Operations and Maintenance Manual

Chlorine and Total Residual Oxidant Monitor

For Use in Hazardous Environments and Extended Reagent Life

Model CLX-Ex2 28034

⚠ WARNING

Read this Manual BEFORE using this equipment.

Failure to read and follow all safety and use information can result in death, serious personal injury, property damage, or damage to the equipment.

Keep this Manual for future reference.

THINK SAFETY FIRST

HF scientific
A WATTS Brand

Table of Contents

1.0 Safety

This manual contains basic instructions that must be followed during the commissioning, operation, care and maintenance of the instrument. The safety protection provided by this equipment may be impaired if it is commissioned and/or used in a manner not described in this manual. Consequently, all responsible personnel must read this manual prior to working with this instrument.

In certain instances icons or symbols, have been added to give further clarification to the instructions. Refer to the *Table of Contents* to easily find specific topics and to learn about unfamiliar terms.

This manual is intended to be used in conjunction with No.28749 for more information on the connection and operation of the Air Sentinel.

1.1 Symbols Used in This Manual

⚠ WARNING This symbol identifies hazards which, if not avoided, could result in death or serious injury.

⚠ CAUTION This symbol identifies hazards which, if not avoided, could result in minor or moderate injury or damage to the equipment.

NOTICE This symbol identifies important information, practices or actions.

This pictorial alert you to the need read the manual, possibly at a different section.

This pictorial alerts you to electricity, electrocution and shock hazards.

1.2 Use in Explosive Environments Safety

In the interests of safety the operator must ensure the atmosphere where the instrument is located is safe from gases, vapors, dust or other flammable conditions whenever the instrument is opened for service or maintenance. At all other times the door must be kept closed with purge air connected the purge system operating with the all GREEN lamps lit indicating safe operation.

⚠ WARNING

If power is retained to the CLX-Ex2 after opening the enclosure door while NOT in bypass mode, immediately close the enclosure door and remove power to the instrument. Contact HF scientific service department for further instruction.

2.0 Overview

The CLX-Ex2 Online Chlorine Monitor allows for the reading of chlorine levels of process water on-line. The CLX-Ex2 has been designed to meet the design criteria specified by Standard Methods for the Examination of Water and Wastewater (21th Edition) Method 4500-Cl G. DPD Colorimetric Method. The CLX-Ex2 uses a 515nm LED as the measurement light source.

This instrument has been designed to operate in explosive atmospheres and meets the IECEx rating as stated in the specifications. The instrument does this with the use of an approved purge/pressurization controller called the Air Sentinel. Please refer to the companion manual Cat. No. 28749 for all information on:

- Operation of the Air Sentinel.
- Electrical power connections.
- Purge Air Connection.

In addition this instrument has vortex cooling. This instrument will automatically control a connected compressed air line to lower the temperature of one of the reagents, allowing the reagent an operating life of up to 3 months.

Every effort has been made to ensure the accuracy of this manual. Due to the continuous development and improvement of all instrumentation, there may be slight differences between this manual and the instrument received. Therefore, no legal claims can be made against any discrepancies herein.

2.1 Specifications

Measurement Range	0.00 – 10.00 mg/L (PPM) or 0.00 – 15.00 mg/L (PPM)
Accuracy	For 0.00 – 10.00 mg/L Range: ±5% of reading or ±0.03 mg/L (PPM) whichever is greater for range of 0-6.0 mg/L(PPM)±10% of reading from 6.01-10.00 mg/L (PPM) For 0.00 – 15.00 mg/L Range: ±10% of reading or ±0.03 mg/L (PPM) whichever is greater
Resolution	0.01 mg/L (PPM)
Cycle Time	Adjustable; 60 seconds to 10 minutes (600 seconds)
Display	Multi-Line Liquid Crystal Backlit Display
Alarms	One NO relay contact 120-240VAC 2A
Analog Output	Powered 4-20 mA, 600 Ω drive, isolated
Communications Port	Bi-directional RS-485 with Modbus
Water Pressure	Integral pressure regulator 0.34 bar (5.0 PSI) to 10.3 bar (150 PSI.)
Flow Rate to Waste	200 – 400 ml/min.
Operating Temperature	0°C – 55°C (32°F – 131°F)
Wetted Materials	PVC, Borosilicate Glass, Reslyn (FFKM), Viton® (FKM), Polypropylene, 316 Stainless Steel, Acetal, Noryl®, Silicone
Sample Temperature Range	0°C – 55°C (32°F – 131°F)
Power Supply	100 to 240VAC, 47-63 Hz, 250VA
Insulation Rating	Double Insulated, Pollution Degree 2, Overvoltage Category II
Environmental Conditions	Altitude up to 2000 meters Up to 95% RH (non-condensing)
IECEx Hazloc Rating	Ex pxb IIC T4 Gb 0°C ≤ Ta ≤ 55°C
Compressed Air	Water and oil free, -40°F (-40°C) Dew Point, Particles <5u, ISA Grade Hydrocarbon Free. Full time clean dry air at 5.5 - 7 bar (80-101.5 PSI) @35 SLPM (1.2 SCFM) @ 20°C (68°F) Max
Regulatory Compliance and Certifications	CE Approved, ETL listed to UL 61010-1 Issued May 11 2012 3rd Ed and ETL certified to CSA 22.2 No. 61010.1 issued May 11 2012 EN61326:2006
Shipping Weight	27.2kg (60lbs.) Reagents are Shipped Separately
Shipping Dimensions	93 cm X 62 cm X 32 cm (36½" X 24½" X 12½")

***Viton® is a trademark of The Chemours Company FC, LLC**
Noryl® is a registered trademark of SABIC Global Technologies B.V.

2.2 Unpacking and Inspection of the Instrument and Accessories

The table below indicates the items included in the shipment.

Item	Quantity
CLX–Ex2 Monitor	1
Instruction Manual	1
Tubing/Cuvette Kit: 8 black pump tubes, 2 different Cap Assemblies, 1 replacement cuvette	1
Check Valve Flushing Kit	1

Remove the instrument from the shipping crate. Carefully inspect all items to ensure that no visible damage has occurred during shipment. If the items received do not match the order, please immediately contact the local distributor or the HF scientific Customer Service Department.

2.3 Instrument Labels

The following labels should be applied to the outside of the enclosure.

Purpose	Location	Label
Serial number, manufacturer, part number, power rating, CE and UL marking	Front of Enclosure	hf scientific, A WATTS Brand, Ft. Myers, Fl toll free: 888-203-7248 PRODUCT: TRO MONITOR MODEL: CLX-Ex2 28034 SERIAL NO.: 201911237 RATING: 100-240 VAC 47-63Hz 250VA L# 73106 PATENT NO. US 7,794,660 B2 ASSEMBLED IN THE USA
Warning and informational	Front of Enclosure	WARNING: PRESSURIZED ENCLOSURE Enclosure shall not be opened unless power is removed or area has been properly tested and is known to be non-hazardous! MINIMUM OVER PRESSURE: ≥ 0.6 MILLIBAR MAXIMUM OVER PRESSURE: 4 MILLIBAR MINIMUM PURGE FLOW RATE: 35 SLPM MINIMUM PURGE DURATION: 5 MINUTES MAXIMUM LEAKAGE RATE: 45 LPM L# 74014
Informational	Front of Enclosure	IECEx LC 14.0006 ExNB 19 ATEX 0014 Ex pxb IIC T4 Gb 0°C ≤ Ta ≤ 55° C

2.4 The Display

Figure 1 illustrates all the items that can appear on the display. The upper row of the display (1) is used for reporting the chlorine levels and to provide user guidance in the customer setting routine. The lower row of the display (2) is used to communicate error messages (message queue) and provide user guidance. The display has two icons (3) that are used to indicate the use of access code and offset mode. In addition, mode arrows (4) are used to indicate the current instrument operating mode; AUTO (normal operation), CAL (calibration) and CONFIG (configuration).

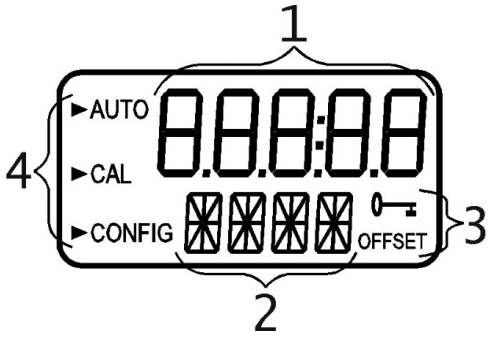


Figure 1: Display used in the instrument

2.5 The Touch Pad

Figure 2 illustrates the touch pad. The touch pad has six buttons: **PRIME, SERVICE, MODE/EXIT,** ↵, ▲ and ▼

The **MODE/EXIT** button is used to cycle between the three operational modes of the instrument: **CAL, CONFIG,** and **AUTO** (Measurement) mode. The ↵ button enters the option or mode that is highlighted or chosen. The ▲ and ▼ buttons are used to change settings.

The **PRIME** and **SERVICE** buttons are dedicated controls. The **PRIME** will start 75 reagent pump pulses to prime the tubing after a change or addition of reagent bottles. The **SERVICE** button will drain the instrument and hold all operations until either the **SERVICE** button is pushed again or the power is reset. This button should be used while changing the tubing, the measurement cuvette or reagent bottles.

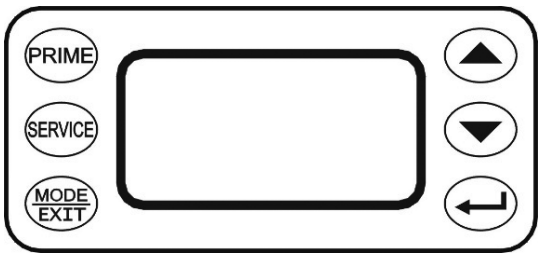


Figure 2: The CLX-Ex2 touch pad

2.6 Orientation

From the diagram below the major components can be located. Note that two reagents are required the buffer and the indicator. The reagents are discussed in the Routine Maintenance section 11.0.

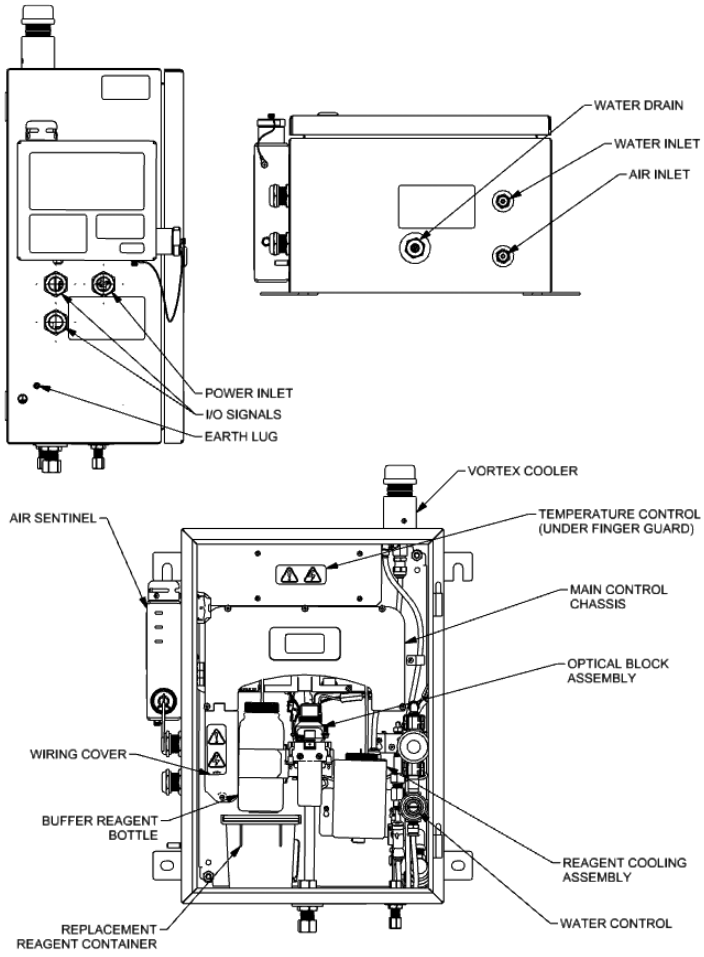


Figure 3: The CLX-Ex2 with Cover Open

3.0 Theory of Operation

3.1 The Measurement

The CLX-Ex2 has two solenoid valves, one for sample water (FLOW) and one for draining of the cuvette (PURGE). A third solenoid, along with four check valves forms a reagent pump. Sample water flow is controlled by the FLOW solenoid valve. The PURGE solenoid valve is used to empty the cuvette in the measurement chamber.

The measurement chamber consists of a sample inlet, a purge drain, and an overflow. The reagent is added from the check valves integrated into the lower portion. A green LED provides the 515 nm source lamp, a red LED is used for sample level and flow measurement. A single detector is located 180º from the green LED. A replaceable glass cuvette separates the LEDs from the detector and maintains the measurement path length. Sample water flows in the inlet at the bottom, through the measurement cuvette and out through an overflow drain. This flow is used to both fill the cuvette and flush the system.

The reagents are dispensed from two replaceable bottles. One bottle has a buffer to control the pH; the second has an indicator that contains the DPD, which produces color when chlorine is present in the sample. The degree of color is dependent on the amount of chlorine in the sample water.

The measurement chamber is open to view operations. A white LED backlights the chamber for a clearer view. The white LED will flash to attract attention in the case of a warning or failure. Most warnings and failures are also displayed on the screen. To prevent interference, the white LED is turned off during measurements.

During normal operation the CLX-Ex2 will run through a timed cycle. A simplified cycle will consist of the following sequences:

- Flushing – continuous sample flow
- Purging – PURGE valve opens
- Zeroing – no flow with cuvette full
- Adding Reagents – one pulse of the reagent pump
- Mixing with sample – sample flow pulses in
- Reading resulting sample – no flow with cuvette full
- Purging – PURGE valve opens to remove reacted sample

The cycle above is simplified and does not describe all the actions and testing that occurs. The CPU continuously diagnoses the entire system for correct operation and sample water flow. If an error occurs, a message is posted to the message queue on the LCD screen.

The reagent is added by a single pulse of the reagent solenoid. When the reagents require replacement, the **PRIME** button is pushed to bring new reagents into the system. During **PRIME** the reagent solenoid is pulsed several times to draw fluid from the two reagent bottles and fill the tubes with new reagent. A complete **PRIME** takes less than a minute.

The **SERVICE** button empties the cuvette, stops the flow of sample water, and clears any errors. This provides a convenient way to replace reagents and the measurement cuvette. If more extensive servicing is performed, all power to the CLX-Ex2 should be removed. If the CLX-Ex2 is to be turned off, it is recommended that the instrument be placed in **SERVICE** mode before removing power. This ensures that the cuvette is emptied and the flow is off.

3.2 The Air Sentinel Controller

The Air Sentinel controller governs the power to the instrument. For normal instrument operation air needs to passes through fitting on the base of the main enclosure and constantly purge any vapors that could build-up. All GREEN lamps indicate a safe operating condition. Only when this condition is reached will power be applied to the measurement portion of the instrument.

Start-up

At start-up with the enclosure door open the Air Sentinel will display a RED **PRESSURE** lamp on the visual indicator indicates that the system is not pressurized and no power is sent to the instrument.

Closing the door with the air pressure applied, will cause the Air Sentinel to display a GREEN **PRESSURE** lamp and a RED **TIMER** lamp. During this time the enclosure will undergo an automatic dilution purge period of 5 minutes where at least 5 volumes of free space inside the enclosure will be exchanged with clean purge air. No power is applied to the rest of the instrument during this time.

After the enclosure air has gone through this purge period the Air Sentinel will display all GREEN lamps. At this time the instrument is deemed safe and power is applied to rest of the instrument.

⚠ WARNING

Do not apply power to the Air Sentinel controller unless the area has been properly tested and is known not to contain explosive materials.

Bypass Key

Use of the bypass key disables the safety features and safe operation of this instrument. It is imperative that this operation be performed only after the area has been tested and known to be safe.

If power is retained to the CLX-Ex2 after opening the enclosure door while NOT in bypass mode, immediately close the enclosure door and remove power to the instrument. Contact HF scientific service department for further instruction.

Assuming the area has been tested and is known not to contain explosive materials; a bypass service key is provided and can be used. In this operating mode power will be retained to the rest of the instrument even though the door is open. It is imperative that this mode is only used after area is known to be safe. This operation disables the safe operation of this instrument.

Upon turning the key, the indicator will display the RED **BYPASS & TIMER** lamps. This is an indication of the maintenance mode. Power is retained to the instrument. The key cannot be removed in this mode of operation.

After maintenance has been performed the door should be closed and latched. Air pressure will once again pressurize the enclosure. The maintenance key can now be turned and removed and the key cover replaced. The purge controller will display GREEN **PRESSURE & BYPASS** lamps indicating a safe operation and power is kept applied to the instrument. The **TIMER** lamp will remain RED for 5 minutes to indicate a bypass operation had taken place.

3.3 Remote Standby

This feature will allow for remotely placing the instrument into a standby mode. This can be done to lower reagent usage while not performing ballasting or de-ballasting operations. The last operation of each cycle is a flush and hold. Whenever the instrument is not being used (standby), it is stored such that the optics is clean and dry.

Dry contacts are provided as feedback as to the operation of the instrument (operating or standby). For more information on this feature refer to sections 4.4.4 *Remote Standby Connections and 6.2 Routine Measurement with Remote Standby.*

3.4 The Reagents

The indicator reagent reacts with any oxidant, generally chlorine, to create a pink color which the instrument measures and compares with a sample of water without reagents.

The buffer reagent is required to control the sample pH to bring the sample to neutral. The reagents are provided already hydrated and require little operator preparation.

Each 125 mL indicator will require the addition and mixing of the DPD powder contained in the small brown bottle. This activates the indicator reagent. The indicator reagents should be changed out on a 90 day basis even if they are not fully used.

The 500 ml buffer does not require any preparation and is good for one year.

After one year all the reagents will have been consumed and replacement reagent set will be required. This can be ordered through agent Catalog No.09991. This set will include four sets of Indicator reagents plus one 500 mL bottle of Buffer.

3.5 The Reagent Cooler

A reagent cooler is provided for the 125 ml indicator reagent.

For proper operation power must be applied by the Air Sentinel controller to the cooling chamber temperature controller. Clean dry compressed air must also be provided at pressures between 5.5 and 7 bar (80 to 101.5 PSI).

The cooling chamber temperature controller governs the solenoid which controls air flow to the vortex cooling unit. The air flow is turned on or off as required to maintain the indicating reagent temperature at 20-25˚C. This extends the life of the reagent up to 90 days.

To provide this extended reagent life, power to the cooling power supply and air pressure must be supplied full time.

4.0 Installation and Commissioning

Prior to use for the first time, one of the reagents (the indicator) will have to be mixed. Refer to section 11.2 *Replacing or Installing the Reagents.*

4.1 Mounting and Site Selection

The instrument is designed for wall mounting. Choose a location that is easily accessible for operation and service and ensure that the Purge Control lamp is about eye level. Consideration must be made for the plumbing and electrical conduit connections. The overall mounting dimensions of the instrument are shown in Figure 4.

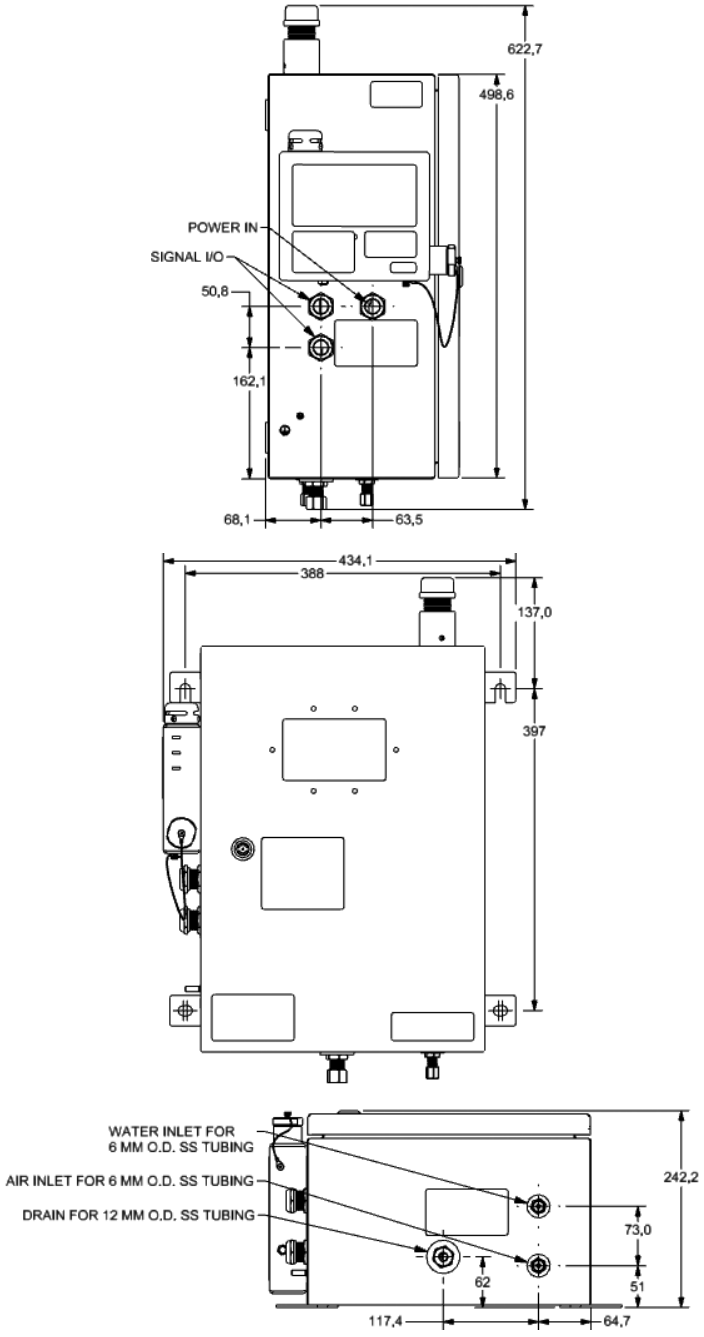


Figure 4: Overall Mounting Dimensions of the Instrument

Be sure that the instrument be mounted as close as possible to the sampling point to ensure a quick response time (within 2-3 meters (6-10 ft) of the sampling point).

4.2 Plumbing

The instrument is designed to require very little head pressure to operate, but will need around 0.34 bar (5 PSI). The maximum pressure for proper operation should not exceed 10.3 bar (150 PSI). The maximum allowable fluid temperature is 55°C (131°F).

NOTICE

The fluid waste from drain connection of this instrument contains reagents diluted with large quantities of sample water. HF scientific recommends that in the case of ballast installations, the waste stream is reintroduced to the bilge tanks. This waste fluid must NEVER be reintroduced into the incoming water stream.

All plumbing connections are intended to be made through stainless steel connections.

The water sample inlet requires 6 mm OD stainless steel tubing. The fitting is a compression fitting so the installer need only place the supplied the nut and feral over tubing and tighten.

The water drain requires 12 mm OD stainless steel tubing. This fitting is also a compression fitting so the installer need only place the supplied the nut and feral over tubing and tighten.

Properly installed and sealed connections are required to ensure the water tightness and ratings of the instrument.

NOTICE

The drain must be open to the Atmosphere for proper operation.

4.3 Air Supply

This instrument requires water and oil free air, (-40°C [-40°F] Dew Point, Particles <5u, ISA Grade Hydrocarbon free). The air needs to be provided at between 5.5 and 7 bar (80-101.5 PSI) with a volume of 4 cubic foot/min as measured at 5.5 bar (80 PSI). This air supply must be provided continuously from a known safe area. Min flow is 35 SLPM

The air connection requires 6 mm stainless steel tubing. A compression type fitting is supplied on the base of the main enclosure that simply requires the installer to slip the supplied nut and feral over the tubing and then tighten the nut.

4.4 Electrical Connections

All electrical connections must pass through the three compression grommets on the left side of the instrument. Cabling must be selected to ensure that these connections are tight. The grommets can accept cabling from 11 to 21 mm diameter. One grommet is supplied for system power and two are supplied for low voltage I/O connections. These grommets must be tightened to maintain cabinet air pressure.

Most of the low voltage electrical communication connections to the instrument are made at the termination area which is located on the left side of the instrument. Remove the access cover by loosening the captive screw. The connections are labeled and are self-descriptive. Please follow all government recommendations for installation of electrical connections to and between the instrument and other peripheral devices.

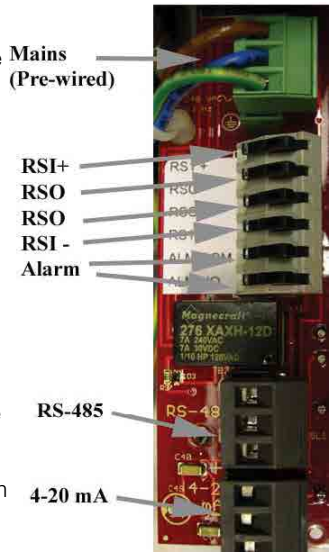
All terminals are designed to accept wires in the range of 14-28 AWG. All wires should be stripped to a length of 6 mm (¼").

For line power connections refer to the companion manual Catalog No. 28749.

4.4.1 RS-485

The RS-485 half-duplex (2-wire) digital interface operates with differential levels that are not susceptible to electrical interferences. This is why cable lengths up to 3000 ft can be implemented. The last device on each bus may require terminating with a 120 ohm resistor to eliminate signal reflection on the line. Do not run RS-485 cables in the same conduit as power. Set-up of the RS-485 is covered in 8.3 *Configuring the RS– 485 Port.*

To prevent damage to the instrument, ensure that power is disconnected prior to making connections. For ease of connecting, remove the plug-in terminal block. Connections are labeled beside this termination on the PC board. The recommended cable is 22 AWG shielded twisted pair. The grey terminal block is removable to assist in making connections.



4.4.2 Relay

One relay alarm connections labeled ALM COM & ALM NO is provided. Please note that this is a fail- safe so the "normal" condition is power to the CLX-Ex2 on and no alarm condition.

The relay is rated 240VAC 2A. Operation of this alarm is covered in section 8.4 *Configuring the Alarm.*

4.4.3 4-20 mA

The 4-20 mA output is driven by a 15 VDC power source and can drive recorder loads up to 600 ohms. Transformer isolation is provided on the CLX-Ex2.

Do not run 4-20 mA cables in the same conduit as power. Operation of this output is covered in section 8.1 *Setting the 4-20 mA.*

To prevent damage to the instrument, and for general safety ensure that power is disconnected to the CLX-Ex2 prior to making any connections. Polarities of the connections are labeled beside this termination on the PC board.

The recommended cable is 22 AWG shielded twisted pair. To prevent ground loops, connect the shield at either the CLX-Ex2 or at its destination, but not both. The grey terminal block is removable to assist in making connections.

The 4-20mA is factory calibrated. An adjustment is available on the 4-20mA in sections 8.12 and 8.13. In addition to making adjustments, these menus output continuous 4 mA or 20 mA and can be used as a signal test. Remember that the configuration mode will timeout after 15 minutes.

4.4.4 Remote Standby Connections

The instrument operates on user control software, where an external control initiates each cycle. This control line is called the RSI short for Remote Standby Input.

The CLX-Ex2 will indicate the current status on another line called RSO or Remote Standby Output. These connections are a relay contact that is closed when busy and open during when in standby mode.

The connections are labeled RSI and RSO. The RSI has + and – polarity connection associate with it and expects a 24VDC control signal.

The RSO is simply a relay contact and is not polarized.

4.4.5 RS-485/4-20 mA cable Ferrite

To meet IEC requirements for RF radiated immunity a clamp-on type ferrite is supplied in the accessory kit. It should be placed on the RS-485 or 4-20 mA cable outside, as close as possible to the CLX-Ex2. If both outputs will be used, an additional ferrite will be needed and can be ordered from HF scientific Catalog number 24560T.

4.4.6 Modbus Control

In addition to the above mentioned Remote Standby Connections, the same control can be achieved using Modbus control. Two special Modbus addresses are provided.

The reading cycle is initiated using the coil 00005 with default at False (0). Setting this address to True (1) initiates the reading cycle.

At any time the standby status can be check at Modbus Coil Address 00005 or Modbus Input Address 10005. False (0) indicates standby and True (1) indicates the measurement cycle is taking place. Control is only available from the Coil Address 00005.

4.5 Installing Reagents

The CLX-Ex2 will require that two reagents be installed prior to operation. These are a buffer and an indicator. For reagent preparation refer to section 11.2 *Replacing and Installing the Reagents.*

5.0 Air Sentinel Controller Operation

The Air Sentinel controller is mounted on the side of the main enclosure. This controller will ensure proper safe operation of the CLX-Ex2. If of all the required conditions are met, the controller will act as a power governor. It does this by monitoring the pressurization of the main enclosure with clean dry air. Should this air supply pressure fail the **PRESSURE** lamp on the Air Sentinel unit will turn RED and power to the rest of the instrument is disconnected.

⚠ WARNING

Do not apply power to the Air Sentinel controller unless the area has been properly tested and is known not to contain explosive materials.

5.1 Start Up

When power is applied to the CLX-Ex2 for the first time, ensure that the air supply is connected as stated in section 4.3 and the cabinet is closed and locked. Once power is applied, the Air Sentinel will go through a purge period of 5 minutes where at least five volumes of the enclosure are pushed through the CLX-Ex2 and out the Air Sentinel vent. During the purge period the **TIMER** lamp Air Sentinel will be RED indicating the purge is in process and no power is applied to the rest of the CLX-Ex2.

At the complete of the purge, the **TIMER** lamp will go GREEN and power will be applied to the rest of the system. As long as the proper air supply conditions are met the CLX-Ex2 will continue to operate.

5.2 Indicator Lamps

The indicator lamps are a very quick way to determine to operation of the controller and thus the safety condition of the CLX-Ex2.

Lamp Color Matrix	Function	Default
All lamps GREEN	Safe Operation	Power ON
TIMER lamp RED	Instrument purging or Bypass operation	Power OFF
PRESSURE lamp RED	Unsafe Operation	Power OFF
BYPASS lamp RED	Bypass Key Operating	Power ON
No Lamps on	No power applied to CLX-Ex2	No power applied everything off

Using the table above, you can quickly determine the operating condition of the instrument. Under normal operation all GREEN lamps should appear.

5.3 Maintenance Bypass Operation

⚠ WARNING

Use of the bypass key disables the safety features and safe operation of this instrument. It is imperative that this operation be performed only after the area has been tested and known to be safe.

NOTICE

When shipped from the factory the bypass key is shipped on the strap securing the key cap. Once the commissioning of the system has been done these should be moved to a known secure location. It is not advised that they be left on the strap.

To perform some maintenance operations on the CLX-Ex2 it is necessary to have the entire instrument powered up while the enclosure door is open. Under these conditions normally the Air Sentinel controller would determine that the enclosure is not pressurized and power will be removed to the measurement section of the CLX-Ex2. To allow for this situation, a special maintenance bypass key is supplied.

Located on the right side of the Air Sentinel controller is a knurled cap. Removing this cap reveals the key slot. Insert the key, push in slightly and turn it clockwise to engage the bypass operation. The **TIMER & BYPASS** lamps will turn RED to indicate the bypass mode. Assuming the area around the CLX-Ex2 has been tested and known to be safe, the enclosure door can now be safely opened and power will remain on to the entire system. The key cannot be removed while operating in the maintenance bypass mode.

⚠ WARNING

Do not operate the CLX-Ex2 for long periods of time in the bypass mode. This is intended only for maintenance operations.

Do not operate the CLX-Ex2 in the bypass mode unattended.

To return the instrument to normal, safe operation, close the enclosure door. Ensure that the air supply is connected turn the key counter-clockwise and remove. Replace the key cover. If the pressure in the cabinet has built up to a normal acceptable level, the Air Sentinel will show all GREEN lamps and the instrument will continue to run.

6.0 Operation

Under normal operation the Air Sentinel controller lamps will all be GREEN indicating safe operation. If the lamps are not GREEN, correct this condition first. Please refer to section 5.0 Air Sentinel Controller Operation.

The CLX-Ex2 Online Chlorine Monitor allows for the measurement of the chlorine of process water on-line. The chlorine value of the process water is usually reported in **m**illigrams per **L**iter (mg/L), these units are equivalent to **P**arts **P**er **M**illion (PPM).

The CLX-Ex2 has two available measurement ranges, 0.00 – 10.00 or 0.00 – 15.00 mg/L (PPM). Although the unit will display above the range, these readings will not be within the stated accuracy. As the reagents degrade due to aging, readings above the set range may decrease in value.

6.1 Routine Measurement

First, ensure that all plumbing and electrical connections are complete before continuing.

The following steps describe how to measure the value of chlorine of a sample using this instrument:

1. Apply power to the instrument and allow the unit to warm up. The instrument may have to re-calibrate the water level sense detector. This WCAL or water calibration will take few minutes to perform.
2. When a continuous process stream is flowing through the instrument, the instrument will display the measured chlorine level of the sample by displaying it on the LCD screen. In addition, the equivalent signal is provided on the analog (4-20 mA) output, or the digital (RS-485) output, depending on the options selected.

6.2 Routine Measurement with Remote Standby

First, ensure that all plumbing and electrical connections are complete before continuing.

The following steps describe how to measure the value of chlorine of a sample using this instrument:

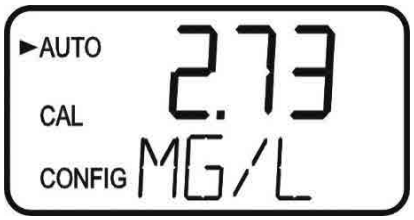
1. Apply power to the instrument. The instrument will perform a water calibration (WCAL). During this time the RSO contact will be closed, indication the system is busy. This automatic calibration is necessary and will only be performed once on power up.
2. When the system has completed the WCAL, the RSO contacts will open indicating that it is in standby mode and is ready to take a measurement.
3. Application of 24VDC to the RSI+ will initiate a read cycle. The RSO contacts will close to indicate the system is busy.
4. At the completion of the cycle, the RSO contacts will open and the measured chlorine level of the sample will be displayed on the LCD screen. In addition, the equivalent signal is provided on the analog (4-20 mA) output, or the digital (RS-485) output, depending on the options selected.

The system is ready to take another measurement.

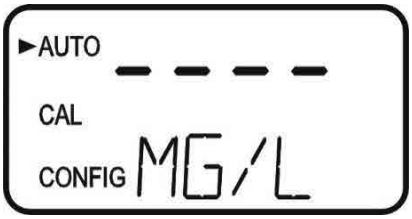
As mentioned previously the same control can be performed via Modbus. Setting Coil 00005 to a 1 will start a cycle. See 4.4.6 *Modbus Control.*

These screens can be seen through the window of the CLX-Ex2 with the door closed, however to access the anything other than measurement screens requires that the instrument be placed in bypass and the enclosure door be opened.

During normal operation, the instrument will have the arrow beside **AUTO** highlighted with the current scale displayed on the lower row of the display and the measured reading on the upper row of the display (see screen shown).



The screen depicted indicates that the system has just been started or just entered **AUTO** mode from Service mode and no readings have been taken yet.



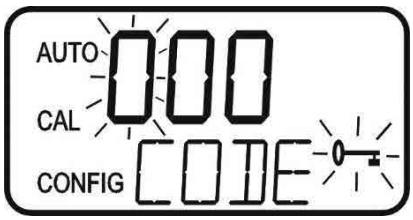
NOTICE

Please note that calibrations will not be allowed until a reading is posted.

6.3 Security Access Feature

The instrument is equipped with a security access code feature that can be activated in the configuration mode. If the security feature is enabled, the screen shown in the illustration below will appear when the **MODE/EXIT** button is pressed.

The security code (333) must be entered to gain access to **CAL** or **CONFIG** menus. Notice that the first number in the code is flashing. The flashing indicates that this is the number to be changed. Use the ▲ or ▼ arrows to select the first of the three numbers in the code and then press the ↵ button to accept the first number of the code. Now enter the second number in the code. Proceed as with the first number followed by ↵ . Then repeat the process for the third number in the access code, and finish with the ↵ button.



If the valid access code has been selected, the instrument will be directed to the calibration mode. If the wrong access code is selected, the instrument will return to the **AUTO** mode. Refer to section 8.4 *Enabling the Security Access* for more information.

6.4 The White LED

A white LED is used to illuminate the measurement cuvette for easy viewing of the instrument operations. During the Zeroing portion of the cycle and the Measurement portion of the cycle, when the green LED is active, the white LED is turned off to lower interference. This is normal operation for the instrument and does not represent an error or problem.

The white LED is also used to draw attention to a problem as described in section 10.1 *CLX-Ex2 Fault Detection*. In these instances the white LED blinks at a constant rate dependent on the severity of the problem, but is still turned off as described above. Please note that any fault is always posted to message queue on the lower portion of the LCD.

7.0 Instrument Calibration

The instrument was tested prior to leaving the factory. The instrument operates from a pre-determined calibration curve for high accuracy of residual oxidant concentration. It is not necessary to recalibrate to maintain accuracy specifications.

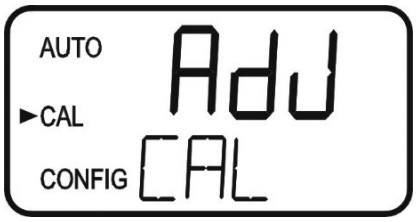
If re-calibration is required by a regulatory authority, this can easily be performed if required. The method is by comparison against another instrument, such as a laboratory or hand held photometer (such as HF scientific's Chlorine Pocket Photometer).

There are two points of calibration. The slope or gain and the zero (offset). To perform the zero calibration, the instrument must be plumbed to a sample of known chlorine free water, such as de-ionized water for a zero adjustment.

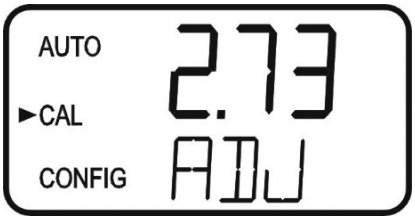
7.1 Slope (gain) Calibration Procedure

It is important that the chlorine level be quite stable to use this method. The comparison will be made against a trusted measurement such as a chlorine photometer, spectrophotometer, or an amperometric titration.

1. Obtain a grab sample of the flow prior entering the instrument.
2. Measure the value of the sample with one of the methods shown above.
3. On the CLX-Ex2, press the **MODE/EXIT** button once. The screen is shown below.



4. Press ↵ to enter the calibration adjustment.



5. The screen will show the current reading on the CLX-Ex2. Using the ▲ and ▼ buttons adjust the reading to agree with the laboratory method or portable photometer.
6. Press ↵ to accept the calibration adjustment and return to **AUTO** measurement mode.

NOTICE

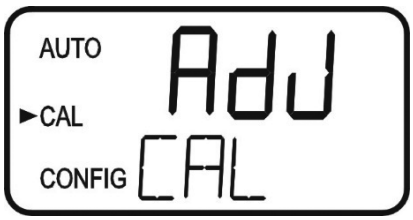
There is a limit to the size of the change that can be made to a current reading. The upper limit is the current reading times 1.5. The lower limit is the current reading divided by 1.5.

Ensure a reading is posted to the display before calibrating to avoid a nOnE error.

7.2 Zero (offset) Calibration Procedure

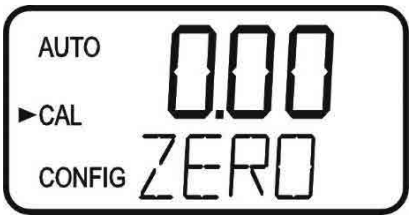
Generally this calibration is only required if readings are expected to be below 1 mg/L or if it is required by a regulatory authority. To perform this calibration, the water supply to the CLX-Ex2 must be changed to chlorine free water such as de-ionized water. This chlorine free water must be run through the instrument for at least 5 minutes prior to using the following procedure.

1. On the CLX-Ex2, press the **MODE/EXIT** button once. The screen is shown below.



2. Press either the ▲ or ▼ buttons to get the following screen.

3. Press ↵ to enter the zero calibration screen.



4. The screen will show the current reading on the CLX-Ex2. Since there is no chlorine, the only reading may be a slight offset due to the absorbance of the reagents. There should be no pink color developed.
5. Press ↵ to perform a Zero calibration. When the calibration has completed the instrument will return to **AUTO** measurement mode automatically.

NOTICE

There is a limit of ±0.20 mg/L total adjustment available. A ZERO Cal. greater than this will cause a CAL warning and no calibration will have occurred. Enter SERVICE mode to clear this error.

7.3 Restore Factory Settings

If the CLX-Ex2 displays a CAL error or the calibration was incorrectly performed, it may be preferred to restore the factory calibration. All factory defaults settings including the factory calibration can be reset by holding down the ▲ button and then pressing and releasing the ↵ button then releasing the ▲ button.

8.0 Instrument Configuration (CONFIG mode)

⚠ WARNING

Only access when the atmosphere has been tested and known to be safe.

Please note that these operating screens cannot be seen except through the door window with the cabinet door closed or in maintenance bypass mode. See section 5.3 for more information on this.

If changes to the configuration have to be performed, you will need to enter the maintenance bypass mode see section 5.3 for more information.

The instrument has been designed to provide the ability to customize the instrument according to needs at any time during normal operation. This mode has been split into sub-menus to facilitate instrument configuration. This section describes how to use each of the sub-menus to configure the instrument. While in the configuration mode, the instrument has a time-out feature that automatically returns the system operation to the **AUTO** mode after a fifteen (15) minute period of no button pushes.

Enter the **CONFIG** mode of the instrument by pressing the **MODE/EXIT** button until the arrow beside **CONFIG** is illuminated, then press the ↵ button to scroll through the sub- menus.

NOTICE

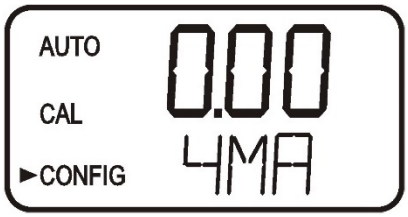
To exit the CONFIG mode, press the MODE/EXIT button any changes that were made will be saved.

8.1 Setting the 4-20 mA Output

The first configuration selection is **4-20** for the 4-20 mA output. Select the either **On** or **OFF** using the ▲ and ▼ buttons. Once the desired output has been set, press the ↵ button to accept it. The next prompts will depend on the output selected. Also see sections 8.12 and 8.13.

If the 4-20 mA output was turned **On**, prompts to set the 4mA **(4MA)** and 20mA **(20MA)** chlorine limits will be displayed. There will also be a menu to adjust the error level (ERLV). The first prompt will be the chlorine limit assigned to the 4 mA output level:

Select the chlorine level to assign to the **4MA** using the ▲ and ▼ buttons.

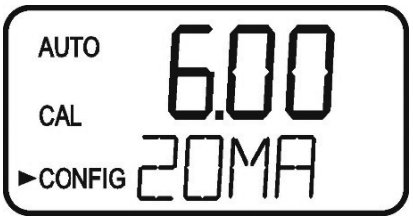


Once the desired level has been set, press the ↵ button to accept it.

NOTICE

The 4MA can be set higher than 20MA level to invert the output current if required. This may be required to control a dosing pump.

The next prompt will be the chlorine level assigned to the 20MA. Select the chlorine level using the ▲ and ▼ buttons. Once the desired level has been set, press the ↵ button to accept it.

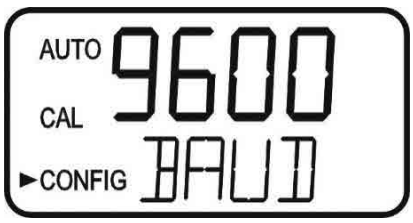


8.2 Configuring the Error Level

In case of an error in the CLX-Ex2, the 4-20 mA reading can be used to indicate a problem by sending the current to either 4.00 mA, 2.00 mA or 0 mA. The factory default setting is OFF. Select the desired ERLV by using the ▲ and ▼ buttons then press the ↵ button to accept the desired error response.

8.3 Configuring the RS–485 Port

The instrument is equipped with an RS 485 port which operates in Simple bus or Modbus. Prompts will appear for setting the baud rate, the address and the Modbus transmission mode (RTU or ASCII).



Select the correct baud rate (1200, 2400, 4800, 9600, or 19200) for operation of the I/O port by pressing the ▲ or ▼ buttons to change the displayed baud rate.

Press the ↵ button to continue on and select the desired instrument address using the ▲ or ▼ buttons. Once the selection is satisfactory, press the ↵ button.

To use the Modbus mode, select **ASCII** or **RTU**. See section 9.1.2.

8.4 Configuring the Alarm

One relay is provided that are designed to operate as an independent programmable alarm or as a system problem alarm. Please note that changes to the alarm will not be recognized until the start of the next cycle. Two settings must be selected to fully program the alarm:

1. The alarm function (HI, LO, OFF or Error)
2. The alarm set point (level at which the alarm activates)

These items are described below:

Alarm Function: The alarm can either be turned OFF or selected to operate in one of three different manners:

1. HI alarm: the relay changes state when the measured chlorine level is higher than the programmed alarm level (set point).
2. LO alarm: the relay changes state when the measured chlorine level is lower than the programmed alarm level (set point).
3. Error alarm: If there is a system fault or problem the alarm will change states.

Alarm Set Point: The level at which the alarm activates is called the alarm set point. On the instrument, the alarm set point is designated as “S/P”. The set point is adjustable to any valid chlorine level over the range of the instrument in steps of 0.01 mg/L. This setting is not available if the Error function is chosen.

8.4.1 Alarm 1

Alarm 1 Function: The **ALM1** is displayed and the display indicates the current function of alarm 1 (**HI, LO, OFF, or Error**). Use the ▲ or ▼ buttons to cycle through and select the desired function. Press the ↵ button to accept the selection.

Alarm 1 Set Point: This prompt is used to select the set point for this alarm; this is indicated by “S/P” shown on the lower row of the display. Select the desired alarm level by using the ▲ and ▼ buttons. Once the desired set point has been set, press the ↵ button to accept it.

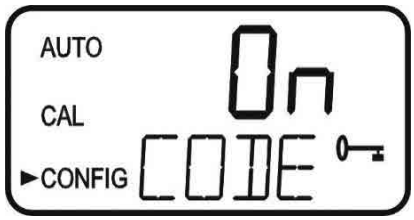
The Remote Standby limits the relays to a single normally open connection.

NOTICE

Due to the cyclic nature of the CLX-Ex2, relay chatter is not an issue. There is no need for alarm delays or hysteresis.

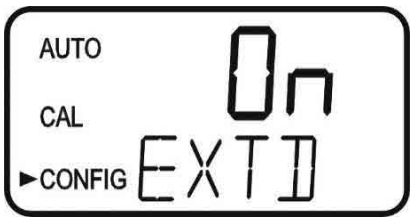
8.5 Enabling the Security Access

The instrument is equipped with a security access. If this option is turned on, the user is required to input the access code into the instrument to get to any mode other than **AUTO**. The only code is **333**. This code may not be changed. See section 6.3 for more information on this security feature. The security key icon will be visible and flashing on the display whenever the access option is selected using the ▲ or ▼ buttons. (**On or OFF**).



8.6 Extended Settings

The last settings are grouped together to prevent them from being adjusted by accident. To gain access to the extended settings, select **On** using the ▲ or ▼ buttons and press the ↵ button.

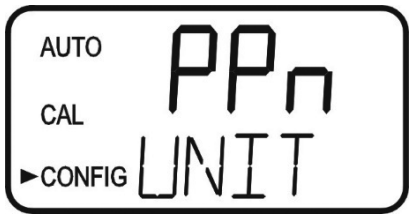


If extended settings are set to **OFF**, pressing the ↵ button will save all settings and the CLX-Ex2 will automatically return to the normal **AUTO** mode of the instrument.

8.7 Units of Measurement

The unit of measure can be set to either mg/L (milligrams per liter) or PPM (parts per million). The factory setting is mg/L. Select the desired UNIT using the ▲ and ▼ buttons and press the ↵ button to accept it.

mg/L screen



PPM screen

8.8 Averaging and Filtering

The CLX-Ex2 can display and output averaged readings to help smooth out the response and eliminate large reading variation in rapidly changing processes. There are 5 settings for the averaging feature:

1 = No averaging, each reading is in “real time”.

2 = The current reading and previous reading are averaged.

3 = The current reading and previous 2 readings are averaged.

4 = The current reading and previous 3 readings are averaged.

5 = The current reading and previous 4 readings are averaged.

The factory setting is averaging of 2. Select the desired AVG using the ▲ and ▼ buttons and press the ↵ button to accept it.

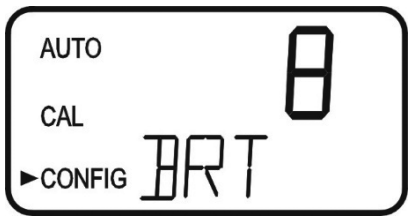
In addition to averaging, the CLX-Ex2 has a software filter that limits the change between consecutive readings to 20%. For example, the reading following a reading of 1.00 ppm could not be displayed as higher than 1.20 ppm or lower than 0.80 ppm. This filter also helps smooth out large changes and eliminate reading spikes. After 3 consecutive readings, it is assumed that the large change in the readings is "real", and the filter will be disabled. For example, the change between reading 1 and 2, and readings 2 and 3 will be limited to 20%, but the change between readings 3 and 4 will not be limited.

Note: This software filter is completely disabled when the averaging (AVG) is set to 1.

8.9 LCD Backlight Brightness

The LCD backlight brightness may need to be adjusted. This is of particular interest if multiple instruments are located in the same area and it is desired for the entire group to have the same appearance. Ten levels are available. The factory setting brightness is 8.

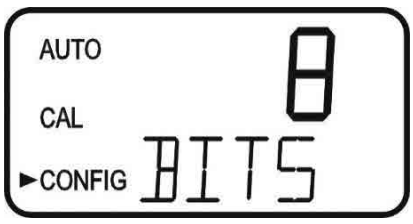
Change the brightness by pressing the ▲ or ▼ button. When the desired brightness has been selected, press the ↵ button.

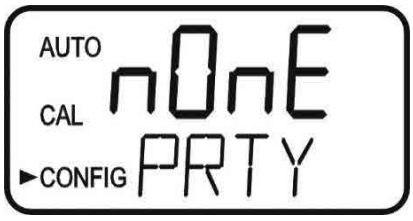


8.10 RS-485 Parameters

These menus will only appear if the RS-485 is enabled (see 8.3). The factory setting is 8 Bit, no (nOnE) Parity, 1 Stop Bit.

Make selections using the ▲ and ▼ buttons then press the ↵ button to move to the next menu.

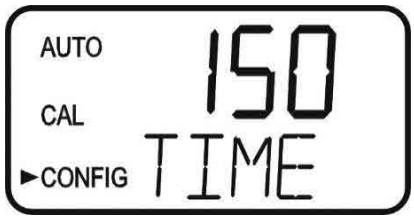




8.11 Cycle Time

The cycle time can be changed using this menu. **Please note that changing this menu will directly affect the volume of reagent that will be consumed.**

Make selections using the ▲ and ▼ buttons then press the ↵ button. Allowable setting is from 60 to 600 seconds (10 minutes).



NOTICE

The indicator reagent has a defined life after being mixed regardless of the cycle time setting. If the reagent is kept in the powered cooling chamber the life is 90 days.

8.12 Water Conservation

To conserve water, the flush time can be adjusted use as little water as possible.

NOTICE

This feature is generally not used in ballast water applications and should be set to OFF.

The instrument requires 110 seconds to complete its normal operations, when the **WCON** is turned **On**, at the factory cycle time the instrument sits idle for about 40 seconds. This results in about a 25% water savings. The actual amount of water conservation is dependent on the incoming water pressure and the cycle time setting.

The use of this option may result in some slight loss of accuracy. The factory setting for this option is **OFF**.

Make selections using the ▲ and ▼ buttons then press the ↵ button to exit to **AUTO** mode and save all configuration settings. If the 4-20 mA in section 7.1 is turned ON, there are two additional menus that will appear before returning to **AUTO** mode.

8.13 4mA Adjustment

If the 4-20 mA setting is turned ON (8.1 *Setting the 4-20 mA Output)*, the following two menus will appear. The first menu outputs a constant 4 mA while allowing for a small amount of adjustment. The adjustment can be made using the ▲ and ▼ buttons. This adjustment will allow the operator to make the CLX-Ex2 agree with a PLC or SCADA system. The adjustment limits are ± 200 counts or about ± 0.2 mA.

This setting will be slightly different on each instrument as each CLX-Ex2 will be factory set to 4.00mA. Press the ↵ button when adjustments are complete to save this setting and move on to the 20mA adjustment.

8.14 20mA Adjustment

This menu operates similar to the previous menu. This menu outputs a constant 20 mA while allowing for a small amount of adjustment. The adjustment can be made using the ▲ and ▼ buttons. The adjustment limits are ± 1000 counts or about ± 1 mA.

This setting will be slightly different on each instrument as each CLX-Ex2 will be factory set to 20.00mA.

When complete with the 20mA adjustment, press the ↵ button to exit to AUTO mode and save all configuration settings.

9.0 Additional Features and Options

9.1 RS-485 Outputs

The CLX-Ex2 has the capability to operate in two different RS-485 modes. Included are a simple communication mode and Modbus communications. Both modes will automatically configure and do not require any changes or selections.

9.1.1 Simple Communication

The CLX-Ex2 can provide basic communications over simple programs such as the Hilgraeve HyperTerminal that is included with most Microsoft Windows packages. The user could also use Visual Basic or other programs. The factory setting communication parameters are 8 bits, no parity and 1 stop bit. These can be changed in the Extended CONFIG menus 8.9 *RS-485 Parameters.*

The master computer will send out:

- Byte #1 the attention character "**:**" in ASCII or **3A** Hex
- Byte #2 the address of the CLX-Ex2 being queried
- Byte #3 & 4 CR LF or 0D 0A in hex

The CLX-Ex2 will respond with:

- The same attention character "**:**" in ASCII or **3A** Hex
- The address of the CLX-Ex2
- The Reading
- The Unit (mg/L)

A sample communication would look like this:

(Master computer requesting a report from address #1)	**:1 CRLF**
(CLX-Ex2 set to address #1 Response)	**:001 0.0249mg/L**

9.1.2 Modbus Communication

Modbus protocol communication is included with this instrument. The Modbus address list is available from HF scientific or online at www.hfscientiifc.com.

10.0 Troubleshooting

10.1 CLX-Ex2 Fault Detection

⚠ WARNING

Only access when the atmosphere has been tested and known to be safe.

Please note that these operating screens cannot be seen except through the door window with the cabinet door closed or in maintenance bypass mode. See section 5.3 for more information on this.

The CLX-Ex2 performs continuous diagnostic monitoring. In the CLX-Ex2, there are 4 severity levels of fault detection. Level 4, 3 and 2 will allow normal operation, but warn of the problem. Level 1 is an instrument failure and the instrument will not operate. Any faults are displayed in a queue form in the bottom row of the LCD.

A **level 4 fault** is simply a screen indication that one of the alarm levels has been activated. This fault level will not affect the 4-20 mA and will only affect the alarm activated. The sample back light blinks at a rate of once every 4 seconds.

A **level 3 fault** indicates a failure or a problem that usually can be corrected by the operator. Refer to the chart below. If any of these errors occur, the instrument will still display readings and probably will operate correctly. These faults will self-clear when the problem is corrected. If any of these faults occur, they may affect the 4-20mA and any alarm dependent on the detection setting (Error). See sections 8.2 and 8.4.1 for error settings. The sample back light blinks at a rate of once every 2.5 seconds to indicate these faults.

Level 3 (Self-Clearing) fault conditions		
Message	**Description of Fault**	**Corrective Action**
MA	4-20 mA enabled and loop open	Check 4-20 mA wiring or turn off 4- 20mA if not used
CAL	Calibration invalid –not accepted	Recalibrate if needed
WATR	No water flowing	Check water flow
FAST	Intake water flow too fast	Set flow rate (see section 10.2)
SLOW	Sample cuvette filling too slowly	Set flow rate (see section 10.2)
PURG	Sample cuvette has slow purge	Check drain lines
NPRG	Sample cuvette not purging	Check drain lines
ISOL	Problem with intake solenoid	Check wiring, check for clogged solenoid
PSOL	Problem with purge solenoid	Check wiring, check for clogged solenoid
GLAS	Dirty cuvette	Replace or clean cuvette
WCAL	Water Level Calibration Invalid	Clear fault (see section 10.3)

A **level 2 fault** indicates a severe problem that will usually require technical assistance from HF scientific customer service (see section 10.6). The queued display will show **POST**. If this fault occurs it will affect the 4-20mA and any alarm set for fault detection (Error). The sample back light blinks at rate of once every 1 second.

A **level 1 fault** is a system fault. This is NOT a problem that the operator can correct, and the unit must be returned to the factory for service (see section 10.6). These failures consist of failures in the CPU, A/D, EEPROM or other devices internal to the instrument. The queued display will show **FAIL**, the upper display will show a four or five digit fault code. If this fault occurs, it will affect the 4-20mA and any alarm set for fault detection (Error). The instrument will not operate with this fault. The sample back light blinks at rate of once every 0.4 seconds.

If any fault condition occurs, the message indicating the fault will be shown on the lower row of the display.

10.2 Setting Flow Rate

The flow rate on the CLX-Ex2 was factory adjusted and usually should not need adjustment. Installation variances may affect the flow. The optimal flow rate through the CLX-Ex2 may be adjusted if needed. The flow is adjusted by removing regulator vinyl cap and turning the adjustment screw on the pressure regulator. To assist in this adjustment follow the procedure shown below:

1. Press the **SERVICE** button.
2. Wait for the display to read HOLd, then press **Mode/ Exit**.
3. Display will show FLOW with the number 0. Press either the ▲ or ▼ button.
4. CLXB will drain, and then pulse in water while a count is displayed on the screen.
5. The display will show one of three messages HI, LO or Good.

The flow test determines if the flow rate is suitable for proper operation. Loosen the locking nut then adjust the pressure regulator using a coin or a large flat blade screwdriver. Press either the ▲ or ▼ button while in the FLOW routine to display a new flow rate. Please note that only ¼ turn incremental adjustments should be made to the regulator on each attempt.

If the message is LO, turn the regulator control clockwise. If the message is HI, turn the regulator counterclockwise. If the message is Good, no adjustment is required. Tighten the locking nut after adjustment and replace the regulator vinyl cap. To return to normal operation, press the ↵ button.

10.3 Clearing Faults

Every time **SERVICE** mode is exited, all faults are cleared. If the original fault or a new fault occurs, it will be posted.

In the case of WCAL, it is possible the power was enabled before a water sample was available. Ensure a water sample is available and then press PRIME to force another Water Calibration (WCAL).

10.4 Reagent Clogs

If reagents fail to flow or Prime it may be due to a clog in either the tubing or at a check valve. To alleviate this you may have to flush the system with Chlorine Free water, preferably Deionized water. See section11.4 *Check Valve Flushing Kit.*

10.5 Diagnostic Chart

Symptom	Cause	Cure
Lower display shows **MA**	4-20 mA loop open	Check wiring. See sections 4.4.4 and 8.1
Lower display shows **FAIL**	Major system fault	Refer to section 10.1
Readings are erratic	**(1)** Bubbles in solution **(2)** Debris in flow **(3)** Bad or sticky check valves	**(1)** See above **(2)** Install T strainer at inlet **(3)** Flush check valves as described in section 10.4 or replace the valves
Readings are lower than expected	**(1)** Condensate or leaky measurement cuvette **(2)** Measurement cuvette dirty **(3)** Reagents bad or expired **(4)** Buffer reagent not being dispensed	**(1)** Install desiccant cartridge kit **(2)** Replace or clean cuvette **(3)** Replace reagents **(4)** Check buffer lines and check valves
Upper display flashes	Sample Over-Range	Check sample. Sample may be too high to read
Upper display shows nOnE while attempting to calibrate	No current reading displayed	Wait for CLX-Ex2 to post a reading

10.6 Technical and Customer Assistance

If for any reason assistance is needed regarding this instrument please do not hesitate to contact either the HF scientific Technical Service Department or the HF scientific Customer Service Department:

HF scientific
16260 Airport Park Drive, Suite 140
Fort Myers, FL 33913
Phone: 239-337-2116
Toll Free: 888-203-7248
Fax: 239-454-0694
Email: hf.info@wattswater.com
Website: www.hfscientific.com

11.0 Routine Maintenance

⚠ WARNING

Only access when the atmosphere has been tested and known to be safe.

Please note that to perform these maintenance operations the cabinet door must be open and the instrument in maintenance bypass mode. See section 5.3 for more information on this.

NOTICE

Specific condition of use: Parts of the enclosure are non-conducting and exceed the maximum permissible resistance according to the IEC 60079-0. Therefore, to avoid electrostatic charge build-up, it must not be rubbed or cleaned with solvents or a dry cloth when installed/used within a potentially explosive atmosphere.

11.1 Maintenance Schedule

The recommended schedule is shown below. It is important to replace the reagents to get reliable accurate readings from the CLX-Ex2. The Buffer supplied can last for up to one year. Each mixed indicator reagent will last for up to 90 days* when kept special cooling chamber. The one year kit includes one buffer bottle and four sets of indicator reagents. The Buffer reagent is mounted in a clip and is further held with a Velcro strap. The indicator reagent is in a 125ml bottle mounts inside an insulator and also mounts in a clip with a Velcro security strap. See section 11.2 for more information on the reagents.

The CLX-Ex2 is shipped with one CLX-Ex2 Tubing/Cuvette kit, HF part #09950EX. The kit consists of the following:

Qty	Part
1	Spare Buffer Cap Assembly
1	Spare Indicator Cap Assembly
8	Pump Tubes
1	Spare Cuvette

Two replacement sets of reagent cap/tubing assemblies are supplied with the CLX-Ex2; one for the buffer and one for the indicator.

Additional kits can be ordered from your local HF scientific distributor or representative. It is recommended to keep one kit on hand at all times.

Generally, both pump tubes should be replaced annually. Spare cap assemblies for both the buffer and the indicator are supplied and can be replaced when needed.

Every 90 days

1. The indicator reagent required for operating this instrument must be changed at least every 90 days. The buffer reagent can be used up to one year.
2. The internal strainer should be checked and cleaned if necessary.
3. The glass cuvette should be inspected. Check for excessive debris on the inside surface of the glass. It is suggested to keep a spare cuvette to replace when required. The old cuvette may be cleaned, if possible, for future replacement.

Flushing the System

Press the SERVICE button to stop the water flow. Remove old reagents and discard. Place the suction tubes in a small container of clean water. Press SERVICE to return to operation mode, press PRIME and then ↵ to flush the system with water. Remove the suction tubes from the water Press PRIME and then ↵ to remove most of the water.

NOTICE

After a PRIME the CLX-Ex2 will perform a water calibration (WCAL). It will take a few minutes to complete this procedure.

**The 1 year buffer and 90 day indicator reagent life is primarily used on ballast water applications. The assumption is based on the factory default of a 60 second cycle and up to 60 hours total operation per month.*

Pump Tubing Replacement

The black pump tubes may need replacement more often due to the fact that they are subject to wear. The inline check valves should not need to be replaced and should be saved. Please note that the check valves are directional as shown below.

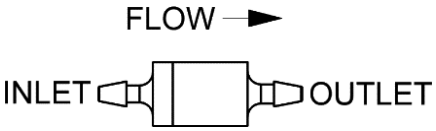


Figure 5: Inline check valve

Steps:

1. Flush the system as described above to reduce personal contact with the reagents.
2. Press SERVICE to stop the flow of sample water and drain the cuvette.
3. Remove and retain the thumb screw on top of the pump; pull the pump hammer and spring up and out of the way. There is no need to completely remove the hammer and spring.
4. Working on one reagent side at a time. Replace the black tubing between optics inlet and the check valve OUTLET. Discard the old tubing.
5. Ensure the check valve is placed into its seat.
6. Repeat steps 4 and 5 for the other reagent.
7. Replace the hammer and spring back into place and secure with the thumb screw.
8. Check the drawing on the following page to ensure correct installation.
9. Return to operation as described.

Cap Assembly Replacement

When the Cap Assemblies needs to be changed follow the procedure shown below. It is recommended that both assemblies are changed at the same time.

Steps:

1. Flush the system as described above to reduce personal contact with the reagents.
2. Press SERVICE to stop the flow of sample water and drain the cuvette.
3. Replace the buffer cap (blue or black cap) assembly.
4. Repeat step 3 above, for the indicator side (white cap).
5. Replace reagents, prime and return to service.

Cuvette Replacement

Check the condition of cuvette and change if it appears badly soiled or discolored. Follow the steps below.

Steps:

1. Replace the two Cap Assemblies.
2. Turn the knurled top on the optics system counterclockwise (as viewed for the top) until the cuvette just “pops” out, but do not remove the top.
3. When the cuvette “pops” out, move the retaining O-ring and remove the cuvette. You may need a stiff wire such as a bent paper clip to grasp the cuvette. Retain this cuvette for future use if it can be cleaned.
4. Install the new cuvette by pushing it firmly in place and turning the knurled top clockwise until the cuvette is held securely.
5. Check the drawing on the following page to ensure correct installation.
6. Return to operation as described.

T-Strainer Cleaning

The T-strainer is integral to the instrument and must be checked occasionally. When necessary it must be removed and cleaned. The strainer screen may require replacement after a period of time.

Steps:

1. Press SERVICE to stop the flow of sample water and drain the cuvette.
2. Ensure the source water is turned off.
3. The T-strainer is clamped to the intake regulator. The removal requires the use of a flat blade screwdriver as shown in the photo. Once the two clamps are opened the T-strainer can be removed.
4. Disconnect the top of the T-strainer and regulator from the tubing and clear of the enclosure.

5. Remove and clean the screen and then reassemble.
6. Be sure to tighten the bowl of the strainer.
7. Be certain the clamps are tightened fully and the tubing connections are complete. You may require pliers to close the clamps.
8. Turn source water back on.
9. Return to normal operation.
10. Check for any leaks.

Return to Normal Operation

Press the SERVICE button to return sample flow to the system. Check for leaks. If a leak occurs press SERVICE again, repair leak and try again. Once the system is operating correctly, return or replace reagents and press PRIME and then ↵ one time to restart reagent flow. The system will automatically return to normal operation.

NOTICE

Tubes may darken due to contact with the reagent. This condition does not affect the performance of these parts.

11.2 Replacing or Installing the Reagents

Reagent kits are available from HF scientific for Total Chlorine Refer to section 12.0 *Replacement Parts and Accessories* for the appropriate Catalog number. There are two reagents required, for the instrument to operate; the buffer and the indicator.

The reagents are provided “wet” and the buffer is ready to use and will last up to one year.

The smaller indicator reagent does require the addition of the DPD power to activate it. Once activated it starts to oxidize. This process is slowed by keeping it in the cooling chamber.

NOTICE

When commissioning the CLX-Ex2 it is recommended to follow the procedure in section 11.4. This procedure only needs to be done once when the instrument first commissioned.

11.3 Indicator Reagent Preparation

Remove the cap of the small liquid indicator reagent and add the contents of the DPD powder bottle (small brown bottle). Cap and shake to fully dissolve the powder.

NOTICE

Once mixed the indicator has an expected life of 90 days if kept in the powered cooling chamber. Write the mixing date on the reagent bottle labels in the area provided.

Dispose of expired reagents correctly.

To replace the reagents, press the **SERVICE** button; this will empty the cuvette and stop any flow of water. Remove the cap on both bottles replace with the cap supplied with the CLX-Ex2. The buffer is installed on the left and the indicator is installed in the cooling chamber. The suction tube for both reagents will reach the bottom of the bottles.

To complete the replacement procedure, press the **PRIME** button and then the ↵ button. This will draw enough of each reagent to completely prime the tubes and replace any old solution. The system will automatically return to normal operation after it has primed.

NOTICE

Use caution when changing the reagents as they are corrosive. These reagents may stain clothing. After changing the reagents, operators should wash their hands.

11.4 Check Valve Flushing Kit

Sometimes upon initial commissioning, the check valves stick and require manual priming. This should not be needed after commissioning. Be careful when using this kit to use only chlorine free water. Complete instructions are included in the kit.

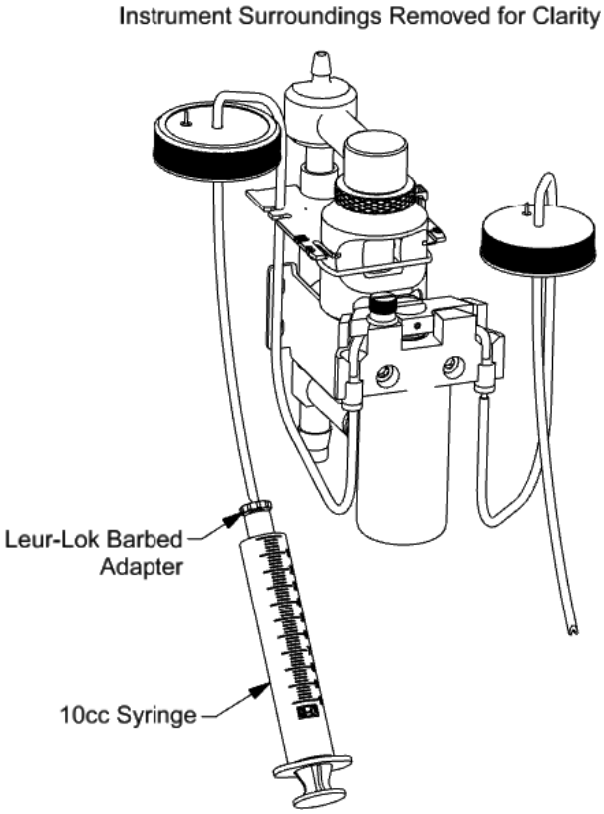


Figure 6: Check Valve Flushing

11.5 Instrument Storage

If the CLX-Ex2 is relocated or will be inactive for long periods of time (several months), remove the reagents. Flush the reagent system as describe in 11.1 *Maintenance Schedule*. Place the instrument in Service mode to drain the system then remove power by disconnecting the mains power plug. It is usually a good idea to disconnect or shut off the source water.

11.6 Cleaning the CLX-Ex2

Flush the system as mentioned in section 11.1 *Maintenance Schedule*. When the flushing is finished, press the SERVICE button wait until the display reads HOLd.

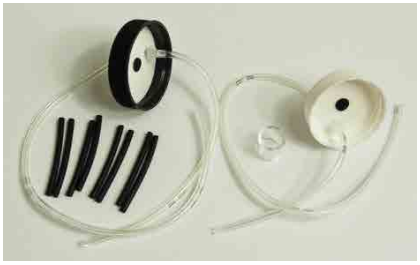
As a matter of safety, always disconnect any power source to the CLX-Ex2 prior to attempting any cleaning. It is recommended that the source water is also shut off.

Isopropyl alcohol (rubbing alcohol) on a soft cotton cloth works very well in removing reagent stains from plastic parts, the key pad and the display. Use care when cleaning around electrical components. Do not use any harsh cleaning agents as these may cause damage to the instrument components.

Ensure that the system is dry prior to applying power.

12.0 Accessories and Replacement Parts List

The items shown below are recommended accessories and replacement parts.

Accessory	Catalog Number	Photo
Reagent Kit – Total Chlorine 12 month supply	09991	
Air Sentinel Purge Control Operating Manual	28749	N/A
Operating Manual CLX-Ex2	28920	(N/A
Tubing/Cuvette Kit	09950EX	
Replacement Cuvette	25018S	
Check Valve Kit	25017S	
Ferrite for 4-20mA or RS-485	24560	

12.0 Accessories and Replacement Parts List (Cont'd)

The items shown below are recommended accessories and replacement parts.

Accessory	Catalog Number	Photo
Check Valve Flushing Kit	25096	
T-Strainer/ Pressure Regulator Assembly	25357	
Replacement T-Strainer Screen	28625	
Water Intake Assembly	28411	

To order any accessory or replacement part, please contact the HF scientific Customer Service Department. If for any reason technical assistance is needed regarding this instrument, please do not hesitate to contact the HF scientific Technical Services Department.

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Notes

13.0 Ballast Water Market Products Limited Warranty

Watts Regulator Co. (the “Company”) warrants each ballast water market instrument product to be free from defects in material and workmanship under normal usage for a period of two (2) years from first use or three (3) years from date of the Company’s invoice from the original sale of the product, whichever occurs first. In the event of such defects within the warranty period, the Company will, at its option, replace or recondition the product without charge. Parts which by their nature are normally required to be replaced periodically, consistent with normal maintenance, specifically reagents, desiccant, sensors, electrodes and fuses, are excluded. Also excluded are accessories and supply-type items.

Proof of purchase from the Company (Company invoice or paid order confirmation) and/or first use (commissioning) must be provided when making a product warranty claim.

THE WARRANTY SET FORTH HEREIN IS GIVEN EXPRESSLY AND IS THE ONLY WARRANTY GIVEN BY THE COMPANY WITH RESPECT TO THE PRODUCT. THE COMPANY MAKES NO OTHER WARRANTIES, EXPRESSED OR IMPLIED. THE COMPANY HEREBY SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

The remedy described in the first paragraph of this warranty shall constitute the sole and exclusive remedy for breach of warranty, and the Company shall not be responsible for any incidental, special or consequential damages, including without limitation, lost profits or the cost of repairing or replacing other property which is damaged if this product does not work properly, other costs resulting from labor charges, delays, vandalism, negligence, fouling caused by foreign material, damage from adverse water conditions, chemical, or any other circumstances over which the Company has no control. In addition, the Company shall not be responsible for any costs incidental to the Company’s warranty response efforts, including, without limitation, costs associated with the removal and replacement of systems, structures or other parts of facilities, de-installation, decontamination and re-installation of products, or transportation of products to and from the Company. This warranty shall be invalidated by any abuse, misuse, misapplication, improper installation or improper maintenance, alteration of the product, or use of any parts or accessories (including but not limited to reagents) not provided by the Company.

Some states do not allow limitations on how long an implied warranty lasts, and some states do not allow the exclusion or limitation of incidental or consequential damages. Therefore the above limitations may not apply to you. This Limited Warranty gives you specific legal rights, and you may have other rights that vary from State to State. You should consult applicable state laws to determine your rights. **SO FAR AS IS CONSISTENT WITH APPLICABLE STATE LAW, ANY IMPLIED WARRANTIES THAT MAY NOT BE DISCLAIMED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO ONE YEAR FROM THE DATE OF ORIGINAL SHIPMENT.**

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Latin America: T: (52) 55-4122-0138 • HFscientific.com