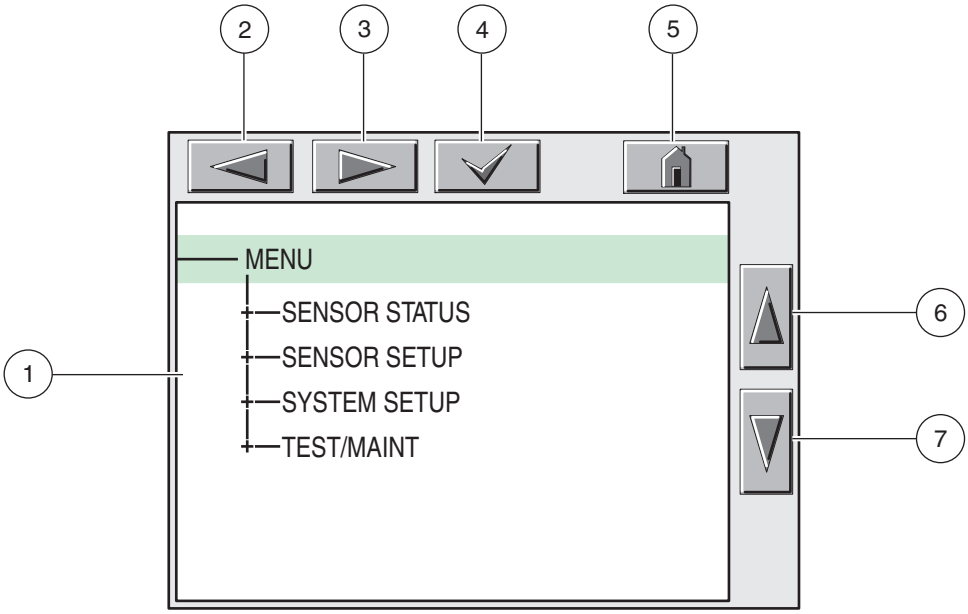
	**MAIN MENU**–displays the Main Menu Structure
	**UP** Arrow–scrolls up to the previous displayed value.
	Displays one value.
	Displays two values at the same time.
	Displays four values at the same time.
	**LIST**–displays the list of connected devices and sensors.
	**DOWN** Arrow–scrolls down to the next displayed value.

4.2.1.2 Using the Menu Windows

If the Menu button (from the pop-up toolbar) is selected, the Main Menu screen is opened. The Main Menu screen allows the user to view the sensor status, configure the sensor setup, system setup, and perform diagnostics.

The menu structure may vary depending on the configuration of the system.

Figure 17 Main Menu



1.	Display Area
33.	**BACK**
34.	**FORWARD**
35.	**ENTER**–confirms the entry or selection.
36.	**HOME**–changes to the display of measured values. The pop-up toolbar cannot open from the menu window. To view the Main Menu from this display, touch the Home button and then the bottom of the screen.
37.	**UP**–scrolls up
38.	**DOWN**–scrolls down

4.2.1.3 Navigating the Menu Windows

To view a menu item, touch the menu item or use the **UP** and **DOWN** keys to highlight the item. The menu item remains highlighted for approximately 4 seconds after it is selected. To view the highlighted command, select the area to the left of the menu item or select the **ENTER** button.

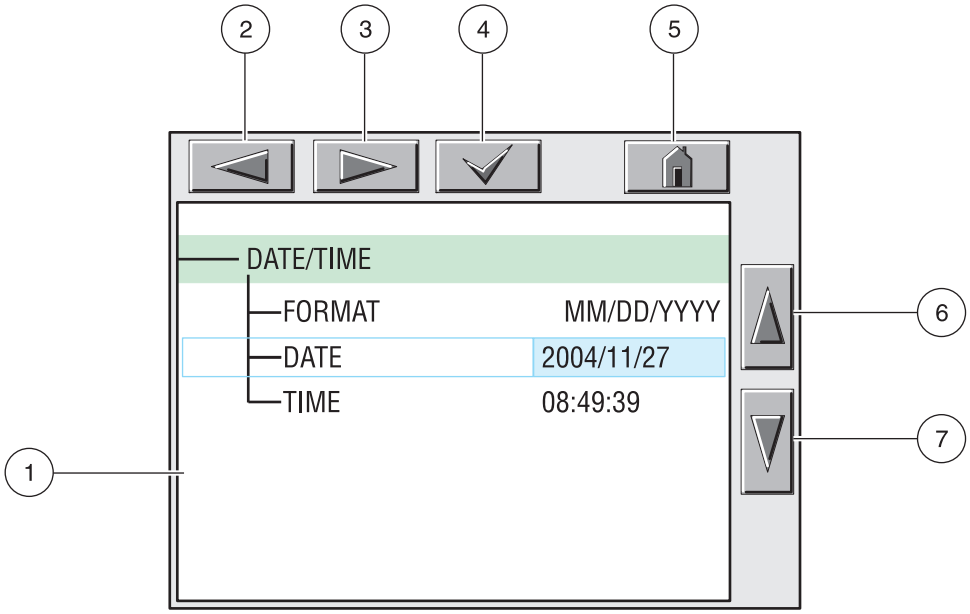
A "**+**" next to a menu command indicates there is a submenu. Touch the "+" to view the submenu. An "**i**" next to a menu command indicates it is information only.

If a menu item is editable, highlight the item and touch the far-left part of the menu item until it is highlighted and press **ENTER** or double-tap the highlighted item. A keypad will be displayed to change an entry (Figure 19 on page 25) or a list box will be displayed (Figure 20 on page 26).

Messages are displayed in the message window (Figure 21 on page 26).

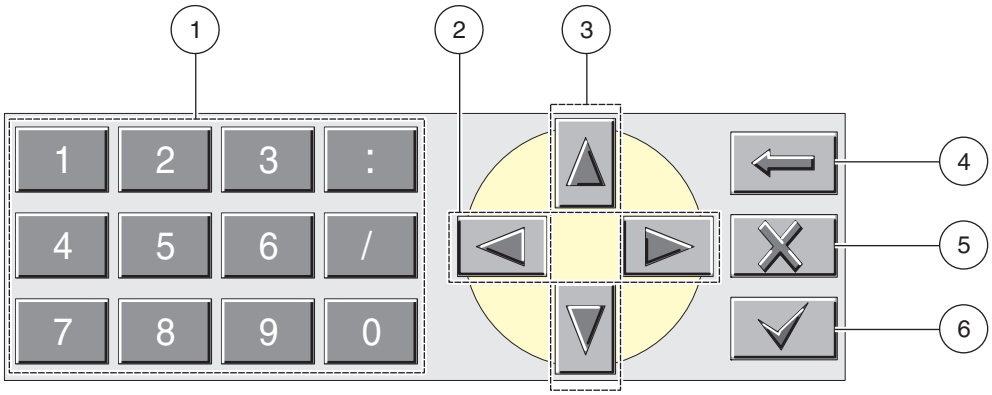
If an entry is incorrect, repeat the entry with the correct values. If the entry is outside the working range, a correction to the entry is made automatically.

Figure 18 Changing a Menu Item



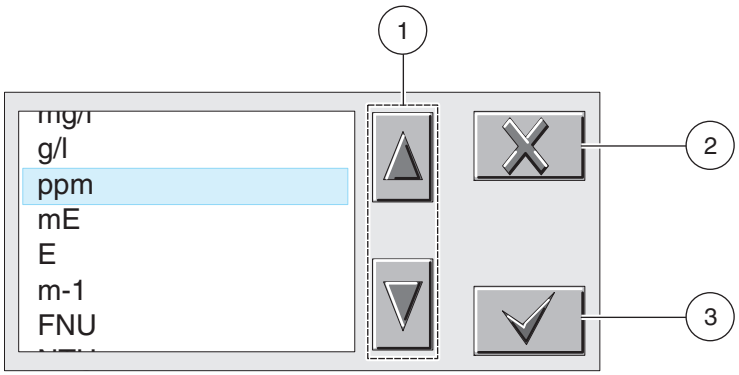
1. Display Area	**42.** **HOME**–changes to the display of measured values.
39. **BACK**	**43.** **UP**–scrolls up
40. **FORWARD**	**44.** **DOWN**–scrolls down
41. **ENTER**–confirms the entry or selection.	

Figure 19 Keypad



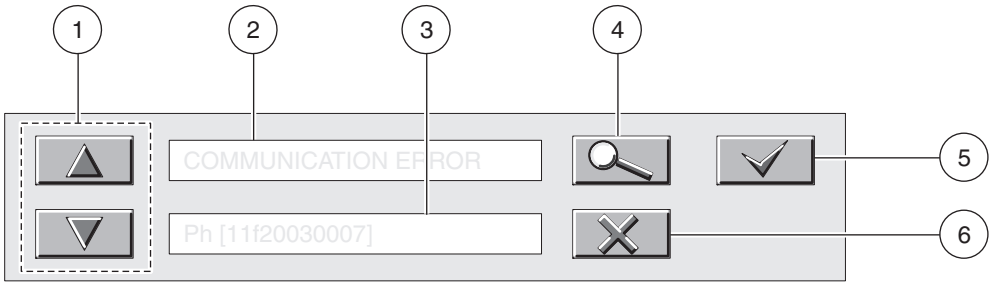
1. Enters numbers or the character as shown on the button.
45. Moves the cursor one position to the left or to the right.
46. Increase/Decrease a number or letter at the cursor position. Keep the button pressed to change the numbers/characters continuously.
47. Deletes the character to the left of the cursor.
48. **CANCEL**–cancels the entry.
49. **ENTER**–confirms the entry or selection.

Figure 20 List Box



1.	Scrolls up or down
50.	**CANCEL**–cancels and entry.
51.	**ENTER**–confirms a selection.

Figure 21 Message window



1.	Scrolls up or down.
52.	Displays the messages or warnings.
53.	Displays details on the selected entry.
54.	This button changes back to the previous display.
55.	**ENTER**–confirms an entry.
56.	**CANCEL**–cancels an entry.

Section 5 Operation

5.1 Sensor Setup

When a sensor is initially installed, the serial number of the sensor will be displayed as the sensor name. To change the sensor name refer to the following instructions:

1. Select Main Menu.
2. From the Main Menu, select SENSOR SETUP and confirm.
3. Highlight the appropriate sensor if more than one sensor is attached and confirm.
4. Select CONFIGURE and confirm.
5. Select EDIT NAME and edit the name. Confirm or cancel to return to the Sensor Setup menu.

5.2 Sensor Data Logging

The sc controller provides one data log and one event log for each sensor. The data log stores the measurement data at selected intervals. The event log stores a variety of events that occur on the devices such as configuration changes, alarms, warning conditions, etc. The data log and the event log can be read out in a CSV format. For downloading the logs please refer to the controller user manual.

5.3 Sensor Diagnostics Menu for pH and ORP Menu

SELECT SENSOR (if more than one sensor is attached)

STATUS	
ERROR LIST	See section 7.1 on page 37.
WARNING LIST	See section 7.2 on page 37.

5.4 pH Sensor Setup Menu

SELECT SENSOR (if more than one sensor is attached)

CALIBRATE	
1-POINT AUTO	Calibration with a single buffer — normally pH 7.
2-POINT AUTO	Calibration with two buffers — normally pH 7 and pH 4 or 10.
1-POINT MANUAL	Calibration against a single known sample.
2-POINT MANUAL	Calibration against two samples, both with a known pH.
TEMP ADJUST	Adjust the displayed temperature by up to ± 15 °C.
DEFAULT SETUP	Restores the system to the original factory calibration.

5.4 pH Sensor Setup Menu (continued)

CONFIGURE	
EDIT NAME	Enter a 10-digit name in any combination of symbols and alpha or numeric characters.
SELECT MEASURE	Select the appropriate measurement units to display.
DISPLAY FORMAT	Select the measurement resolution (xx.xx pH or xx.x pH).
TEMP UNITS	Choose from the displayed options (°C or °F).
LOG SETUP	Choose SENSOR INTERVAL to set the sensor log interval or select TEMP INTERVAL to set the temperature log interval.
REJECT FREQUENCY	Choose 50 or 60 Hz depending on the power line frequency for optimal noise rejection. Default is 60 Hz.
FILTER	Select 0–60 second signal averaging time.
TEMP ELEMENT	Select type of temperature element from the displayed choices.
SELECT BUFFER	Select the buffer type (standard 4, 7, 10 or DIN 19267) from the displayed choices.
PURE H20 COMP	Allows the user to specify that ammonia, morpholine, or other user-defined electrolyte is being used in the application, allowing a temperature-dependent linear slope factor to be applied to the measured pH.
CAL DAYS	Number of days since the last calibration. Default notification at 60 days.
SENSOR DAYS	Number of days the sensor has been in operation. Default notification at 365 days.
DEFAULT SETUP	Resets all user-editable options to their factory-defaults.
DIAG/TEST	
PROBE INFO	Display the sensor type, entered name of the sensor (Default: sensor serial number.), the sensor serial number, the software version number, and the sensor driver version number.
CAL DATA	Displays the pH slope and the date of the last calibration
SIGNAL	SENSOR SIGNAL: Displays the sensor output in mV SENSOR ADC COUNTS: Displays the sensor ADC counts TEMP ADC COUNTS: Displays raw data for temperature ADC counts. ADC counts are comparable to A/D counts and are for sensor electronic diagnostic purposes only. ELECTRODE STATE: Identifies the state of the electrode (good or bad) depending on whether the impedance is within preset limits. ACTIVE ELECT: Displays the impedance (Mohms) of the active electrode if Imped Status is set to Enabled. REF. ELECTRODE: Displays the impedance (Mohms) of the reference electrode if Imped Status is set to Enabled. IMPED STATUS: Sensor diagnostic. Choose Enabled or Disabled.
COUNTERS	SENSOR DAYS: displays the cumulative days the sensor has been in use. RESET SENSOR: Allows the sensor counter to be reset to zero. ELECTRODE DAYS: Cumulative days the electrode has been in use.

5.5 ORP Sensor Setup Menu

SELECT SENSOR (if more than one sensor is attached)

CALIBRATE	
1-POINT MANUAL	Calibration against a single known sample.
TEMP ADJUST	Adjust the displayed temperature by up to ± 15 °C.
DEFAULT SETUP	Restores the system to the original factory calibration.
CONFIGURE	
EDIT NAME	Enter up to a 10-digit name in any combination of symbols and alpha or numeric characters. Press **ENTER** when the entry is complete. The name will be displayed on the status line with the measurement value.
SELECT SENSOR	Choose from the displayed sensor type (pH or ORP).
TEMP UNITS	Choose from the displayed options (°C or °F).
LOG SETUP	Choose SENSOR INTERVAL to set the sensor log interval or select TEMP INTERVAL to set the temperature log interval.
AC FREQUENCY	Choose 50 or 60 Hz depending on the power line frequency for optimal noise rejection. Default is 60 Hz.
FILTER	Select 0–60 second signal averaging time.
TEMP ELEMENT	Select type of temperature element from the displayed choices.
SELECT BUFFER	Select the buffer type (standard 4, 7, 10 or DIN 19267) from the displayed choices.
PURE H20 COMP	Allows the user to specify that ammonia, morpholine, or other user-defined electrolyte is being used in the application, allowing a temperature-dependent linear slope factor to be applied to the measured pH.
CAL DAYS	Number of days since the last calibration. Default notification at 60 days.
SENSOR DAYS	Number of days the sensor has been in operation. Default notification at 365 days.
IMPED LIMITS	Set min/max electrode sensor impedance limits.
DEFAULT SETUP	Resets all user-editable options to their factory-defaults.
DIAG/TEST	
PROBE INFO	Display the sensor type, entered name of the sensor (Default: sensor serial number.), the sensor serial number, the software version number, and the sensor driver version number.
CAL DATA	Displays the pH slope and the date of the last calibration
SIGNAL	SENSOR SIGNAL: displays the sensor output in mV SENSOR ADC COUNTS: displays the sensor ADC counts TEMP ADC COUNTS: shows raw data for temperature ADC counts. ADC counts are comparable to A/D counts and are for sensor electronic diagnostic purposes only. ELECTRODE STATE: Identifies the state of the electrode (good or bad) depending on whether the impedance is within preset limits. ACTIVE ELECT: Shows the impedance (Mohms) of the active electrode if Imped Status is set to Enabled. REF. ELECTRODE: Shows the impedance (Mohms) of the reference electrode if Imped Status is set to Enabled. IMPED STATUS: Sensor diagnostic. Choose Enabled or Disabled.
COUNTERS	SENSOR DAYS: displays the cumulative days the sensor has been in use. RESET SENSOR: allows the sensor counter to be reset to zero. ELECTRODE DAYS: Cumulative days the electrode has been in use.

5.6 pH Calibration

The manufacturer offers one and two point automatic and manual calibrations for pH. An automatic calibration identifies the buffer table corresponding to the chosen buffer and automatically calibrates the probe after it stabilizes. A manual calibration is performed by placing the pH sensor in any buffer or sample with a known value and then entering that known value into the controller.

The value of the sample used in the manual calibration may be determined by laboratory analysis or comparison reading.

1. From the Main Menu, select SENSOR SETUP and confirm.
2. Select the appropriate sensor if more than one is attached and confirm.
3. Select CALIBRATE and confirm.
4. Select 1 POINT AUTO. Select the available Output Mode (Active, Hold, or Transfer) and confirm.
5. Move the clean probe to buffer and confirm to continue.
6. Confirm when stable. A screen will display 1 Point Auto Complete and the slope (XX.X mV/pH).
7. Return the probe to process.

5.6.1 Two Point Automatic Calibration

1. From the Main Menu, select SENSOR SETUP and confirm.
2. Select the appropriate sensor if more than one is attached and confirm.
3. Select CALIBRATE and confirm.
4. Select 2 POINT AUTO. Select the available Output Mode (Active, Hold, or Transfer) and confirm.
5. Move the clean probe to Buffer 1 and confirm.
6. Confirm when stable.
7. Move the clean probe to Buffer 2 and confirm.
8. Confirm when stable. A screen will display 2 Point Calibration Complete and the slope (XX.X mV/pH).
9. Return the probe to process.

5.6.2 One Point Manual Calibration

1. From the Main Menu, select SENSOR SETUP and confirm.
2. Select the appropriate sensor if more than one is attached and confirm.
3. Select CALIBRATE and confirm.

4. Select 1 POINT MANUAL. Select the available Output Mode (Active, Hold, or Transfer) and confirm.

5. Move the clean probe to solution and confirm to continue.

6. Confirm when stable. Edit the solution value and confirm.

7. Confirm when stable. A screen will display 1 Point Manual Complete and the slope (XX.X mV/pH).

8. Return the probe to process.

5.6.3 Two Point Manual Calibration

1. From the Main Menu, select SENSOR SETUP and confirm.

2. Select the appropriate sensor if more than one is attached and confirm.

3. Select CALIBRATE and confirm.

4. Select 2 POINT MANUAL CAL. Select the available Output Mode (Active, Hold, or Transfer) and confirm.

5. Move the clean probe to Solution 1 and confirm.

6. Confirm when stable. Edit the solution value and confirm.

7. Move probe to solution 1 and confirm.

8. Confirm when stable. Edit the solution value and confirm.

9. A screen will display 2 Point Manual Cal Complete and the slope (XX.X mV/pH).

10. Return the probe to process.

5.7 ORP Calibration

The manufacturer offers a one point manual calibration for ORP. The value of the sample used in the manual calibration may be determined by laboratory analysis or comparison reading.

1. From the Main Menu, select SENSOR SETUP and confirm.

2. Select the appropriate sensor if more than one is attached and confirm.

3. Select CALIBRATE and confirm.

4. Select 1 POINT MANUAL CAL. Select the available Output Mode (Active, Hold, or Transfer) and confirm.

5. Move the clean probe to Solution and confirm.

6. Confirm when stable. Edit the solution value and confirm.

7. A screen will display 1 Point Manual Complete and the slope (XX.X mV).

8. Return the probe to process.

5.8 Concurrent Calibration of Two Sensors for pH and ORP

1. Begin a calibration on the first sensor and continue until “Wait to Stabilize” is displayed.
2. Select LEAVE and confirm. The display will return to the main measurement screen. The reading for the sensor currently being calibrated will flash.
3. Begin the calibration for the second sensor and continue until “Wait to Stabilize” is displayed.
4. Select LEAVE and confirm. The display will return to the main measurement screen and the reading for both sensors will flash. The calibration for both sensors are now running in the background.
5. To return to the calibration of either sensor select SENSOR SETUP from the Main Menu and confirm. Select the appropriate sensor and confirm.
6. The calibration in progress will be displayed. Continue with the calibration.

5.9 Adjusting the Temperature

View or change the temperature using the steps below.

1. From the Main Menu, select SENSOR SETUP and confirm.
2. Select the appropriate sensor if more than one is attached and confirm.
3. Select CALIBRATE and confirm.
4. Select TEMP ADJUST and confirm.
5. Select MEASURED TEMP and confirm.
6. The temperature will be displayed. Edit the temperature and confirm.

DANGER
Only qualified personnel should conduct the tasks described in this section of the manual.

DANGER
Seul un technicien qualifié peut effectuer les tâches d'installation décrites dans cette section du manuel.

DANGER
Explosion hazard. Do not connect or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

DANGER
Risque d'explosion. Couper le courant ou s'assurer que l'emplacement est designe non dangereux avant de replacer le aucon composant.

DANGER
Explosion hazard. Substitution of components may impair suitability for Class 1, Division 2.

DANGER
Risque d'explosion. La substitution de composants peut rendre ce materiel inacceptable pour les emplacements de Classe 1, Division 2..

6.1 Maintenance Schedule

Maintenance Task	90 days	Annually
Clean the sensor[1]	x	
Inspect sensor for damage	x	
Replace Salt Bridge and fill solution[2]		x
Calibrate Sensor (as required by regulatory agency)	**Per the schedule mandated by your regulatory agency.**	

[1] Cleaning frequency is application dependent. More or less frequent cleaning will be appropriate in some applications.
[2] Salt bridge replacement frequency is application dependent. More or less frequent replacement will be appropriate in some applications

6.2 Cleaning the Sensor

CAUTION
Before cleaning with acid, determine if the chemical reaction between the acid and the sample will create a hazardous chemical reaction. (For example, do not put a sensor that is used in a cyanide bath directly into a strong acid for cleaning because this chemical combination may produce poisonous cyanide gas.)

1. Clean the exterior of the sensor with a stream of water. If debris remains remove loose contaminate buildup by carefully wiping the entire measuring end of the sensor (process electrode, concentric metal ground electrode, and salt bridge) with a soft clean cloth. Rinse the sensor with clean, warm water.

2. Prepare a mild soap solution of warm water and dish detergent or other non-abrasive soap that does not contain lanolin such as laboratory glass cleaner.

Note: *Lanolin will coat the glass process electrode and can adversely affect sensor performance.*

3. Soak the sensor for 2 to 3 minutes in the soap solution.

4. Use a small soft bristle brush (such as a toothbrush) and scrub the entire measuring end of the sensor, thoroughly cleaning the electrode and salt bridge surfaces. If surface deposits cannot be removed by detergent solution cleaning, use muriatic acid (or other dilute acid) to dissolve them. The acid should be as dilute as possible. Experience will determine which acid to use and the appropriate dilution ratio. Some stubborn coatings may require a different cleaning agent. For assistance, contact Technical and Customer Service (U.S.A. only) on page 43.

DANGER
Acids are hazardous. Always wear appropriate eye protection and clothing in accordance with material safety data sheet recommendations.

5. Soak the entire measuring end of the sensor in dilute acid for no more than 5 minutes. Rinse the sensor with clean, warm water then place the sensor back into the mild soap solution for 2 to 3 minutes to neutralize any remaining acid.

6. Remove the sensor from the soap solution, and rinse the sensor again in clean, warm water.

7. After cleaning, always calibrate the measurement system.

6.2.1 Replacing the Standard Cell Solution and Salt Bridge

If calibration cannot be attained, rejuvenate the sensor by replacing its standard cell solution and salt bridge as shown in Figure 22. If calibration is still not possible, refer to Section 7 on page 37.

1. To remove the salt bridge, hold the sensor upright (electrode at top), and use pliers or a similar tool to turn it counterclockwise. Take care not to damage the protruding process electrode. Properly discard the old salt bridge.

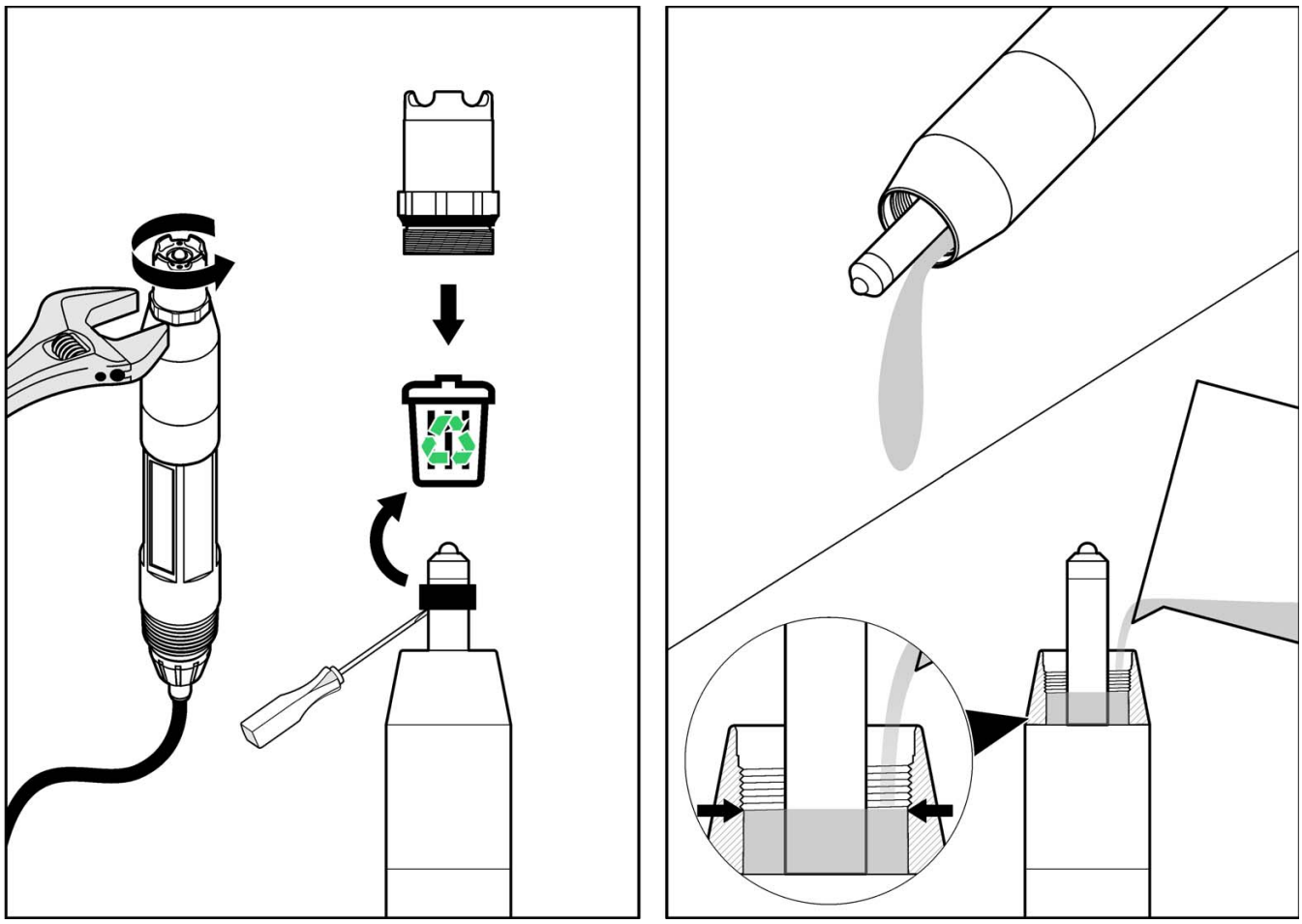
2. Replace the standard cell solution in the sensor reservoir.

   a. Pour out the aged solution, and thoroughly flush the reservoir with standard cell solution.

   b. Fill the reservoir to the bottom of the salt bridge mating threads with fresh standard cell solution (Cat. No. 25M1A1025-115).

3. Carefully thread the new salt bridge clockwise until it is finger-tight and the bottom surface of the salt bridge is in full contact with the top surface of the sensor body. Tighten the salt bridge another ½ turn with the wrench or tool.

Figure 22 Replacing Standard Cell Solution and Salt Bridge



Section 7 Troubleshooting

7.1 Error Codes

When a sensor is experiencing an error condition, the sensor reading on the measurement screen will flash and all relays and analog outputs associated with the sensor will be held. The following conditions will cause the sensor reading to flash:

- Sensor calibration
- Relay timer washing cycle
- Loss of communication

Highlight the Sensor Diag menu and press **ENTER**. Highlight Errors and press **ENTER** to determine the cause of the error.

Errors are defined in Table 6.

Table 6 Error Codes

Displayed Error	Definition	Resolution
ADC FAILURE	System measurement fails	Contact Technical Consulting Services.

7.2 Warnings

A sensor warning will leave all menus, relays, and outputs functioning normally, but will cause a warning icon to flash on the right side of the display. Highlight the Sensor Diag menu and press **ENTER** to determine the cause of the warning.

A warning may be used to trigger a relay and users can set warning levels to define the severity of the warning. Errors are defined in Table 7.

Table 7 Warning Codes

Displayed Warning	Definition	Resolution
PROBE OUT RANGE	Measured pH/ORP exceeds the expected value range.	Contact Technical Consulting Services.
TEMP OUT RANGE	Measured temperature exceeds the expected value range.	Contact Technical Consulting Services.
FLASH FAILURE	System flash memory write has failed.	Contact Technical Consulting Services.
ACTIVE. ELEC	Standard electrode is not performing within the required specifications.	Contact Technical Consulting Services.
REF. ELECTRODE	Reference electrode is not performing within the required specifications.	Contact Technical Consulting Services.
CAL REQUIRED	60 days has elapsed since the last calibration	Perform a calibration.
REPLACE SENSOR	One year has elapsed since the sensor has been installed.	Clean the sensor and replace the salt bridge and standard cell solution (see section 6.2 on page 34 and section 6.2.1 on page 35). Reset the counter in the SENSOR SETUP>CONFIGURE> SENSOR DAYS menu. If necessary, replace the sensor.

7.3 Troubleshooting the pH Sensor

Clean the sensor using the procedure described in section 6.2 on page 34. If the measuring system cannot be calibrated after cleaning, replace the standard cell solution and salt bridge (see section 6.2.1 on page 35) and try calibrating again. If the measuring system still cannot be calibrated, check the sensor operation.

Some simple tests using the sc100 or a multimeter and two pH buffers will determine if the pH sensor is operating properly. The use of pH 7 and pH 4 buffers is preferred but pH 10 can be used in place of pH 4 if it more closely covers the measurement range of interest.

Determine if the sensor has integral digital electronics or uses an external digital gateway. If the sensor uses a digital gateway, it will be hard-wired to the gateway through terminal connections inside the digital gateway enclosure. If the sensor uses the digital gateway and therefore does not have integral digital electronics, proceed with section 7.3.1. If the sensor has integral digital electronics, move to section 7.3.2 on page 39.

7.3.1 Troubleshooting a pH Sensor without Integral Digital Electronics

1. Disconnect the red, green, yellow, and black sensor wires from the digital gateway.

2. Place the sensor in a pH 7 buffer. Before continuing, allow the temperatures of the sensor and buffer to equalize to approximately 25 °C (70 °F).

3. Verify that the sensor temperature element (300 ohm thermistor) is operating properly by measuring the resistance between the yellow and black wires. The reading should be between 250 and 350 ohms at approximately 25 °C (70 °F).

4. Reconnect the yellow and black wires.

5. Connect the multimeter (+) lead to the red wire and (–) lead to the green wire. With the sensor in the pH 7 buffer, measure the dc millivolts. The sensor offset reading should be within the factory-specified limits of –50 and +50 mV. If it is, record the millivolt value reading and continue with step 6. If the reading is outside these limits, discontinue this test and contact Technical Support.

6. With the multimeter still connected, rinse the sensor with water and place it in either pH 4 or pH 10 buffer. Allow the temperatures of the sensor and buffer to equalize to approximately 25 °C (70 °F) then measure the sensor span reading as shown in Table 8 and Table 9 on page 39.

Span Reading in pH 4 Buffer
With the sensor in pH 4 buffer, the sensor span reading should be at least +160 mV more than the offset reading taken in step 5.

Table 8 Typical Span Reading Examples (pH 4 buffer)

Offset Reading (in pH 7 buffer)	Span Reading (in pH 4 buffer)
–50 mV	+110 mV
–25 mV	+135 mV
0 mV	+160 mV
+25 mV	+185 mV
+50 mV	+210 mV

Span Reading in pH 10 Buffer
With the sensor in pH 10 buffer, the sensor span reading should be at least –160 mV less than the noted offset reading taken in step 5.

Table 9 Typical Span Reading Examples (pH 10 buffer)

Offset Reading (in pH 7 buffer)	Span Reading (in pH 10 buffer)
–50 mV	–210 mV
–25 mV	–185 mV
0 mV	–160 mV
+25 mV	–135 mV
+50 mV	–110 mV

If the span reading is at least +160 mV more than or –160 mV less than the offset reading in pH 4 or pH 10, respectively, the sensor is within factory-specified limits. If not, contact Technical Support.

7.3.2 Troubleshooting the pH Sensor with Integral Digital Electronics

1. Place the sensor in pH 7 buffer and allow the buffer and sensor to reach temperature equilibrium. This can be verified by monitoring the sensor temperature value for a stable temperature measurement. This value is shown on the sc100 display when it is in measurement mode.

2. From the Sensor Setup Menu on the sc100, highlight “Diag/Test” and press **ENTER**.

3. Highlight “Sensor Signal” and press **ENTER**. This sensor offset reading should be within factory-specified limits of –50 and +50 mV. If it is, write down this millivolt value reading and perform step 4. If the reading is outside these limits, discontinue this test and contact Technical Support.

4. Rinse the sensor and place it in pH 4 or 10 buffer and allow the buffer and sensor to reach temperature equilibrium. This can be verified by monitoring the sensor temperature value for a stable temperature measurement. This value is located on the sc100 display when it is in measurement mode.

5. From the Sensor Setup Menu on the sc100, highlight “Diag/Test” and press **ENTER**.

6. Highlight “Sensor Signal” and press **ENTER**. Then measure the sensor span value.

Span Reading in pH 4 Buffer
With the sensor in pH 4 buffer, the sensor span reading should be at least +160 mV more than the offset reading as shown in Table 10 and Table 11.

Table 10 Typical Span Reading Examples (pH 4 buffer)

Offset Reading (in pH 7 buffer)	Span Reading (in pH 4 buffer)
–50 mV	+110 mV
–25 mV	+135 mV
0 mV	+160 mV
+25 mV	+185 mV
+50 mV	+210 mV

Span Reading in pH 10 Buffer
With the sensor in pH 10 buffer, the sensor span reading should be at least –160 mV less than the noted offset reading taken in step 6. Examples of typical readings:

Table 11 Typical Span Reading Examples (pH 10 buffer)

Offset Reading (in pH 7 buffer)	Span Reading (in pH 10 buffer)
–50 mV	–210 mV
–25 mV	–185 mV
0 mV	–160 mV
+25 mV	–135 mV
+50 mV	–110 mV

7. If the span reading is at least +160 mV more than or –160 mV less than the offset reading in pH 4 or pH 10, respectively, the sensor is within factory-specified limits. If not, contact Technical Support.

7.4 Checking ORP Sensor Operation

Simple tests using the sc100 or a multimeter and a 200 mV reference solution can determine if the ORP sensor is operating properly. Determine if the sensor has integral digital electronics or uses an external digital gateway. If the sensor uses a digital gateway, it will be hard-wired to the digital gateway through terminal connections within the digital gateway enclosure. If the sensor uses a digital gateway proceed with section 7.4.1. If the sensor has integral digital electronics, move to section 7.4.2 on page 40.

7.4.1 Troubleshooting the ORP Sensor without Integral Digital Electronics

1. Disconnect the red, green, yellow, and black sensor wires from the digital gateway.

2. Place the sensor in a 200 mV reference solution and allow the temperature of the sensor and reference solution to equalize to approximately 25 °C (70 °F).

3. Verify that the sensor temperature element (300 ohm thermistor) is operating by measuring the resistance between the yellow and black wires. The reading should be between 250 and 350 ohms at approximately 25 °C (70 °F).

4. Reconnect the yellow and black wires.

5. Connect the multimeter (+) lead to the red wire and (–) lead to the green wire. With the sensor in the 200 mV reference solution, measure the dc millivolts. The reading should be between 160 and 240 mV. If the reading is outside these limits, contact Technical Support.

7.4.2 Troubleshooting the ORP Sensor with Integral Digital Electronics

1. Place the sensor in 200 mV reference solution and allow the buffer and sensor to reach temperature equilibrium. This can be verified by monitoring the sensor temperature value for a stable temperature measurement. This value is located on the sc100 display when it is in measurement mode.

2. From the Sensor Setup Menu on the sc100, highlight “Diag/Test” and press **ENTER**. Highlight “Sensor Signal” and press **ENTER**. The reading should be between 160 and 240 mV. If the reading is outside these limits, contact Customer Service.

Section 8 Replacement Parts and Accessories

8.1 Replacement Items, Accessories, and Reagent and Standards

Item Description	QTY	Catalog Number
Air blast cleaning system, 115 V, includes Kynar® (PVDF) washer head with 7.6 m (25 ft) tubing and quick connect fitting, and a compressor in a NEMA 4X enclosure	each	1000A3335-005
Air blast cleaning system, 230 V, includes Kynar® (PVDF) washer head with 7.6 m (25 ft) tubing and quick connect fitting, and a compressor in a NEMA 4X enclosure	each	1000A3335-006
Air/Water blast cleaning head	each	1000A3335-004
Buffer, pH 7	500 mL (1 pint)	2283549
Buffer, pH 4	500 mL (1 pint)	2283449
Buffer, pH 10	500 mL (1 pint)	2283649
Buffer, pH 7	1 gallon	2283556
Buffer, pH 4	1 gallon	2283456
Buffer, pH 10	1 gallon	2283656
Buffer, pH 7	500 mL (1 pint)	2283549
Cable, interconnect, unterminated ends, specify length in whole feet	each	1W1100
Cable, sensor extension, 1 m (3 ft)	each	6122400
Cable, sensor extension, 7.7 m (25 ft)	each	5796000
Cable, sensor extension, 15 m (50 ft)	each	5796100
Cable, sensor extension, 31 m (100 ft)	each	5796200
Connector Cable	each	6139900
Instruction manual, Differential pH System, English	each	6120218
Plug, sealing, conduit opening	each	5868700
O-ring, Viton	each	5H1304
O-ring, EPDM	each	5H1306
O-ring, Perflouro	each	5H1096-019
ORP Standard Solution, 200 mV	500 mL (1 pint)	25M2A1001-115
ORP Standard Solution, 600 mV	500 mL (1 pint)	25M2A1002-115
ORP Standard Solution, 200 mV	1 gallon	25M2A1001-123
ORP Standard Solution, 600 mV	1 gallon	25M2A1002-123
Salt Bridge, PEEK® Body, PVDF outer junction	each	SB-P1SV
Salt Bridge Ryton® Body, PVDF outer junction	each	SB-R1SV
Standard Cell Solution	each	25M1A1025-115
Strain relief, Heyco	each	16664

Section 9 How to Order

U.S.A. Customers

By Telephone:
6:30 a.m. to 5:00 p.m. MST
Monday through Friday
(800) 227-HACH (800-227-4224)

By Fax:
(970) 669-2932

By Mail:
Hach Company
P.O. Box 389
Loveland, Colorado 80539-0389 U.S.A.
Ordering information by e-mail: orders@hach.com

Information Required

- Hach account number (if available)
- Your name and phone number
- Purchase order number
- Brief description or model number
- Billing address
- Shipping address
- Catalog number
- Quantity

International Customers

Hach maintains a worldwide network of dealers and distributors. To locate the representative nearest you, send an e-mail to: intl@hach.com or contact:

Hach Company World Headquarters; Loveland, Colorado, U.S.A.
Telephone: (970) 669-3050; Fax: (970) 669-2932

Technical and Customer Service (U.S.A. only)

Hach Technical and Customer Service Department personnel are eager to answer questions about our products and their use. Specialists in analytical methods, they are happy to put their talents to work for you.

Call 1-800-227-4224 or e-mail techhelp@hach.com

Section 10 Repair Service

Authorization must be obtained from Hach Company before sending any items for repair. Please contact the Hach Service Center serving your location.

In the United States:
Hach Company
Ames Service
100 Dayton Avenue
Ames, Iowa 50010
(800) 227-4224 (U.S.A. only)
FAX: (515) 232-3835

In Canada:
Hach Sales & Service Canada Ltd.
1313 Border Street, Unit 34
Winnipeg, Manitoba
R3H 0X4
(800) 665-7635 (Canada only)
Telephone: (204) 632-5598
FAX: (204) 694-5134
E-mail: canada@hach.com

In Latin America, the Caribbean, the Far East, Indian Subcontinent, Africa, Europe, or the Middle East:
Hach Company World Headquarters,
P.O. Box 389
Loveland, Colorado, 80539-0389 U.S.A.
Telephone: (970) 669-3050
FAX: (970) 669-2932
E-mail: intl@hach.com

Section 11 Limited Warranty

Hach Company warrants its products to the original purchaser against any defects that are due to faulty material or workmanship for a period of one year from date of shipment unless otherwise noted in the product manual.

In the event that a defect is discovered during the warranty period, Hach Company agrees that, at its option, it will repair or replace the defective product or refund the purchase price excluding original shipping and handling charges. Any product repaired or replaced under this warranty will be warranted only for the remainder of the original product warranty period.

This warranty does not apply to consumable products such as chemical reagents; or consumable components of a product, such as, but not limited to, lamps and tubing.

Contact Hach Company or your distributor to initiate warranty support. Products may not be returned without authorization from Hach Company.

Limitations

This warranty does not cover:

- Damage caused by acts of God, natural disaster, labor unrest, acts of war (declared or undeclared), terrorism, civil strife or acts of any governmental jurisdiction
- Damage caused by misuse, neglect, accident or improper application or installation
- Damage caused by any repair or attempted repair not authorized by Hach Company
- Any product not used in accordance with the instructions furnished by Hach Company
- Freight charges to return merchandise to Hach Company
- Freight charges on expedited or express shipment of warranted parts or product
- Travel fees associated with on-site warranty repair

This warranty contains the sole express warranty made by Hach Company in connection with its products. All implied warranties, including without limitation, the warranties of merchantability and fitness for a particular purpose, are expressly disclaimed.

Some states within the United States do not allow the disclaimer of implied warranties and if this is true in your state the above limitation may not apply to you. This warranty gives you specific rights, and you may also have other rights that vary from state to state.

This warranty constitutes the final, complete, and exclusive statement of warranty terms and no person is authorized to make any other warranties or representations on behalf of Hach Company.

Limitation of Remedies

The remedies of repair, replacement or refund of purchase price as stated above are the exclusive remedies for the breach of this warranty. On the basis of strict liability or under any other legal theory, in no event shall Hach Company be liable for any incidental or consequential damages of any kind for breach of warranty or negligence.

Section 12 Compliance Information

Hach Co. certifies this instrument was tested thoroughly, inspected and found to meet its published specifications when it was shipped from the factory.

The Model sc100/sc1000 Controller with Differential pH/ORP sensor has been tested and is certified as indicated to the following instrumentation standards:

Product Safety

UL 61010A-1 (ETL Listing # 65454)
CSA C22.2 No. 1010.1 (ETLc Certification # 65454)
Certified by Hach Co. to EN 61010-1 Amds. 1 & 2 (IEC1010-1) per 73/23/EEC, supporting test records by Intertek Testing Services.

Immunity

This equipment was tested for industrial level EMC per:

EN 61326 (EMC Requirements for Electrical Equipment for Measurement, Control and Laboratory Use) **per 89/336/EEC EMC:** Supporting test records by Hach Company, certified compliance by Hach Company.

Standards include:

IEC 1000-4-2:1995 (EN 61000-4-2:1995) Electrostatic Discharge Immunity (Criteria B)
IEC 1000-4-3:1995 (EN 61000-4-3:1996) Radiated RF Electromagnetic Field Immunity (Criteria A)
IEC 1000-4-4:1995 (EN 61000-4-4:1995) Electrical Fast Transients/Burst (Criteria B)
IEC 1000-4-5:1995 (EN 61000-4-5:1995) Surge (Criteria B)
IEC 1000-4-6:1996 (EN 61000-4-6:1996) Conducted Disturbances Induced by RF Fields (Criteria A)
IEC 1000-4-11:1994 (EN 61000-4-11:1994) Voltage Dip/Short Interruptions (Criteria B)

Additional Immunity Standard/s include:

ENV 50204:1996 Radiated Electromagnetic Field from Digital Telephones (Criteria A)

Emissions

This equipment was tested for Radio Frequency Emissions as follows:

Per **89/336/EEC** EMC: **EN 61326:1998** (Electrical Equipment for measurement, control and laboratory use—EMC requirements) Class “A” emission limits. Supporting test records by Hewlett Packard, Fort Collins, Colorado Hardware Test Center (A2LA # 0905-01) and certified compliance by Hach Company.

Standards include:

EN 61000-3-2 Harmonic Disturbances Caused by Electrical Equipment
EN 61000-3-3 Voltage Fluctuation (Flicker) Disturbances Caused by Electrical Equipment

Additional Emissions Standard/s include:

EN 55011 (CISPR 11), Class “A” emission limits

Canadian Interference-causing Equipment Regulation, IECS-003, Class A

Supporting test records by Hewlett Packard, Fort Collins, Colorado Hardware Test Center (A2LA # 0905-01) and certified compliance by Hach Company.

This Class A digital apparatus meets all requirements of the Canadian Interference-causing Equipment Regulations.
Cet appareil numèrique de la classe A respecte toutes les exigences du Rëglement sur le matÈriel brouilleur du Canada.

FCC PART 15, Class “A” Limits

Supporting test records by Hewlett Packard, Fort Collins, Colorado Hardware Test Center (A2LA # 0905-01) and certified compliance by Hach Company.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense. The following techniques of reducing the interference problems are applied easily.

1. Disconnect the Controller from its power source to verify that it is or is not the source of the interference.
2. If the Controller is connected into the same outlet as the device with which it is interfering, try another outlet.
3. Move the Controller away from the device receiving the interference.
4. Reposition the receiving antenna for the device receiving the interference.
5. Try combinations of the above.

Appendix A General pH Information

A.1 pH Measurement Theory

pH is the negative logarithm of the hydrogen ion activity and a measure of the acidity or alkalinity of a solution.

$$pH = -\log A[H+]$$

pH is normally measured using a glass electrode and a reference electrode.

The glass electrode acts as a transducer, converting chemical energy (the hydrogen ion activity) into an electrical energy (measured in millivolts). The reaction is balanced and the electrical circuit is completed by the flow of ions from the reference solution to the solution under test.

The electrode and reference solution together develop a voltage (emf) whose magnitude depends on the type of reference electrode, the internal construction of the glass electrode, the pH of the solution and the temperature of the solution. This voltage is expressed by the Nernst Equation:

$$E = E_o - (2.3\ RT/F) \times \log A[H+]$$
$$E = E_o - (\text{slope}) \times \log A[H+]$$

where:

E = the emf of the cell

E_o = the zero potential (isopotential) of the system. It depends on the internal construction of the glass and reference electrodes.

R = gas constant

T = temperature in Kelvin

A[H+] = activity of the hydrogen ion (assumed to be equivalent to the concentration of hydrogen ions)

F = Faraday constant

For every unit change in pH (or decade change in ion concentration) the emf of the electrode pair changes by 59.16 mV at 25 °C. This value is known as the Nernstian Slope of the electrode.

The pH electrode pair is calibrated using solutions of known and constant hydrogen ion concentration, called buffer solutions. The buffer solutions are used to calibrate both the electrode isopotential and slope.

A.2 PID Controller Basics

A pH control loop operates as follows: The pH meter measures the value of the pH in the effluent, and, if the pH is different from the setpoint, the controller actuates the reagent pump (or valve) that adds reagent to a mixing tank. The added reagent adjusts the pH value of the process.

The physical layout of the loop, the sizing of the pump (valve), type of mixing tank, and location of the pH electrodes all have a major impact on the ultimate performance of the loop, after the controller is tuned for optimal performance. The largest single performance factor is the delay time around the loop. This includes the response time of the

electrode/meter, time required to deliver the reagent to the process water, time required for the reagent to mix with and react with the process water, and the time required to deliver the completely mixed water to the electrode. If the delay times are too long or the mixing is not complete, the control will be poor regardless of how well the controller is tuned.

The Process pH Meter uses a PID (proportional, integral (reset), derivative (rate) control) control algorithm. Each of the instrument settings along with their effects on the control loop, are described below.

Mode
Manual: The manual output is specified in percent of full-scale PID output (4–20 mA) and is commonly used for testing the output device.

Auto: Allows the process to be controlled automatically using information specified in the Phase, Setpoint, Proportional Band, Integral, and Derivative menus as follows:

Phase
Direct: The control output action will cause the process value to increase.

Reverse: The control output action will cause the process value to decrease.

Setpoint
The setpoint is defined as the desired process value in pH

Proportional Band
The proportional band is the range in pH from the setpoint value where the controller provides proportional control. For example, the desired setpoint for the process is pH 7.0 and the process requires that a reagent must be added to the process water to bring it up to pH 7.0. If the proportional band is set to pH 1.0, the controller will provide proportional output control over the range of pH 6.0 to 8.0. When the process is at pH 6.0, the controller will provide a 100% control output level (assuming that Phase is set to Direct). When the process is at pH 7.0, the proportional control will provide a 0% control output level. When the process is at pH 6.5 the proportional control will provide a 50% output. The output action is equal to the difference between the setpoint and the process value, divided by the proportional band value.

Integral
The integral value is used to reduce the steady state error, between the process value and the setpoint, to zero. For example, assume a process can be manually controlled at a level of pH 8.0 by sending a 35% control output level to a reagent pump. Now, say that the system is set up for the controller to provide proportional only control, with the controller setpoint set to pH 8.0 and the proportional band set to pH 1.0. Note that the nearer the process gets to the pH 8.0 setpoint, the lower the control output level is. In fact, when the process is at pH 8.0, the output level will be 0%. Since the process requires that the pump be operated at 35% for the process to reach pH 8.0, its apparent that proportional-only control will never quite reach the desired setpoint of pH 8.0. This is where the integral control comes in.

Integral control can be thought of as adding up the output action from the proportional control over time. For example, the proportional control output reaches a steady state level of 5%. If the integral time is set to five minutes, the integral action of the controller will add an additional 5% to the controller output level over a 5-minute interval. The integral action is additive, so for every 5-minute interval an additional 5% is added to the controller's output level. This will allow the controller to bring the process to the desired setpoint level. Note that the longer the integral time setting, the longer it takes for the

integral action to affect the process. The integral control action is disabled by setting it to zero. Note that the integral time is in minutes.

Derivative
Derivative control is used to adjust the control output level based upon the rate at which the process value is approaching or passing the setpoint. Derivative control action would be used in cases where the process value can rapidly ramp up and overshoot the setpoint. The derivative setting is in minutes. The output action of the derivative control is equal to the rate of change of the process (in pH units per minute) times the derivative time, divided by the proportional band, times negative one. For example, if the process pH is changing at a rate of pH 0.20 per minute, the derivative time is set to 3.0 minutes, the proportional band is set to pH 0.80, and the action is “direct” the derivative control output action will be approximately equal to: (–0.20 pH/minute X 3.0 minute) /0.80 pH = –75%.

During calibration, the analog outputs can remain active, be held, or be transferred to a preset mA value.

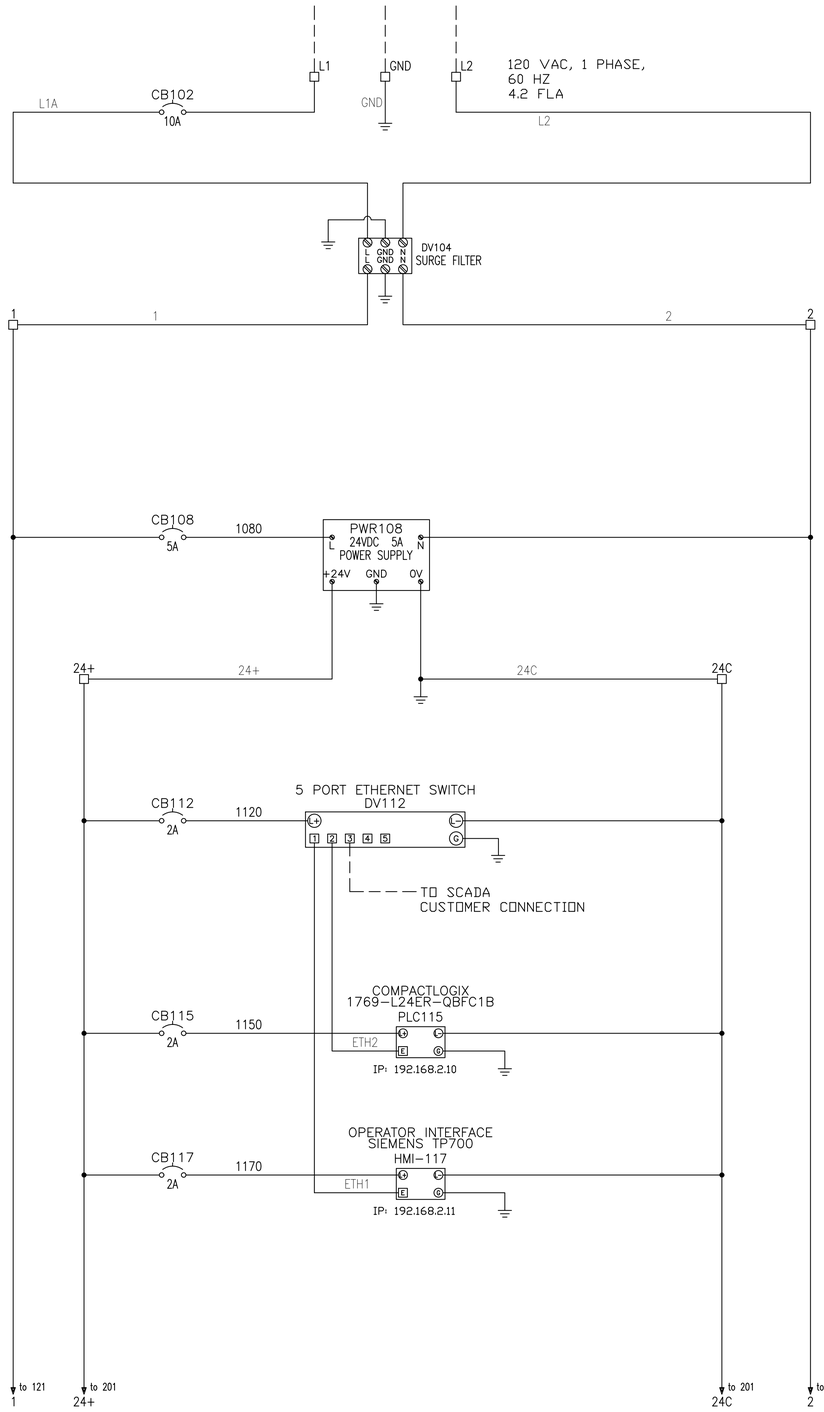
Appendix B Modbus Register Information

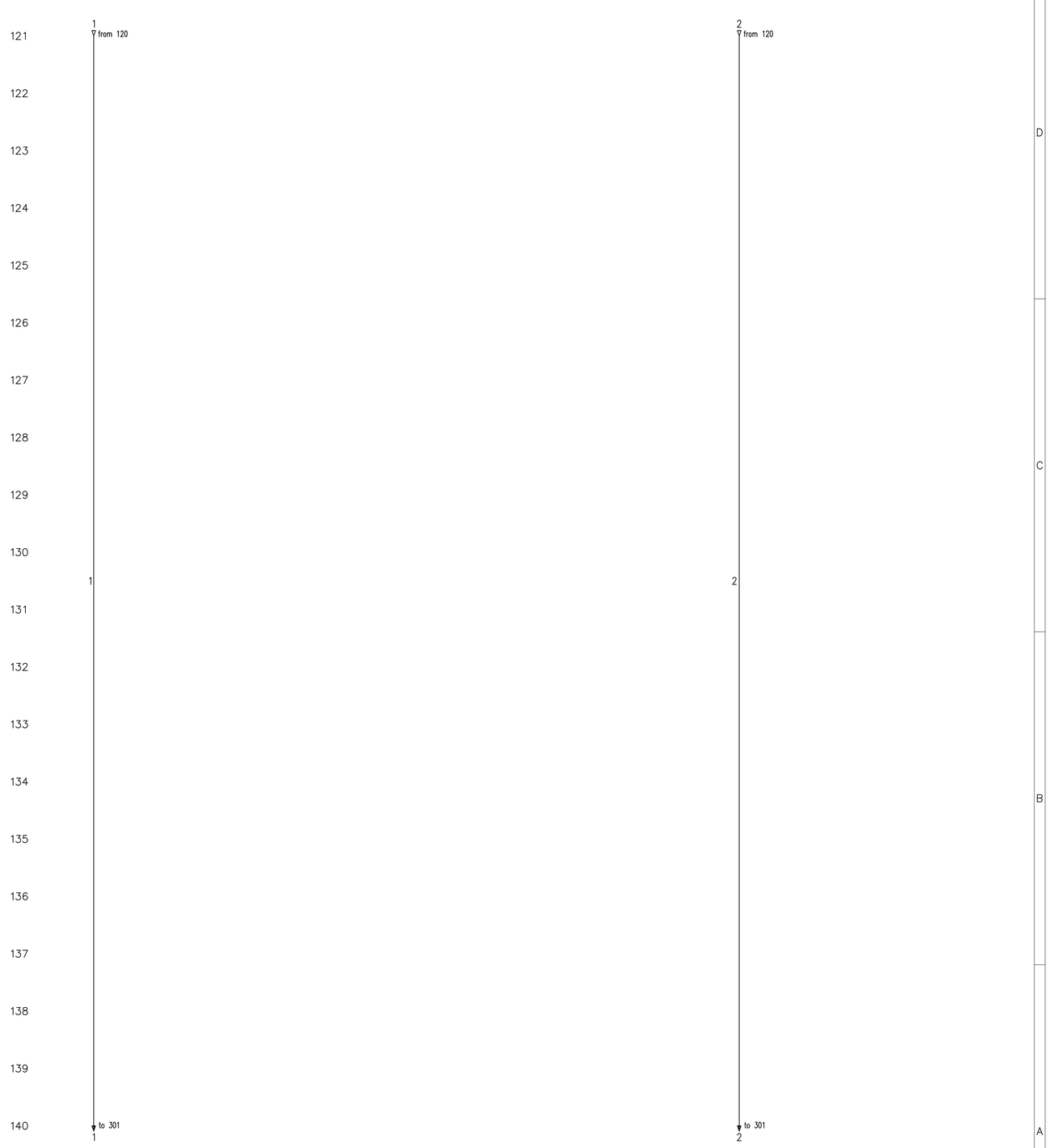
Table 12 Sensor Modbus Registers

Group Name	Tag Name	Register #	Data Type	Length	R/W	Description
Tags	SensorMeasTag	40001	Integer	1	R	Sensor measurement tag
Measurements	pHMeas	40002	Float	2	R	pH /ORP measurement
Tags	TempMeasTag	40004	Integer	1	R	Temperature measurement tag
Measurements	TempDegCMeas	40005	Float	2	R	Temperature measurement
Configuration	SensorName	40007	String	6	R/W	Sensor name
Tags	FuncCode	40013	Integer	1	R/W	Function code tag
Tags	NextState	40014	Integer	1	R/W	Next state tag
Configuration	MeasType	40015	Integer	1	R/W	Measurement type-pH or ORP
Configuration	TempUnits	40016	Integer	1	R/W	Temperature units-C or F
Configuration	pHFormat	40017	Integer	1	R/W	pH display format
Configuration	TaggedPhFormat	40018	Long	2	R	pH display tagged format
Configuration	Filter	40020	Integer	1	R/W	Sensor filter
Configuration	TempElementType	40021	Integer	1	R/W	Temperature element type
Tags	TempUserValueTag	40022	Integer	1	R	Temperature user value tag
Configuration	TempUserDegCValue	40023	Float	2	R/W	Temperature user value
Configuration	pHBuffer	40025	Integer	1	R/W	pH buffer type
Configuration	PureWaterCompType	40026	Integer	1	R/W	Pure H_2O compensation type
Configuration	PureWaterCompUser	40027	Float	2	R/W	Pure H_2O compensation user val
Calibration	OutputMode	40029	Integer	1	R/W	Output mode
Calibration	CalLeave	40030	Integer	1	R/W	Cal leave mode
Calibration	CalAbort	40031	Integer	1	R/W	Cal abort mode
Tags	CalEditValueTag	40032	Integer	1	R	Cal edit value tag
Calibration	CalEditPhValue	40033	Float	2	R/W	Cal edit value
Diagnostics	pHSlope	40035	Float	2	R	pH slope
Diagnostics	SoftwareVersion	40037	String	6	R	Software version
Diagnostics	SerialNumber	40043	String	6	R	Serial number
Diagnostics	pHOffset	40049	Float	2	R	pH offset
Diagnostics	OrpOffset	40051	Float	2	R	Orp offset
Calibration	CalCode	40053	Integer	1	R	Cal code
Configuration	SensorLogInterval	40054	Integer	1	R/W	Sensor data log interval
Configuration	TempLogInterval	40055	Integer	1	R/W	Temperature data log interval
Diagnostics	pHmV	40056	Float	2	R	pH mV
Diagnostics	ProdDate	40058	Date	2	R/W	Production date
Diagnostics	StdElectrode	40060	Float	2	R	Standard electrode impedance
Diagnostics	RefElectrode	40062	Float	2	R	Reference electrode impedance
Diagnostics	LastCalDate	40064	Date	2	R	Last calibration date
Diagnostics	SensorDays	40066	Integer	1	R	Sensor running days
Diagnostics	ElectrodeDays	40067	Integer	1	R	Electrode running days
Diagnostics	ElectrodeStatus	40068	Integer	1	R	Electrode status
Diagnostics	SensorType	40069	Integer	1	R	Sensor type
Configuration	RejectFrequency	40070	Integer	1	R/W	Reject frequency
Diagnostics	DeviceDriver	40071	String	5	R	Device driver
Configuration	CalWarningDays	40076	Integer	1	R/W	Calibration warning days
Configuration	SensorWarningDays	40077	Integer	1	R/W	Sensor warning days

Index

Section 3
Electrical Drawings





NOTES: WIRING SPEC:
- PLC CARD WIRING – #16AWG STRANDED MTW OR EQUAL, 300V @ 90°C, UNLESS OTHERWISE NOTED.
- CONTROL WIRING – #14AWG STRANDED MTW OR EQUAL, 600V @ 90°C, UNLESS OTHERWISE NOTED.
- POWER WIRING – #12AWG STRANDED MTW OR EQUAL, 600V @ 90°C, MINIMUM, SIZED FOR CIRCUIT CURRENT.

WIRE COLOR CODES:
- BLACK – POWER WIRING (MULTI-PHASE) 230VAC OR GREATER, 120VAC UNSWITCHED CONTROL WIRING.
- RED – 120VAC SWITCHED CONTROL WIRING.
- WHITE – 120VAC NEUTRAL WIRING.
- GREEN – GROUNDED CONDUCTORS.
- BLUE – UNGROUNDED DC CONTROL WIRING.
- WHITE W/BLUE STRIPE – GROUNDED DC CONTROL WIRING.
- LIGHT BLUE – INTRINSICALLY SAFE WIRING.
- ORANGE – EXTERNALLY POWERED CIRCUITS (CUSTOMER CONTACTS).

CUSTOMER CIRCUITS:
- DRY CONTACTS ARE RATED FOR 7.5 AMPERES @ 120VAC. SUITABLE PROTECTION AND DISCONNECT MEANS ARE TO BE PROVIDED BY CUSTOMER. USE #14AWG MINIMUM.
- ALL HOLES TO BE SEALED AND GASKETED TO MAINTAIN ENCLOSURE INTEGRITY.

WIRED IN SHOP PRIOR TO SHIPMENT

FIELD WIRING UNLESS OTHERWISE NOTED

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
0	RELEASED FOR FABRICATION	2022-11-03	S.ZICK			
A	FOR SUBMITTAL ONLY NOT FOR FIELD CONSTRUCTION	2022-08-18	S.ZICK			

DESIGNER	S.ZICK	DATE 2022-08-17
CHECKER		DATE
ENGINEER	R.VANSEL	DATE
MANAGER	J.KINNEY	DATE
FILE:		
SCALE:		

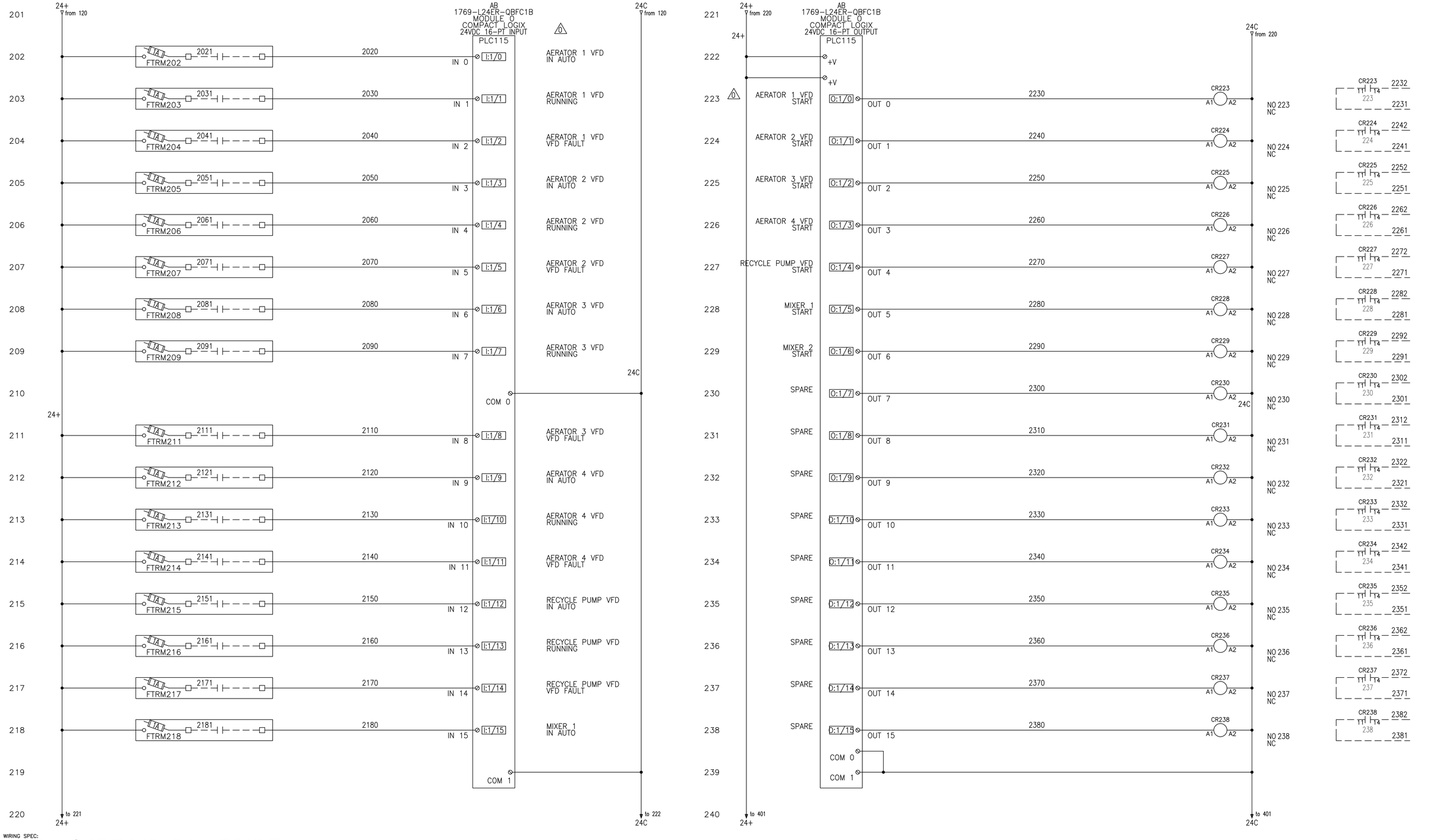
TITLE: SMART BNR Lite
CONTROL SCHEMATICS
120 VAC & 24 VDC PANEL POWER

CLIENT: CITY OF JEFFERSON
JEFFERSON, GA

EVOQUA WATER TECHNOLOGIES
WATER TECHNOLOGIES
WAUKESHA, WI
262-547-0141

PROJECT	CODE	DRAWING	SHEET	REV
2033/001848	4034	453130-891-01	1 OF 1	0

STD: BORDER-0106-24X36D1 | INTL REF: | BAR = 1" AT PLOT SCALE



NOTES: WIRING SPEC:
PLC CARD WIRING – #16AWG STRANDED MTW OR EQUAL, 300V @ 90°C, UNLESS OTHERWISE NOTED.
CONTROL WIRING – #14AWG STRANDED MTW OR EQUAL, 600V @ 90°C, UNLESS OTHERWISE NOTED.
POWER WIRING – #12AWG STRANDED MTW OR EQUAL, 600V @ 90°C, MINIMUM, SIZED FOR CIRCUIT CURRENT.
WIRE COLOR CODES:
BLACK – POWER WIRING (MULTI-PHASE) 230VAC OR GREATER, 120VAC UNSWITCHED CONTROL WIRING.
RED – 120VAC SWITCHED CONTROL WIRING.
WHITE – 120VAC NEUTRAL WIRING.
GREEN – GROUNDED CONDUCTORS.
BLUE – UNGROUNDED DC CONTROL WIRING.
WHITE W/BLUE STRIPE – GROUNDED DC CONTROL WIRING.
LIGHT BLUE – INTRINSICALLY SAFE WIRING.
ORANGE – EXTERNALLY POWERED CIRCUITS (CUSTOMER CONTACTS).
CUSTOMER CIRCUITS:
DRY CONTACTS ARE RATED FOR 7.5 AMPERES @ 120VAC. SUITABLE PROTECTION AND DISCONNECT MEANS ARE TO BE PROVIDED BY CUSTOMER. USE #14AWG MINIMUM.
ALL HOLES TO BE SEALED AND GASKETED TO MAINTAIN ENCLOSURE INTEGRITY.

WIRED IN SHOP PRIOR TO SHIPMENT
FIELD WIRING UNLESS OTHERWISE NOTED

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
0	RELEASED FOR FABRICATION	2022-11-03	S.ZICK			
A	FOR SUBMITTAL ONLY NOT FOR FIELD CONSTRUCTION	2022-08-18	S.ZICK			

	DATE
DESIGNER S.ZICK	2022-08-17
CHECKER	
ENGINEER R.VANSEL	
MANAGER J.KINNEY	
FILE:	
SCALE:	

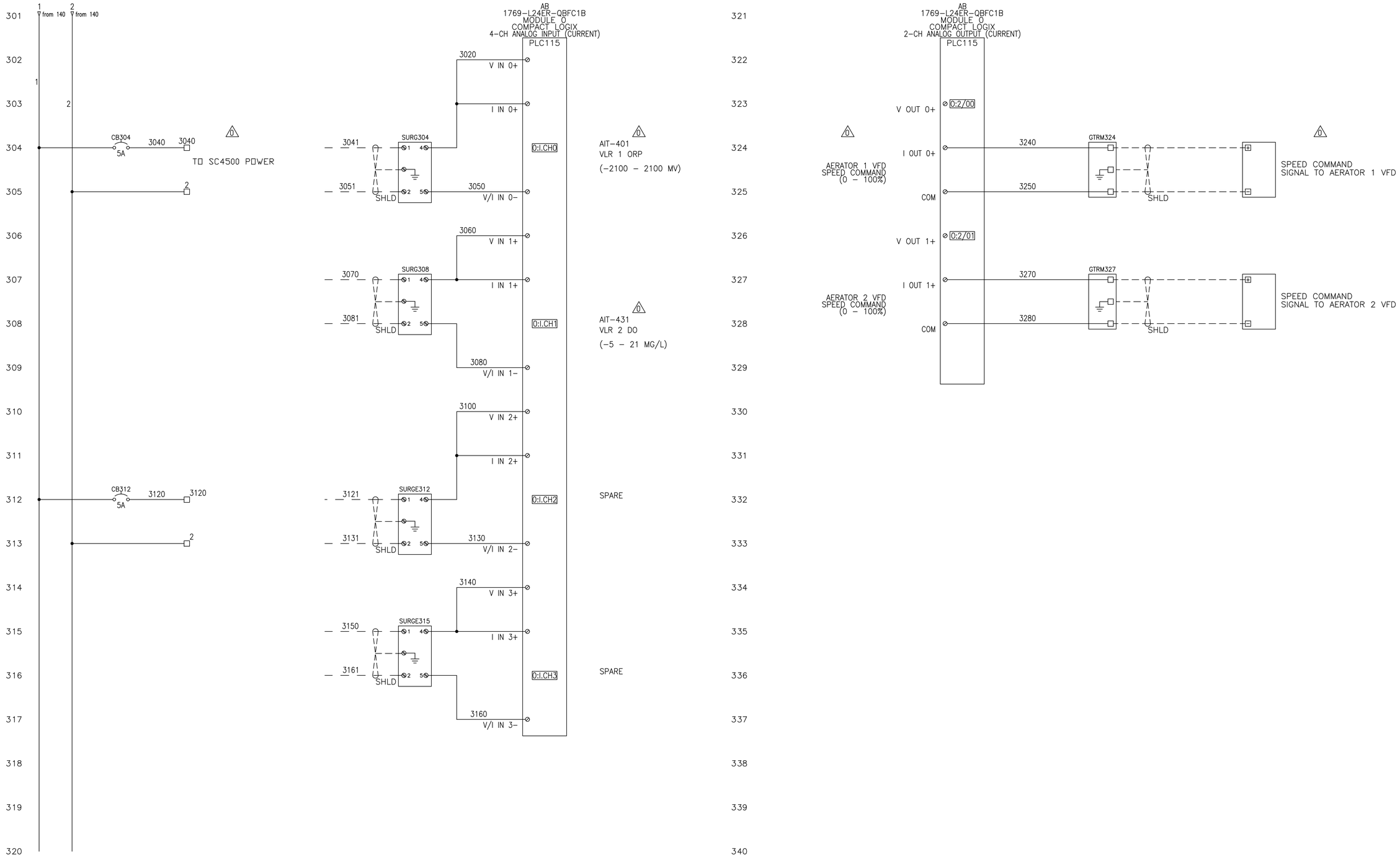
TITLE: SMART BNR Lite
CONTROL SCHEMATICS
DIGITAL INPUTS & OUTPUTS

CLIENT: CITY OF JEFFERSON
JEFFERSON, GA

EVOQUA WATER TECHNOLOGIES
WATER TECHNOLOGIES
WAUKESHA, WI
262-547-0141

PROJECT	CODE	DRAWING	SHEET	REV
2033/001848	4034	453130-891-02	1 OF 1	0

STD: BORDER-0106-24X36D1 | INTL REF: | BAR = 1" AT PLOT SCALE



NOTES: WIRING SPEC:
PLC CARD WIRING – #16AWG STRANDED MTW OR EQUAL, 300V @ 90°C, UNLESS OTHERWISE NOTED.
CONTROL WIRING – #14AWG STRANDED MTW OR EQUAL, 600V @ 90°C, UNLESS OTHERWISE NOTED.
POWER WIRING – #12AWG STRANDED MTW OR EQUAL, 600V @ 90°C, MINIMUM, SIZED FOR CIRCUIT CURRENT.
WIRE COLOR CODES:
BLACK – POWER WIRING (MULTI-PHASE) 230VAC OR GREATER, 120VAC UNSWITCHED CONTROL WIRING.
RED – 120VAC SWITCHED CONTROL WIRING.
WHITE – 120VAC NEUTRAL WIRING.
GREEN – GROUNDED CONDUCTORS.
BLUE – UNGROUNDED DC CONTROL WIRING.
WHITE W/BLUE STRIPE – GROUNDED DC CONTROL WIRING.
LIGHT BLUE – INTRINSICALLY SAFE WIRING.
ORANGE – EXTERNALLY POWERED CIRCUITS (CUSTOMER CONTACTS).
CUSTOMER CIRCUITS:
DRY CONTACTS ARE RATED FOR 7.5 AMPERES @ 120VAC. SUITABLE PROTECTION AND DISCONNECT MEANS ARE TO BE PROVIDED BY CUSTOMER. USE #14AWG MINIMUM.
ALL HOLES TO BE SEALED AND GASKETED TO MAINTAIN ENCLOSURE INTEGRITY.

WIRED IN SHOP PRIOR TO SHIPMENT
FIELD WIRING UNLESS OTHERWISE NOTED

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
0	RELEASED FOR FABRICATION	2022-11-03	S.ZICK			
A	FOR SUBMITTAL ONLY NOT FOR FIELD CONSTRUCTION	2022-08-18	S.ZICK			

DESIGNER	S.ZICK
DATE	2022-08-17
CHECKER	
DATE	
ENGINEER	R.VANSEL
DATE	
MANAGER	J.KINNEY
DATE	
FILE:	
SCALE:	

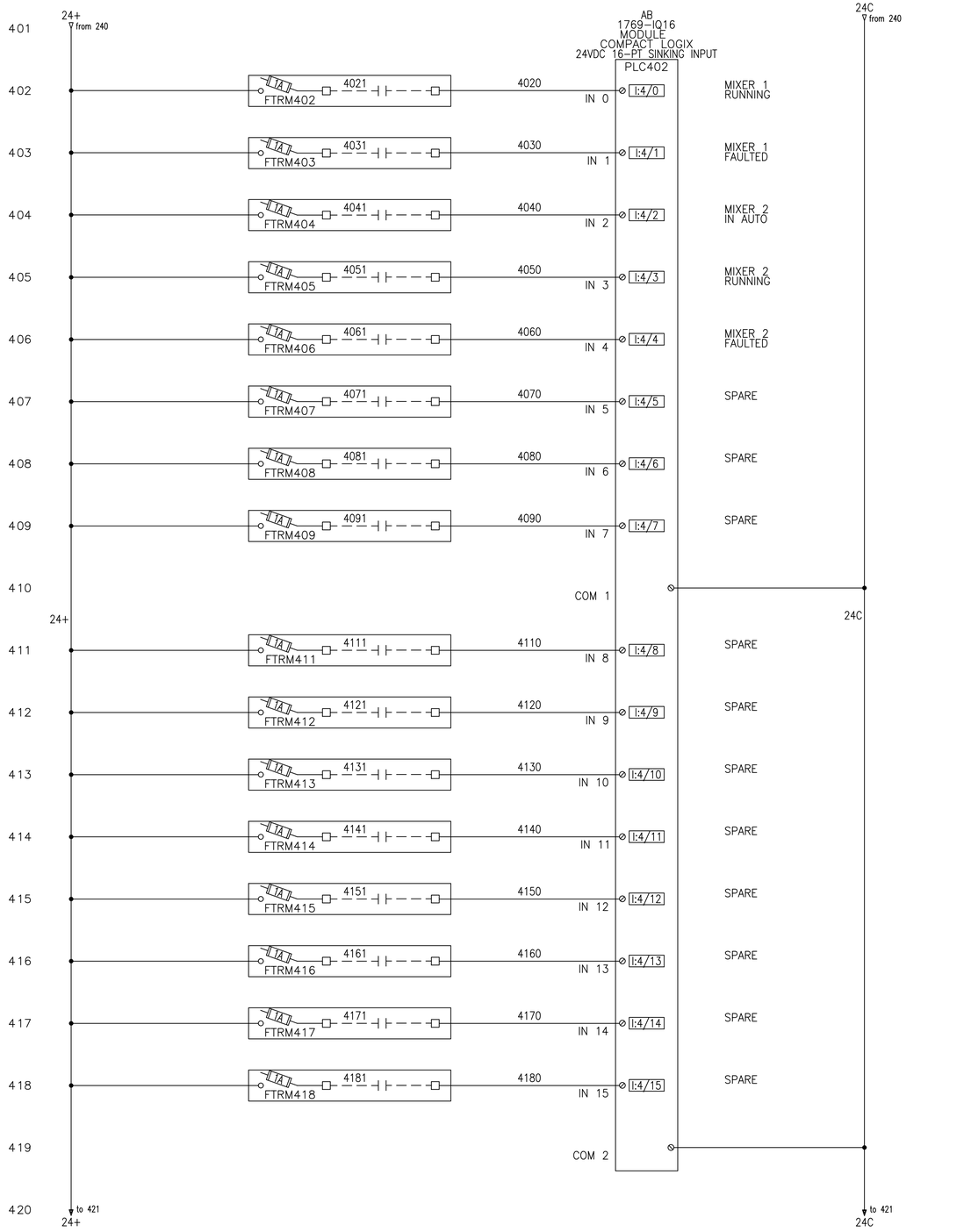
TITLE: SMART BNR Lite
CONTROL SCHEMATICS
ANALOG INPUTS & OUTPUTS

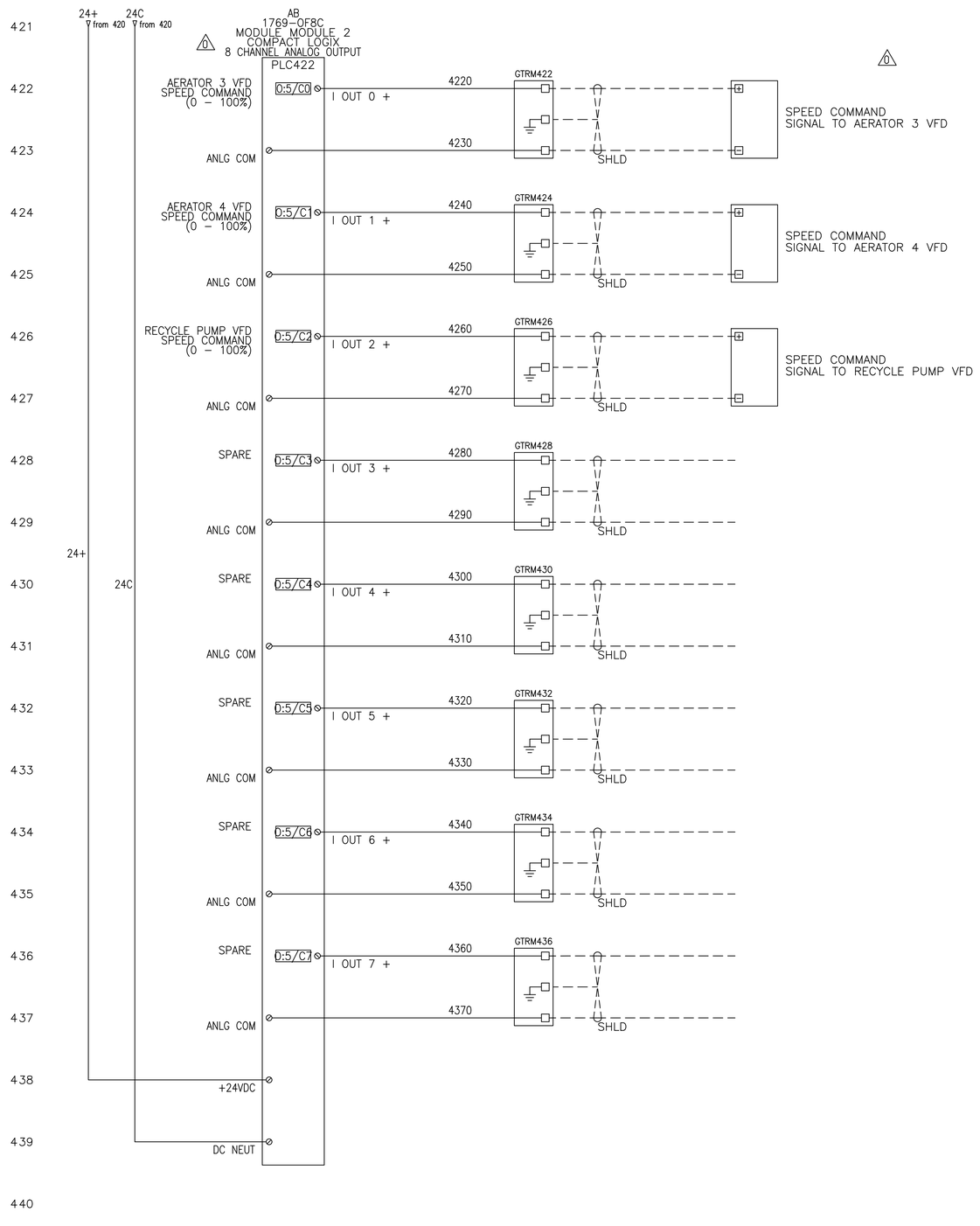
CLIENT: CITY OF JEFFERSON
JEFFERSON, GA

EVOQUA WATER TECHNOLOGIES
WAUKESHA, WI
262-547-0141

PROJECT	CODE	DRAWING	SHEET	REV
2033/001848	4034	453130-891-03	1 OF 1	0

STD: BORDER-0106-24X36D1 | INTL REF: | BAR = 1" AT PLOT SCALE





NOTES: WIRING SPEC:
- PLC CARD WIRING – #16AWG STRANDED MTW OR EQUAL, 300V @ 90°C, UNLESS OTHERWISE NOTED.
- CONTROL WIRING – #14AWG STRANDED MTW OR EQUAL, 600V @ 90°C, UNLESS OTHERWISE NOTED.
- POWER WIRING – #12AWG STRANDED MTW OR EQUAL, 600V @ 90°C, MINIMUM, SIZED FOR CIRCUIT CURRENT.

WIRE COLOR CODES:
- BLACK – POWER WIRING (MULTI-PHASE) 230VAC OR GREATER, 120VAC UNSWITCHED CONTROL WIRING.
- RED – 120VAC SWITCHED CONTROL WIRING.
- WHITE – 120VAC NEUTRAL WIRING.
- GREEN – GROUNDED CONDUCTORS.
- BLUE – UNGROUNDED DC CONTROL WIRING.
- WHITE W/BLUE STRIPE – GROUNDED DC CONTROL WIRING.
- LIGHT BLUE – INTRINSICALLY SAFE WIRING.
- ORANGE – EXTERNALLY POWERED CIRCUITS (CUSTOMER CONTACTS).

CUSTOMER CIRCUITS:
- DRY CONTACTS ARE RATED FOR 7.5 AMPERES @ 120VAC. SUITABLE PROTECTION AND DISCONNECT MEANS ARE TO BE PROVIDED BY CUSTOMER. USE #14AWG MINIMUM.
- ALL HOLES TO BE SEALED AND GASKETED TO MAINTAIN ENCLOSURE INTEGRITY.

WIRED IN SHOP PRIOR TO SHIPMENT

FIELD WIRING UNLESS OTHERWISE NOTED

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
0	RELEASED FOR FABRICATION	2022-11-03	S.ZICK			
A	FOR SUBMITTAL ONLY NOT FOR FIELD CONSTRUCTION	2022-08-18	S.ZICK			

	DATE
DESIGNER S.ZICK	2022-08-17
CHECKER	DATE
ENGINEER R.VANSEL	DATE
MANAGER J.KINNEY	DATE
FILE:	
SCALE:	

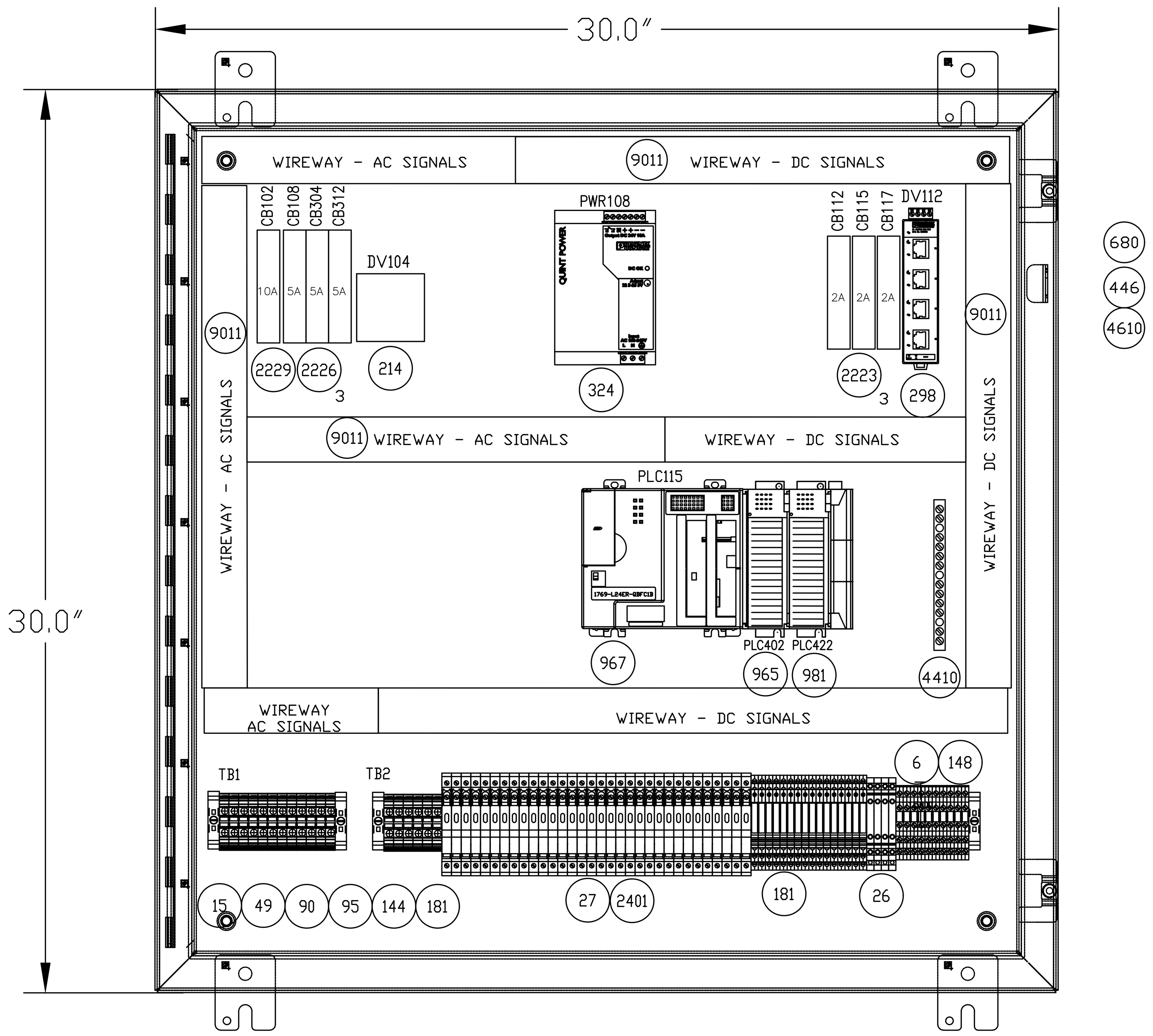
TITLE: SMART BNR Lite
CONTROL SCHEMATICS
DIGITAL INPUTS & ANALOG OUTPUTS

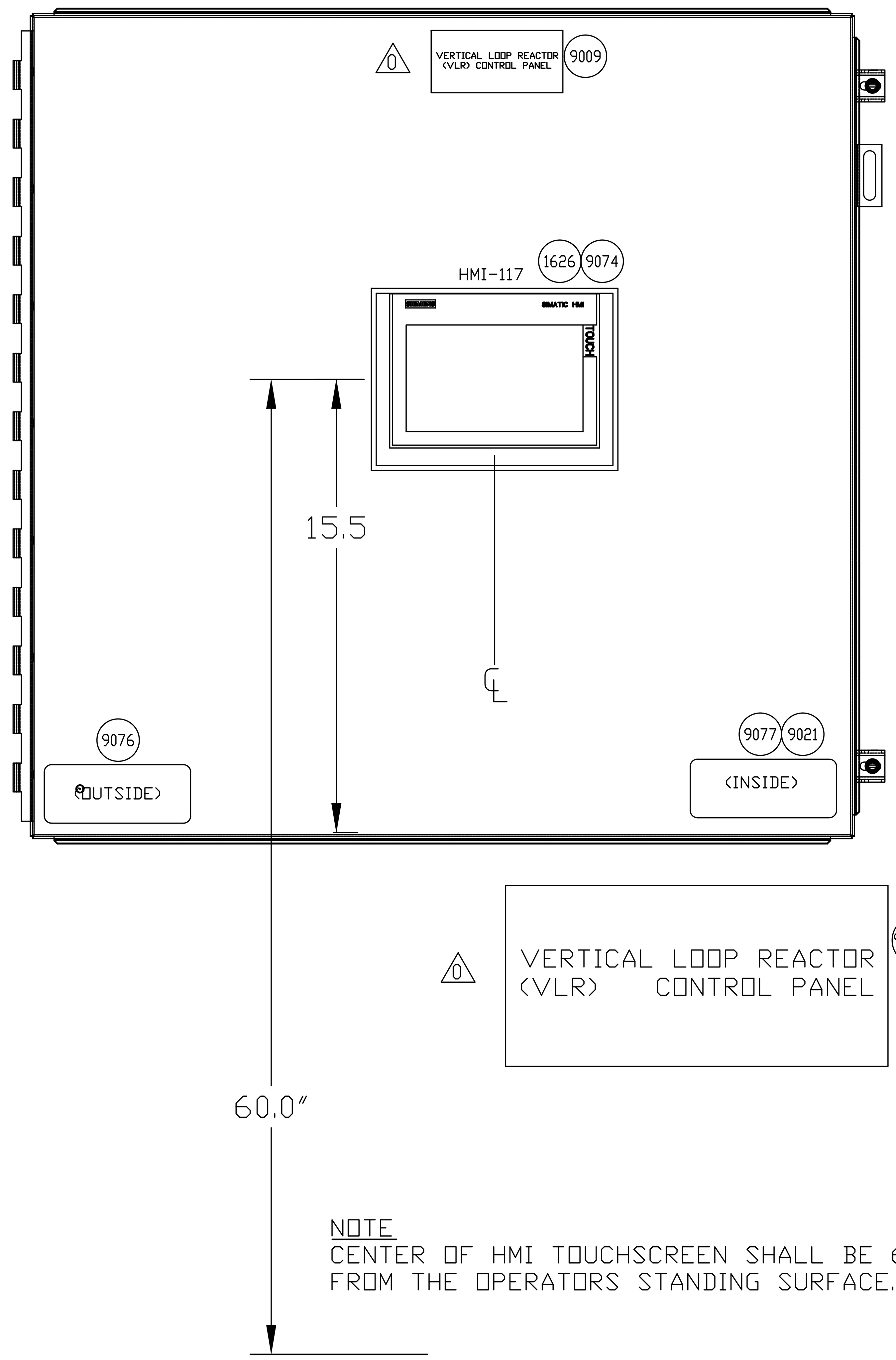
CLIENT: CITY OF JEFFERSON
JEFFERSON, GA

EVOQUA WATER TECHNOLOGIES
WATER TECHNOLOGIES
WAUKESHA, WI
262-547-0141

PROJECT	CODE	DRAWING	SHEET	REV
2033/001848	4034	453130-891-04	1 OF 1	0

STD: BORDER-0106-24X36D1 | INTL REF: | BAR = 1" AT PLOT SCALE





△ VERTICAL LOOP REACTOR (VLR) CONTROL PANEL (9009)

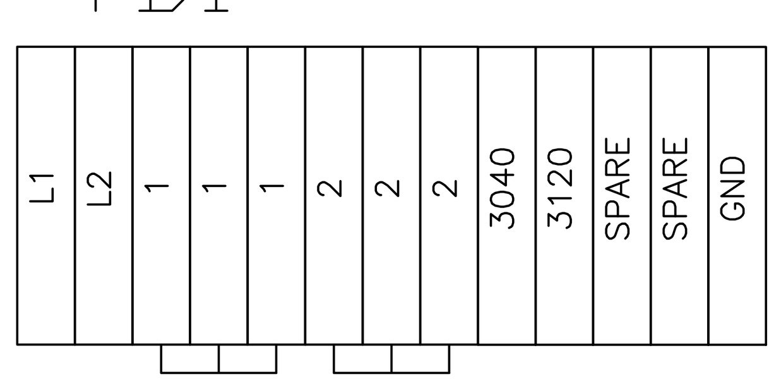
NOTE
CENTER OF HMI TOUCHSCREEN SHALL BE 60" FROM THE OPERATORS STANDING SURFACE.

LIST OF MATERIAL FOR ONE (1) W3T570046 – SMART BNR CONTROL PANEL				
ITEM	QTY	CATALOG	DESC	MFG
6	10	3011054	TWO LEVEL TERMINAL BLOCK W/GROUND	PHOENIX CONTACT
15	19	3044131	UNIVERSAL TERMINAL BLOCK – UT 6 (GRAY)	PHOENIX CONTACT
26	4	2906798	TERMINAL BLOCK, DC SURGE SUPPRESSING, 3STAGE	PHOENIX CONTACT
27	32	3026654	FUSED MULTILEVEL TERMINAL BLOCK W/24 VDC BLOWN FUSE INDICATION	PHOENIX CONTACT
61	2	0801733	DIN MOUNTING RAIL 2 M LENGTH	PHOENIX CONTACT
90	4	1201099	ANGLED BRACKET	PHOENIX CONTACT
95	4	0800886	END ANCHOR	PHOENIX CONTACT
123	2	3047028	END BARRIER – UT 2,4,6,10 (GRAY)	PHOENIX CONTACT
144	2	3030310	TERMINAL JUMPER 5P 600V – UT 6	PHOENIX CONTACT
148	10	5025462	ISOLATION PLUG FOR MULTILEVEL TERMINAL BLOCK	PHOENIX CONTACT
181	16	2966171	MINI RELAY TERMINAL BLOCK WITH 24VDC COIL	PHOENIX CONTACT
214	1	2856702	TRABTECH SURGE FILTER	PHOENIX CONTACT
298	1	1085039	5 PORT NARROW ETHERNET SWITCH	PHOENIX CONTACT
324	1	2938581	QUINT 24 VDC POWER SUPPLY, 5 AMP	PHOENIX CONTACT
446	1	A303008LP	NEMA 12, 30"x30"x8" WALL-MOUNT ENCLOSURE	HOFFMAN
680	1	A30P30	SUB PANEL – 27"x27"	HOFFMAN
965	1	1769-IQ16	COMPACT LOGIX 16-POINT DIGITAL INPUT MODULE	ALLEN BRADLEY
969	1	1769-L24ER-QBFC1B	COMPACT LOGIX PROCESSOR, L24ER, .75MB 16DI, 16DO, 4AI, 2AO	ALLEN BRADLEY
981	1	1769-OF8C	COMPACT LOGIX 8-POINT ANALOG OUTPUT MODULE	ALLEN BRADLEY
1626	1	6AV21240GC010AX0	TP700 COMFORT OPERATOR INTERFACE, 7"	SIEMENS
2223	3	5SJ41027HG40	BRANCH CIRCUIT BREAKER, 2 AMP	SIEMENS
2226	3	5SJ41117HG40	BRANCH CIRCUIT BREAKER, 5 AMP	SIEMENS
2229	1	5SJ41107HG40	BRANCH CIRCUIT BREAKER, 10 AMP	SIEMENS
2401	32	235001	5X20MM FAST-ACTING FUSE, 1A	LITTELFUSE
4410	1	PK12GTA	GROUND BUS BAR	SQUARE D
4610	1	375-M-00002-VC2-1	RUST/CORROSION INHIBITOR, 2FT RADIUS	ZERUST
9009	1	LAMICOID	LEGEND 2"x4", WHITE W/BLACK LETTERS	PANEL SHOP
9011	12	WIREWAY	WIREWAY	PANEL SHOP
9012	2	CAT-5E CABLE, 6 FT	CAT5 ETHERNET CABLE	PANEL SHOP
9021	1		UL/CUL LABEL	PANEL SHOP
9074	1	WMUFD001G-3	1 GB INDUSTRIAL USB MEMORY STICK, SLC TYPE MEMORY	PSI OR EQUAL
9076	1	W2T438450	EVOQUA AUTOMATED CONTROLS LABEL	EVOQUA WT
9077	1	W2T438453	SERIAL #/ DATA LABEL	EVOQUA WT
SPARE PARTS				
2401	5	235001	5X20MM FAST-ACTING FUSE, 1A	LITTELFUSE
4610	1	375-M-00002-VC2-1	RUST/CORROSION INHIBITOR, 2FT RADIUS	ZERUST

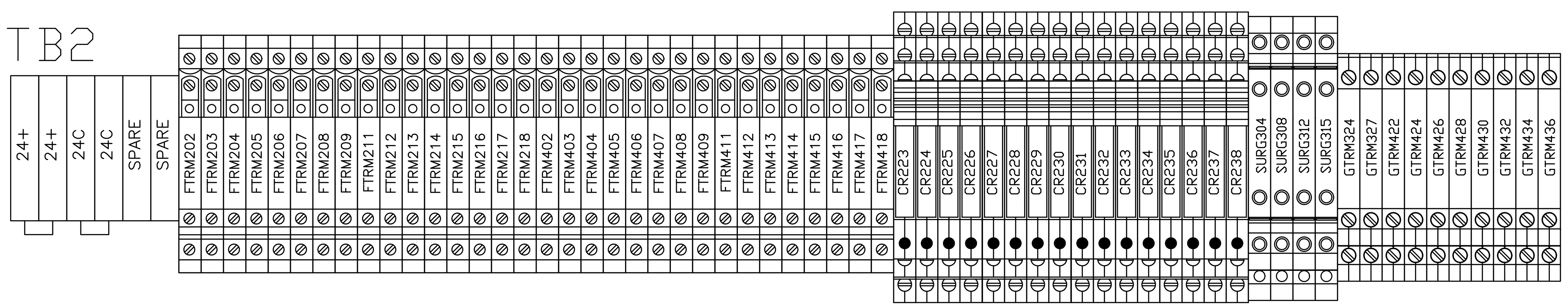
EVOQUA PROVIDED SHIP LOOSE ITEMS					
ITEM	QTY	W2T PART NUMBER	CATALOG	DESC	MFG
IN5	1	W2T553647	9020000	LDO PROBE	HACH
IN6	1	W2T333384	DRS5	ORP PROBE	HACH
IN11	1	W2T295189	25M2A1001-115	200 mV ORP REFERENCE SOLUTION, 500ml	HACH
IN20	2	W3T376887	603-82169	PROBE HANDRAIL MOUNTING KIT	EVOQUA WT
IN36	1	W2T907024	LXZ524.99.00005	SC4500 SUN SHIELD	HACH
IN39	1	W2T909007	LXV525.99A11551	SC4500 ANALYZER – 120VAC POWER	HACH

NOTE:
SEE 453130-891-01 TO 453130-891-04 FOR ELECTRICAL SCHEMATIC.

TB1



TB2



NOTE
ITEM 9076 DETAIL:

evoqua WATER TECHNOLOGIES
Automated Controls
Evoqua Water Technologies
Waukesha, WI
262-547-0141 or 800-524-6324

NOTE:
ITEM 9077 TO BE LABELED WITH THE FOLLOWING:
SERIAL NO. 453130-891-05
CONTROL VOLTS: 120 V, 1 PH., 60 HZ
CONTROL AMPS: 4.2 FLA
SHORT CIRCUIT CURRENT: 5 kA
RMS SYMMETRICAL, 120 V MAXIMUM

PANEL TO BE UL/cUL LISTED

NOTES: WIRING SPEC:
PLC CARD WIRING – #16AWG STRANDED MTW OR EQUAL, 300V @ 90°C, UNLESS OTHERWISE NOTED.
CONTROL WIRING – #14AWG STRANDED MTW OR EQUAL, 600V @ 90°C, UNLESS OTHERWISE NOTED.
POWER WIRING – #12AWG STRANDED MTW OR EQUAL, 600V @ 90°C, MINIMUM, SIZED FOR CIRCUIT CURRENT.
WIRE COLOR CODES:
BLACK – POWER WIRING (MULTI-PHASE) 230VAC OR GREATER, 120VAC UNSWITCHED CONTROL WIRING.
RED – 120VAC SWITCHED CONTROL WIRING.
WHITE – 120VAC NEUTRAL WIRING.
GREEN – GROUNDED CONDUCTORS.
BLUE – UNGROUNDED DC CONTROL WIRING.
WHITE W/BLUE STRIPE – GROUNDED DC CONTROL WIRING.
LIGHT BLUE – INTRINSICALLY SAFE WIRING.
ORANGE – EXTERNALLY POWERED CIRCUITS (CUSTOMER CONTACTS).
CUSTOMER CIRCUITS:
DRY CONTACTS ARE RATED FOR 7.5 AMPERES @ 120VAC. SUITABLE PROTECTION AND DISCONNECT MEANS ARE TO BE PROVIDED BY CUSTOMER. USE #14AWG MINIMUM.
ALL HOLES TO BE SEALED AND GASKETED TO MAINTAIN ENCLOSURE INTEGRITY.

WIRED IN SHOP PRIOR TO SHIPMENT
FIELD WIRING UNLESS OTHERWISE NOTED

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
0	RELEASED FOR FABRICATION	2022-11-03	S.ZICK			
A	FOR SUBMITTAL ONLY NOT FOR FIELD CONSTRUCTION	2022-08-18	S.ZICK			

DESIGNER	DATE
S.ZICK	2022-08-17
CHECKER	DATE
ENGINEER R.VANSEL	DATE
MANAGER J.KINNEY	DATE
FILE:	
SCALE:	

TITLE SMART BNR Lite
ENCLOSURE LAYOUT AND BOM

CLIENT CITY OF JEFFERSON
JEFFERSON, GA

evoqua WATER TECHNOLOGIES — WATER TECHNOLOGIES, WAUKESHA, WI, 262-547-0141

PROJECT	CODE	DRAWING	SHEET	REV
2033/001848	4034	453130-891-05	1 OF 1	0

STD: BORDER-0106-24X36D1 | INTL REF: | BAR = 1" AT PLOT SCALE