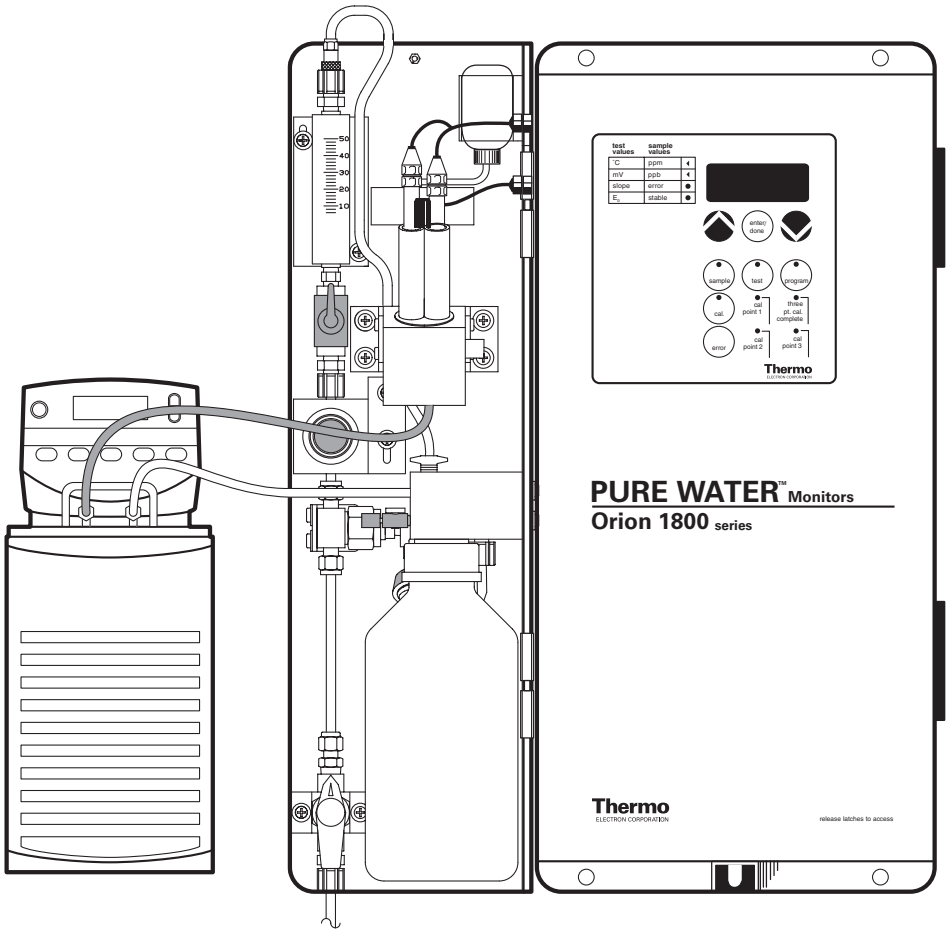
Orion 1817LL

Orion Low-Level Chloride Monitor

INSTRUCTION MANUAL



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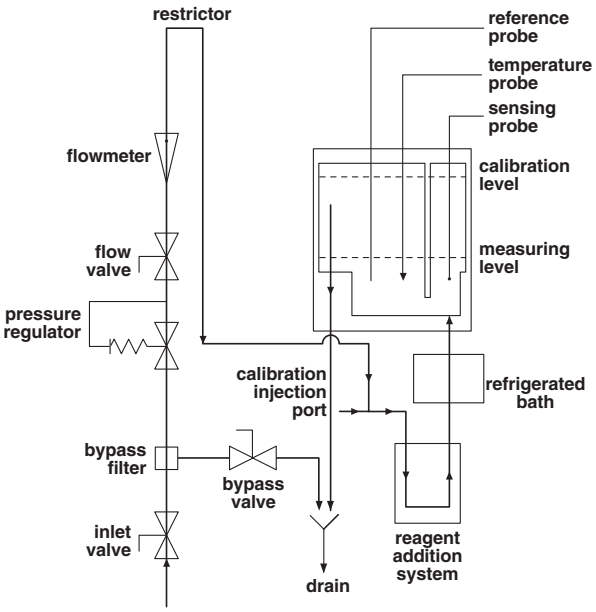
I. GENERAL INFORMATION

Introduction

This manual covers the operation, maintenance and troubleshooting for the Orion 1817LL which incorporates the software features of a three point and off-line calibration.

The Orion 1817LL has a limit of detection of 10±5 ppb. Used to monitor boiler water and boiler blow down, the Orion 1817LL is an indicator that could detect costly condenser leaks. A refrigeration unit cools the sample down below 12 ˚C which enables the sensor to detect chloride at extremely low levels without additional manipulation of the sample. This system includes a new reference electrode, a double junction ceramic frit electrode designed to provide outstanding long term performance; and a chloride sensor known for its superior accuracy at low levels.

Figure 1:
Block Diagram of Sample Flow



Principles of Operation

Figure 1 is a block diagram of sample flow through the monitor. **Figure 2** illustrates the sample flow during normal operation.

As shown in **Figure 2** the sample (temperatures up to 45 ˚C) enters the Series 1800 Monitor and passes through the inlet valve, **1**, bypass filter, **2**, pressure regulator, **3**, flow valve, **4**, flow meter, **5**, and restrictor tubing, **6**, and then flows through the fluid connector block, **7**, into a reagent diffusion bottle, **8**, where the sample is acidified. Once acidified, the sample flows to a refrigeration unit, **9**, that cools the sample to 5-15 ˚C ± 1 ˚C. and the sample is then transferred to the flow cell, **10**, through insulated tubing. Within the flow cell the cooled sample passes the chloride-sensing, **11**, and reference electrode, **12**, in the top portion of the flow cell. The sample then flows past the temperature probe, **13**, into an atmospheric drain, **14**.

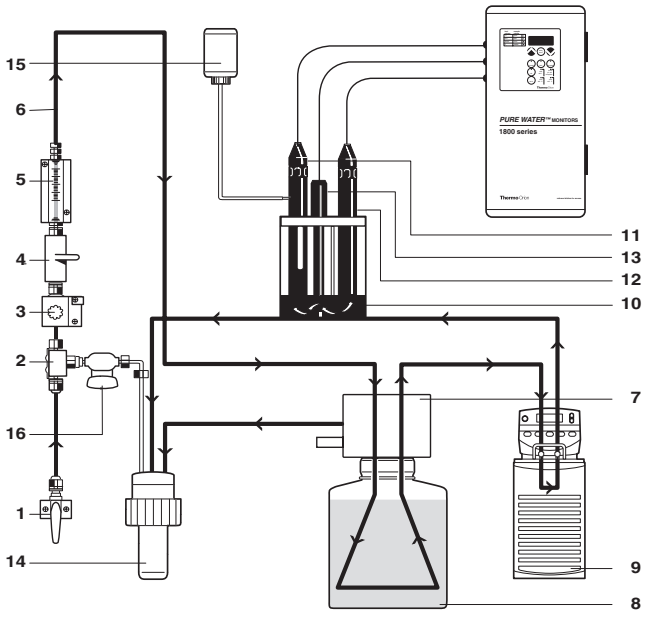


Figure 2:
Flow During Normal Operation

Legend

1. Inlet Valve
2. Bypass Filter
3. Pressure Regulator
4. Flow Valve
5. Flowmeter
6. Flow Restrictor Tubing Bottle
7. Fluids Block
8. Reagent Diffusion Bottle
9. Refrigerated Bath
10. Flow Cell
11. Sensing Electrode
12. Reference Electrode
13. Temperature Probe
14. Drain
15. Electrolyte Reservoir
16. Bypass Valve

Principles of Calibration

Calibration procedures for analytical instruments are important and must be performed carefully. The Orion 1817LL employs a two-segment calibration method to cover a wide range of concentrations, the first segment versus the concentration, and the second segment versus logarithm of the concentration. The calibration is carried out at three chloride levels, concentration being in the ranges of 0-20, 75-125, and 100-10000 ppb from low to high. The first chloride level can be the "zero chloride" solution, the second and the third levels can be generated by introducing known chloride concentration with the dynamic calibrator through the injection port. Calibration parameters of both segments are computed by the microprocessor, and effects from temperature fluctuation are constantly corrected. Based on the potential measured in the sample solution, the microprocessor is makes a judgment of which segment of calibration is to be used to read the chloride concentration.

Response of the Low-Level Chloride Electrode

The U.S. patented chloride electrode responds to changes in chloride ion concentration. This response is described as follows:

The sensing surface of the electrode consists of the mixture of a metal amalgam and a sparingly should be chloride salt of the metal. In samples free of mercury ions, the potential of the electrode is determined by the solubility of the salt, which depends on the temperature and the chloride concentration of the sample.

At low levels of chloride (< 125 ppb), the electrode responds approximately linearly to the changes of chloride concentration at high levels of chloride (> 75 ppb), the electrode responds logarithmically to the changes of chloride concentration in a Nernstian manner. The response can be characterized by the following equations:

Low levels: $E = E_0(T) + S_1(T)^* (C-C_2)$

High levels: $E = E_0(T) + S_2(T)^* \log(C/C_2)$

where:

E	=	measured electrode potential
$E_0(T)$	=	temperature dependent potential value
$S_1(T), S_2(T)$	=	temperature dependent slope values
C	=	concentration (activity) of chloride ion
C_2	=	concentration (activity) of chloride ion of the second standard.

The monitor calls for a three-point calibration to determine the actual values of all the parameters and then enables measurements of chloride at all low and high levels.

In order to achieve the low detection limit, the monitor incorporates a cooling system to reduce the sample temperature. The monitor also uses its microprocessor to constantly update temperature corrections from data supplied by the ATC probe.

Off-line Calibration

The off-line calibration feature of Orion 1817LL allows the user to adjust the monitor to values determined by alternate methods used in their laboratory, such as ion chromatography and colorimetric method. It is essentially a one-point calibration. To perform off-line calibration, a sample is taken from the bypass of the instrument; the sample value is stored in memory; the sample is analyzed by an alternate method of choice; the previously stored reading is adjusted to the lab method result; and the instrument is then returned to the analysis mode. The term “off-line calibration” refers only to the fact that a sample from Orion 1817LL bypass is taken “off-line” for laboratory analysis; in fact, no downtime is experienced during the procedure and the instrument remains on-line throughout.

Three-Point Calibration

This procedure provides maximum calibration accuracy and requires use of dynamic calibrator, Orion 15DC15, 115 V or 15DC20, 220 V. In addition to calculation of electrode E_0 as is done in off-line calibration procedure, this procedure determines electrode slope.

To perform a dynamic three-point calibration, the Orion 1817LL is first connected to a chloride-free sample stream. This can be taken at the first standard of zero chloride. An appropriate diluted standard is then prepared. A supplied syringe is filled with diluted standard and mounted on the calibrator. The calibrator is then mounted near the monitor and the syringe tubing connected to the standard injection port. By adjusting calibrator pump settings, two different flow rates produce two known standards diluted into the sample background. By pressing the appropriate keys on the monitor when prompted, the monitor’s microprocessor completes the calibration.

If a mistake is made or problems occur during calibration, an error light will come on and alert the operator. By pressing the error key, the operator can access information on the display to help determine the problem.

One-Point Calibration

A quick one-point calibration may be run using the QC Sampler (18GRAB). See **QC Sampler Installation and Operational Procedure** section for details.

Sample Requirements

Sample inlet connection - 1/4” NPTF. If particulate matter is present in sample, prefiltration is necessary. Moderate amounts of particulates will be removed by the 60 micron stainless steel filter located after inlet valve.

Flow rate — 40 mL/min. nominal

Pressure — 8 - 100 psig. Consult Thermo Electron for details on sample handling if pressure is outside range.

Temperature — Temperature must be between 5 - 45 ˚C.

Chloride level — Chloride levels are read directly in ppb or ppm, when calibrated with Orion Standard, Orion 941707.

Sample alkalinity — Sample alkalinity acidity should not be more than 50 ppm $CaCO_3$ equivalent. For higher sample alkalinity, contact the Thermo Electron Technical Service Department.

Description of Orion 1817LL

NOTE: Numbers in the description refer to Figure 3.

Sample Inlet Valve (1) — Accepts the sample stream via 1/4 inch NPTF connector. The customer must supply the sample with a pressure between 8 and 100 psig, and a sample flow rate to the analyzer of 50 mL/min. minimum.

Bypass Filter Assembly (2) — 60 micron stainless steel filter traps particulate matter in sample stream.

Pressure Regulator (3) — Adjusts flow on incoming sample stream.

Flow Valve (4) — Used to turn off flow to flow cell.

Flow Meter (5) — Measures sample flow rate. 40 mL/min. nominal flow is required through the analyzer.

Flow Restrictor Tubing (6) — Maintains steady sample flow rate in conjunction with pressure regulator.

Fluid Connector Block (7) — Connects reagent diffusion bottle to sample stream and flow cell assembly.

Reagent Diffusion Bottle (8) — Acidifies and adds iodine to the sample by means of passive diffusion.

Refrigerated Bath (9) — Cools the sample stream to below 10 ˚C.

Flow Cell (10) — Contains reference electrode, sensing electrode, ATC probe and sample measurement reservoir.

Chloride Electrode (11) — Senses chloride ions in sample stream and produces an electrical potential dependent on sample concentration.

Reference Electrode (12) — Provides a constant reference potential and completes the measurement circuit. Must be placed in right hand side of flow cell.

ATC Probe (13) — Measures sample temperature and inputs data to microprocessor for automatic temperature compensation (ATC).

Drain (14) — Atmospheric drain prevents back pressure on reference electrode located behind reagent bottle.

Electrolyte Reservoir (15) - Provides a constant flow of electrolyte solution through reference electrode for maximum stability.

Bypass Valve (16) — Used to throttle flow in bypass system located behind reagent bottle.

LED Display (17) — Provides digital readouts of concentration, temperature, millivolts and error codes.

Keypad (18) — Consists of five mode keys, four prompt indicator lights, two scroll keys and one key for entering data. Mode and error indicators are also incorporated on keypad.

On/Off Switch (19) — Controls all power to the electronics.

Standard Injection Port (20) — Allows connection of dynamic calibrator tubing to fluid connector block during two-point calibration.

Thumbscrew (21) — Supports the reagent diffusion bottle.

Compression Fitting (22) — Connects flow restrictor tubing to flow meter.

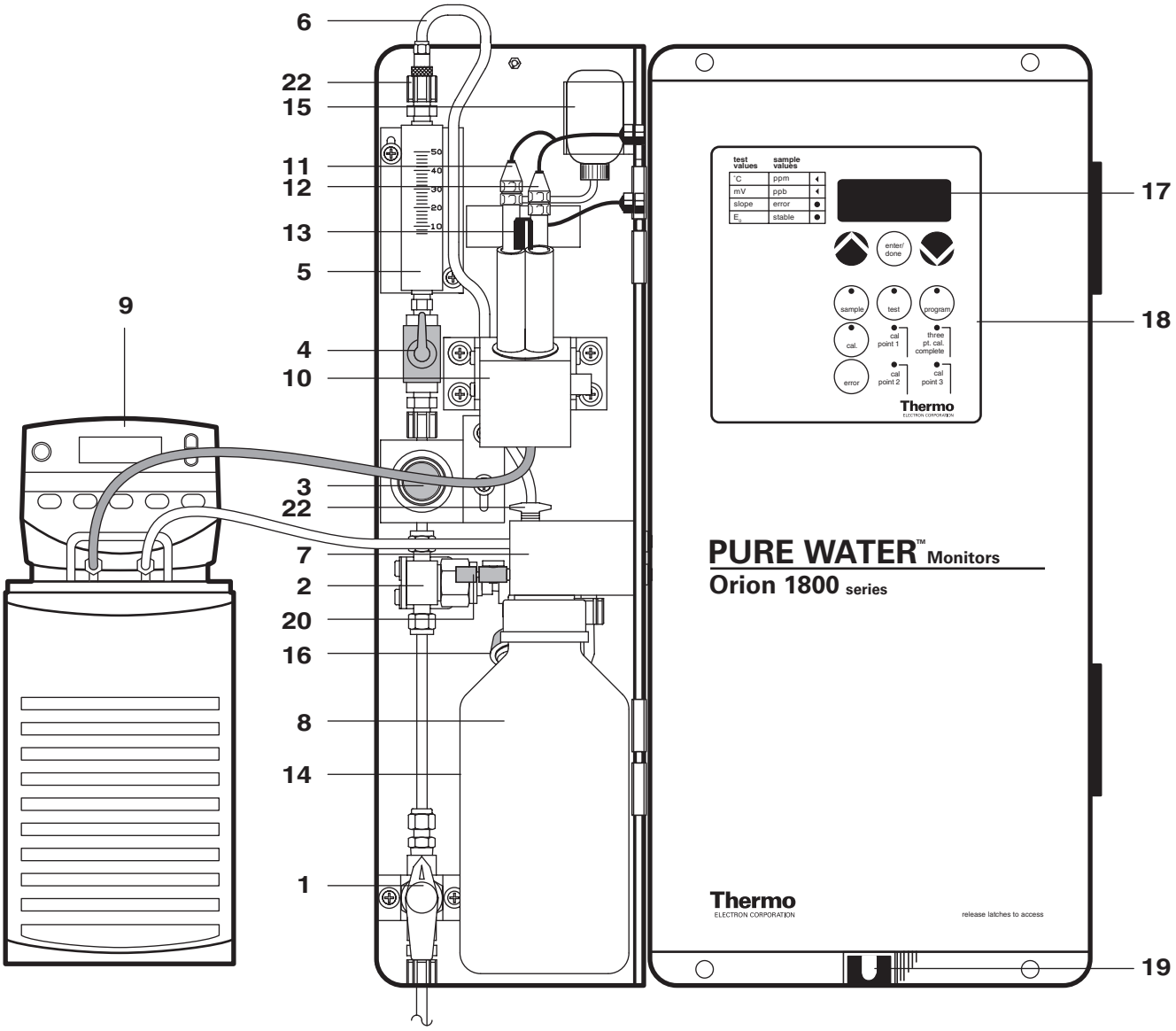


Figure 3:
Major Components of Low-Level Chloride Monitor

II. INSTRUMENT PREPARATION

Unpacking Orion 1817LL

Report any obvious damage of shipping container to carrier and hold for inspection. The carrier (not Thermo Electron) is responsible for any damage incurred
during shipment.

1. Open outer box. Remove foam corner support pieces.
2. Open inner box and remove cardboard retaining shell. Remove accessory boxes (4 pcs.) and instruction manual.
3. Unbolt the monitor from mounting board. Save all hardware for use during installation.
4. Carefully place the monitor at a convenient location. Do not pull or lift instrument by its fluidic components.

Unpacking Refrigeration Unit

1. See manufacture's instructions before removing unit from box.
2. Place cooler within five feet of Orion 1817LL for proper installation.

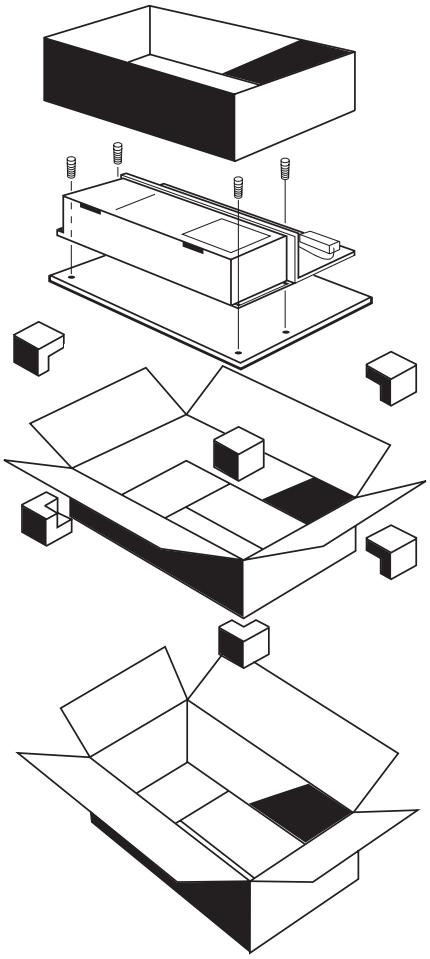


Figure 4:
Unpacking Orion 1817LL

Mounting And Plumbing Instructions

1. Select a site for the instrument that allows it to be permanently bolted (in an upright position) with ample height for atmospheric drain operation and ready access to to both electronic controls. The analyzer location must permit connection to a plumbed in sample line, a drain, an AC power supply and any connections for output devices.
2. The analyzer should be mounted as close to the sampling point as possible, this ensures the fastest possible response to a changing sample condition.
3. Prepare mounting holes. Carefully lift the analyzer and bolt into place. **Do not lift the instrument by holding on to any of the plumbing or fluid handling components.**
4. Connect a waste line to a drain of sufficient capacity, 0.5 inch (1.27cm) OD is recommended.
5. Connect sample line to the 0.25 inch (0.635 cm) NPTF stainless steel inlet. It is recommended that a shut of valve be installed at the sampling point.

Electrical Connection Instructions

1. Remove the protective plastic, front panel inside the cabinet by unscrewing the 4 holding screws. Remove the protective plastic plug at the bottom of the cabinet and feed the AC power line through the hole.
2. Set voltage (from underside of analyzer) to either 115V or 230V (factory default setting is 115V).
3. Connect AC power according to wiring diagram below.
4. All electrical wiring feeding through the chassis of the cabinet must pass through appropriate electrical fittings in order to maintain the design integrity of the splash proof cabinet housing the analyzer electronics. As different types of fittings may be required at various installations, this feed through is to be supplied by the user.

   WARNING: A grounded metal conduit is required for FCC compliance.
5. Replace the protective plastic front panel when complete.

   WARNING: Failure to replace the protective plastic front panel will result in a potential shock hazard.

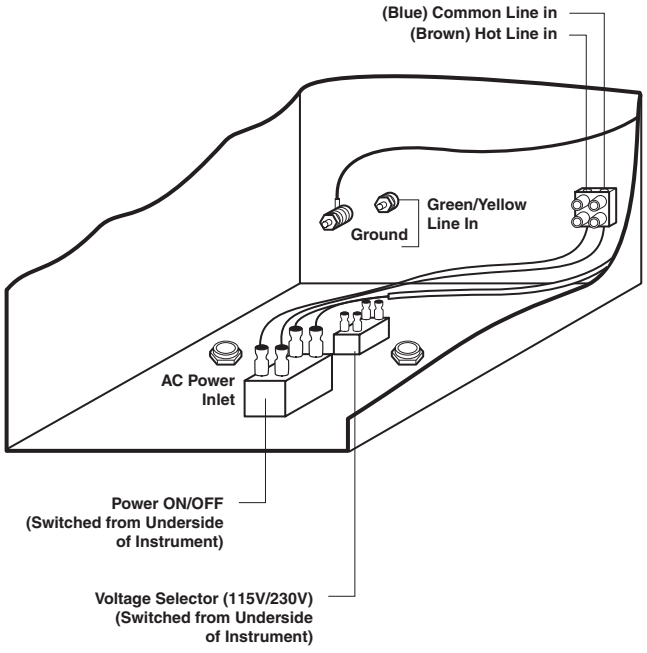


Figure 5:
Electrical Wiring of 1800 Series Monitors

Cooler Connection Instructions

1. Open the bag which contains the tubing components. The bag should contain 10 feet of 1/4" plastic tubing, 5 feet of foam tubing insulation, and two 1/4-3/8 union compression fittings.
2. Cut the plastic tubing into two five-foot lengths. Ensure that the cut is straight, and the tubing end is smooth and undamaged.
3. Remove the nut from the unused compression fitting on the back of the **fluids block**, and slide it over the end of one of the pieces of plastic tubing. Leave about one inch of tubing protruding from the end of the nut, as shown in **Figure 6**.
4. Insert the tubing into the hole of the compression fitting until it cannot be pushed any further. Then, slide the nut back over the threads of the fitting and tighten while holding the tubing in place.
5. Remove the nut from the unused compression fitting on the back of the **flow cell**, and slide it over the end of the other piece of plastic tubing. Leave about one inch of tubing protruding from the end of the nut, as shown in **Figure 6**.
6. Insert the tubing into the hole of the compression fitting until it cannot be pushed any further. Then, slide the nut back over the threads of the fitting and tighten while holding the tubing in place.
7. Remove the larger nut from one of the union compression fitting, and slide it over the end of one of the rigid tubing outlets on the lid of the refrigerated bath. Leave about one inch of tubing protruding from the end of the nut, as shown in **Figure 6**.
8. Slide the compression fitting over the rigid tubing until it cannot be pushed any further. Then, slide the nut back over the threads of the fitting and tighten while holding the compression fitting in place.
9. Repeat steps 7 and 8 for the other compression fitting.
10. Slide the free end of the plastic tubing connected to the flowcell into the insulation tubing. Push the insulation tubing down the length of the plastic tubing until it cannot be pushed any further.
11. Push the free end of the foam insulation back, exposing about two inches of plastic tubing. Remove the smaller nut from one of the union compression fitting on the lid, and slide it over the end of the exposed plastic tubing. Leave about one inch of tubing protruding from the end of the nut, as shown in **Figure 6**.
12. Insert the tubing into the hole of the compression fitting on the lid until it cannot be pushed any further. Then, slide the nut back over the threads of the fitting and tighten while holding the tubing in place.
13. Remove the smaller nut from the unused compression fitting on the lid, and slide it over the free end of the other length of plastic tubing. Leave about one inch of tubing protruding from the end of the nut, as shown in **Figure 6**.
14. Insert the tubing into the hole of the compression fitting on the lid until it cannot be pushed any further. Then, slide the nut back over the threads of the fitting and tighten while holding the tubing in place.

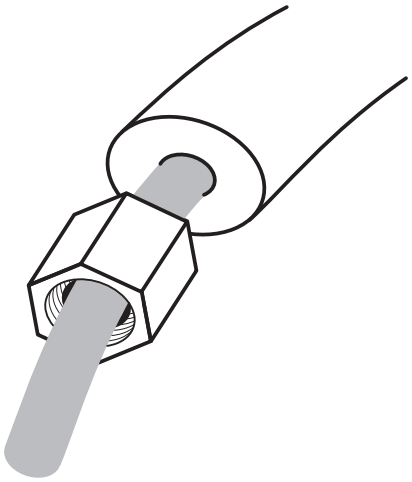


Figure 6:
Picture to be updated in the future

Installation Of Reagent And Diffusion Tubing

WARNING: Formic acid is hazardous. Use protective glasses and gloves. Refer to bottle label for precautions.

1. Support the bottom of the reagent bottle. Turn thumbscrew, counterclockwise to release diffusion bottle. Unscrew white bottle cap and gray tubing connector assembly. (Keep bottle supplied with instrument as a spare.)
2. Take a new bottle of reagent to a well-ventilated area such as a laboratory fume hood. Unscrew and remove white cap.
3. Connect diffusion tubing (use Orion 181060 ONLY) to tubing connector assembly to conform to **Figure 7**. Place the tubing assembly and cap into the bottle.
4. Replace gray cap and screw white cap on tightly.
5. Insert the five nipples on the top of the reagent diffusion bottle into the fluid connector block, as shown in **Figure 7**.
6. Support the bottom of the reagent bottle with one hand and tighten the thumbscrew clockwise.

Installation of Chloride Electrode

1. Unpack chloride electrode (Orion 100025) and carefully remove protective cap. Save cap for future storage of electrode.
2. Insert chloride electrode into sensing hole of flow cell cap. See **Figure 3**. Sensing electrode is placed in the hole to the right of the divider seen in flow cell and the hole closest to the electronics cabinet.

3 Connect electrode to cable marked “Sens. Elect.”

4. Wait at least one hour before calibrating analyzer.

View Front Left Side of Analyzer

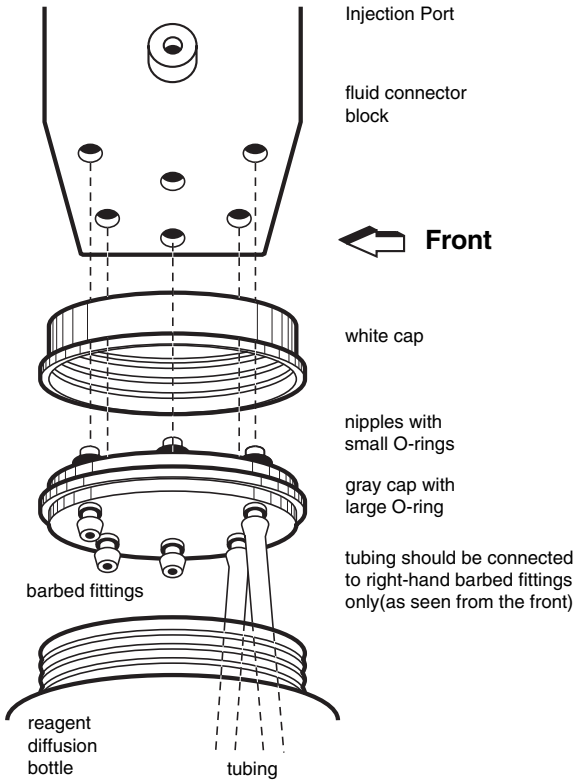


Figure 7:
Reagent Diffusion Bottle Assembly

Installation of Reference Electrode

1. Unpack reference electrode, **7**, (Orion 100057) and tubing from shipping box. Remove protective caps from bottom and sidearm of electrode. Save caps for future storage of electrode. Inspect internal of electrode (item 7 in **Figure 8**). Verify it is at least half filled with the internal fill solution. If not, replace the electrode.
2. While passing 1/8 inch tubing, **31**, into electrode through sidearm, slide 1/4 inch tubing, **32**, over sidearm. The outside tubing should extend 3/8-1/2 inch over sidearm.
3. Remove cap and fluid seal from Orion 900063 electrolyte fill solution bottle, **33**. Hold bottle in upright position. Check that rubber gasket, **34**, is properly aligned, then connect cap end of tubing assembly to bottle. The 1/8-inch tubing should extend into the bottle.
4. Hold reservoir above electrode with bottle cap end down. Electrode should be horizontal with sidearm pointing up. Gently shake electrode to allow any trapped air bubbles to rise into bottle as electrode fills with solution.
5. Dry off ceramic frit on base of electrode with tissue paper. Squeeze bottle for a few seconds. A small amount of filling solution should bead up on frit surface, indicating good electrolyte flow. If no moisture is visible, electrode is clogged and should be replaced.
6. Invert electrolyte bottle and snap into clip, **35**. Use push pin supplied to puncture three air vents on bottom of bottle.

   CAUTION: Failure to vent electrolyte bottle will lead to noisy and drifty readings.
7. Connect electrode to electronic chassis by "keeper cable" labeled "Ref. Elect." Insert electrode into reference hole in flow cell cap. See **Figure 3**.

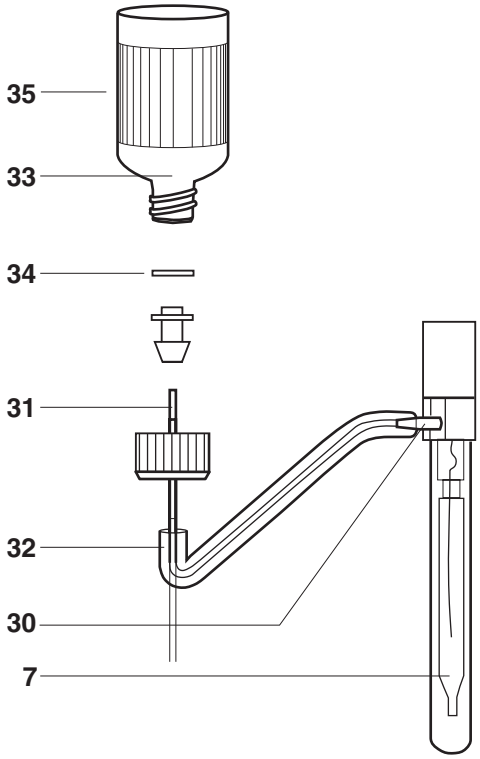


Figure 8:
Reference Electrode Assembly

Installation Of ATC Probe

The automatic temperature compensation (ATC) probe is already connected to the electronics housing. Insert into remaining hole of flow cell cap.

Flow Regulation

When the Orion 1817LL Monitor is first commissioned, it is advisable to flush out fluidics system overnight prior to initial calibration and use. The electronics need not be turned on at this time. Refer to **Figure 3**.

1. Open sample inlet valve, **1**.
2. Pull out red locking ring of pressure regulator, **3**, then adjust black knob so that ball of flow meter reads 40 mL/min. Push in red locking ring to secure the setting.
3. Open bypass valve, **16**. Check for appropriate sample flow. Readjust pressure regulator if required.
4. Wait at least one hour before calibrating analyzer.

III. INSTRUMENT OPERATION

Description of Basic Unit Controls

On/off switch - Controls power to all electronics and air pump. It is located on electronic chassis bottom and includes an integral circuit breaker.

LCD display - Displays four-and-one-half digit plus polarity sign used to read concentration, slope, E_0 millivolts, temperature, error messages, and diagnostic information.

Mode indicating LED — (Located to left of LCD display.) Indicates range (ppb or ppm), error codes, and electrode stable in sample mode. Displays temperature (°C), millivolts, electrode slope, and E_0 on LCD in test mode.

Prompt indicating LED — Prompts the user during calibration. Four LED's located in keypad region are used. These are: cal point 1; cal point 2; cal point 3; three pt. cal complete.

▲ and ▼ keys — Increases or decreases displayed values that can be operator-changed such as alarm level, analog output range, off-line calibration, and blank correction values.

Enter/done key — Enters value displayed on LCD into "permanent" memory for later use. Key also indicates to microcomputer that a required calibration step has been completed.

Sample key — Puts Series 1800 Monitor into sample mode and (re) activates any optional modules. This is also its default mode, e.g., instrument automatically enters sample mode when first turned on and after calibration.

Cal key — Starts Series 1800 Monitor into calibrate mode. Operator is then prompted through the steps necessary for calibration.

Test key — Places Series 1800 Monitor into test mode where LCD displays temperature, millivolts, E_0 and slope. Each successive push of key, steps instrument through this sequence, and an LED on the left of display indicates value displayed.

Error — If error LED is lit (soft error), then pressing key causes LCD to display an error code. Note, in the case of "hard error," LCD would cease to display normal output but would display error code only. Refer to Error Code Table.

Program key — Used to program expected calibration concentrations for three point calibration, and used in conjunction with Cal key for off-line calibration. Also used to display the low range calibration slope.

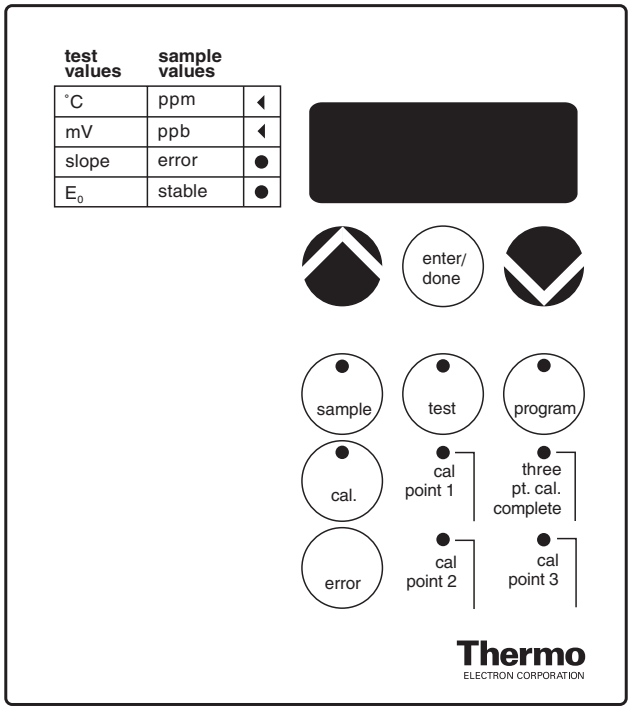


Figure 9:
Front Panel Keypad

Start Up/Normal Instrument Operation

1. Install the Orion 1817LL Monitor according to instructions in INSTRUMENT PREPARATION. Power supply should be wired for proper voltage and instrument suitably grounded.
2. Turn on flow at sample inlet and flush for at least one hour.
3. Power up Orion 1817LL by toggle switch on bottom of electronics case. See **Figure 3**.
4. Observe air bubbling through liquid in flow cell. LCD will display following information sequence:

   a. + 1.8.8.8.8;

   b. 1817 while LEDs sequentially light;
   (NOTE: Mode indicating LEDs and test LED on modules are not tested during start-up sequence.)

   c. Revision number of software program (e.g., -x.y-)
5. After completion of steps 1-4, the Monitor is now in normal operational mode "sample."

Initial Instrument Set-Up

Before first sample measurements on Orion 1817LL can be performed, calibration concentration increments must be programmed into memory. See **Table 1** below. *P2 and P3 values shown are based on use Orion 941707 100 ppm Chloride standard.*

Table 1
Program Key Table

Code	Meaning
P0	1-point cal concentration
P1	Low arrange slope
P2	3-point cal standard 2 concentration
P3	3-point cal standard 3 concentration
P4	3-point cal standard 1 concentration

1. Press **program** key until the LCD displays P2. The current value for the second calibration concentration increment will be displayed. Default value is 100 ppb.
2. Change this value by using keys marked ▲ and ▼. Press **enter/done** key to store appropriate value in memory.
3. Press **program** key until the LCD displays P3. The current value for the third calibration concentration increment will be displayed. Default value is 1 ppm.
4. Change this value by using ▲ and ▼. Press **enter/done** key to store appropriate value in memory and unit will automatically return to sample mode.
5. Press **program** key until the LCD displays P4. The current value for the first calibration concentration increment will be displayed. Default value is 0 ppb.
6. Change this value by using ▲ and ▼. Press **enter/done** key to store appropriate value in memory and unit will automatically return to sample mode.
7. Battery backup of memory will maintain programmed variables for at least one month if battery is fully charged.

Use of Test Mode

When **test** key is pressed, the LCD displays temperature, millivolts, high range, slope and E_0. Every time the **test** key is pressed the monitor steps through this sequence. An LED to the left of display indicates value displayed.

If test mode is entered from sample mode, then sample and test LED are lit. If test mode is entered from calibration mode, then calibrate and test LED are lit. Note that while LCD displays test information, the instrument still continues normal sampling or calibration sequence. Therefore, when sample and test modes are pressed, signal conditioning and optional alarm modules are active. When calibrate and test modes are pressed, calibration prompt LEDs will light as usual.

To exit test mode press **sample** or **calibrate** key as desired. LCD will now display instantaneous computed concentration.

If **sample** key is pressed while in the calibration mode, the current calibration will abort with no data saved.

Error Mode

The Orion 1817LL Monitor diagnoses two types of errors which are termed “hard” and “soft.” In the event of hard error, the analyzer cannot compute any meaningful concentration values, error LED will be lit and LCD will display an error code. The signal conditioner module will indicate zero scale and alarms will be deactivated. Hard error must be corrected prior to resumption of normal operation (E40 and E50) by performing a complete calibration.

If error LED is active but instrument continues to display concentration, this is termed “soft” error. Soft error can affect accuracy and/or precision of displayed concentration but not interfere with instrument’s ability to compute sample concentration. To determine cause of soft error, press **error** key and LCD will display error code.

Table 2

Error Code	Meaning
E00	No errors
E01	Default values are used. The monitor has not been calibrated since start-up or the reset button was pushed.
E02	Sample is outside the temperature range of 5 - 45 ˚C, or: the cooled sample is outside the temperature range of 0 - 15 ˚C.
E03	Combination of **E01** and **E02**
E04	Faulty ATC probe, or related circuitry
E05	Combination of **E01** and **E04**
E10	After calibration the new slope is outside expected range
E20	Calibration due. Last calibration performed 30 days ago. A reminder to perform another calibration.
E30	Calibration due and slope error. This indicates that the last calibration was performed at least 30 days ago and the electrode slope was out of specification at that time.
E40	Calibration overdue. It has been at least 6 weeks since the last calibration. The instrument beyond this point could be out of specification. This is a hard error. The only way to exit this error is to perform a complete three point or off-line calibration. (Blank correction will not affect this error code.)
E50	Calibration overdue and slope error. This indicates that it has been at least 6 weeks since the last calibration and the electrode slope was out of specification at that time. The instrument beyond this point could be out of specification. This is a hard error. The only way to exit this error is to perform a complete three point or off-line calibration. (Blank correction will not affect this error code.)

The most common error codes are combinations of the above codes, but other errors may be displayed:

E12 **E10** and **E02**
E14 **E10** and **E04**
E21 **E20** and **E01**
E22 **E20** and **E02**

Shutdown And Start-Up Procedure

The following steps should be taken if a loss of sample flow is expected for more than one day. These procedures will prevent possible build-up of acidic reagent vapors in the analyzer.

NOTE: At cycling power plants or on units where sample flow to the monitor is frequently interrupted, the installation of a backup sample is recommended. Connect a suitable high purity water source (such as condensate storage tank) into the sample line just upstream of the monitor's sample inlet. By putting shutoff valves in both sample and backup lines at this point, backup or actual sample flow can be quickly valved in or out as required. In this way, continuous flow to the monitor can be supplied and the need for the following startup/shutdown, equilibration and recalibration procedures is eliminated. (Note, however, that for sample flow loss of only a few hours, monitor recalibration should not be required.)

Shutdown

1. Shut off sample flow prior to the analyzer inlet.
2. Turn off power.
3. Drain flow cell.

   DANGER: Shut off power switch at base of monitor before beginning procedure; otherwise, the air pump will spatter acid reagent outward as bottle is removed.

   WARNING: Wear rubber gloves and safety goggles to avoid possible injury from reagent residues in the system.
4. Remove reagent bottle and store in a well ventilated area such as a laboratory fume hood.
5. Carefully pull chloride and reference electrodes out of the top of the flow cell and let them hang by their connectors. Locate protective end cap from reference electrode kit and place on base of reference electrode. This will prevent the reference electrode from drying out.

Start-up

1. Replace the diffusion tubing if sample flow has been off for more than a few days. Tubing becomes brittle with long term exposure to reagent. Use a fume hood and wear rubber gloves and safety goggles for this procedure. If age of reagent is not known, replace it and note in maintenance records. Re-install bottle on analyzer.
2. Polish chloride electrode according to instructions found with Orion 151713 polishing strips which are included with 100025 chloride electrode.
3. Restore sample flow to analyzer. If necessary, adjust pressure and flow rate through analyzer to normal ranges.
4. Remove protective end cap from reference electrode. Re-install electrode on analyzer being careful not to disconnect reservoir tubing from sidearm.
5. When meter reading stabilizes (about one hour), recalibrate according to **Calibration**.

Flow Off

If the analyzer is expected not to have flow for time periods of less than twenty-four (24) hours, leave the instrument on and neglect its output.

If the time is expected to be greater than twenty-four hours, follow Shutdown procedures.

IV. INSTALLATION AND OPERATION OF MODULES

Signal Conditioner Module (Orion 180001)

The Orion 1817LL Monitor is shipped with signal conditioner module (Orion 180001) factory installed. Read section Setting Module Output and if you need to change the factory settings, see Removing Installed Module.

When factory settings are correct for your instrument then proceed to section Electrical Connections - Signal Conditioner Module.

Removing Installed Module

1. Ensure power to the Series 1800 Monitor is turned off at power source.
2. Unscrew module keypad from the black brackets using the two screws on the keypad.
3. Make certain the plungers are pulled back so that the grommet are in a closed position.
4. Slide out module far enough to access DIP switches.

Replacing Installed Module

1. Ensure power to the Series 1800 Monitor is turned off at power source.
2. Open door of electronic assembly. Use No. 2 Phillips screwdriver to remove four screws on decorative panel.
3. Remove module keypad from shipping box.
4. Unscrew module keypad from the black brackets using the two screws on the keypad.
5. Make certain the plungers are pulled back so that the grommet are in a closed position.
6. Proceed to section Setting Module Output.

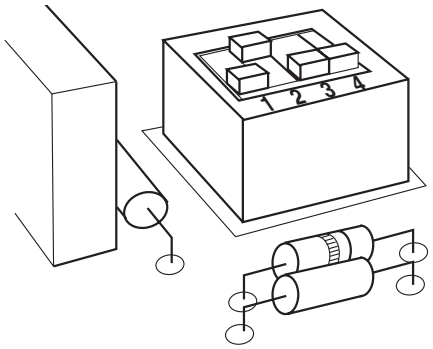


Figure 10:
Dip Switches on Signal Conditioner Board

Setting Module Output

The signal conditioner has two voltage outputs (0-5 or 0-10 volts) and two current outputs (4-20 or 0-20 mA isolated). Switches are preset by manufacturer at 0-5 volts and 4-20 mA but can be reset by DIP switch (see **Figure 10**) on signal conditioner printed circuit board. When required, alter preset output values before sliding the module into the monitor, as follows (also refer to **Table 3**).

1. Current output, factory set at 4-20 mA. 0-20 mA is obtained when switching S1-2 into “OFF” position and S1-3 into “ON” position.
2. Voltage output, factory set at 0-5V DC. 0-10V DC is obtained when switching S1-1 into “ON” position.
3. Slide PC Board onto instrument guide rails. Rear of PC Board should touch backplane and plug should fit securely into its socket. Check that module bracket is against both rails.
4. Push plungers in.
5. Make certain flex cable is attached to keypad and to PC Board. If not, carefully slide header into socket.

Table 3
Signal Conditioner Output Modes

	S1-1	S1-2	S1-3	S1-4
0-5V	OFF	X	X	X
0-10V	ON	X	X	X
4-20 mA	X	ON	OFF	X
0-20 mA	X	OFF	ON	X

X = No effect

Electrical Connections

1. If module keypad is still attached, then unscrew module keypad from black brackets using the two screws on the keypad.
2. Feed wire through hole in chassis bottom labeled “option.” See **Figure 11**.
3. Run wire along wire trough to signal conditioner.
4. Connect wires to voltage (0-5V or 0-10V) or current (0-20 mA or 4-20 mA) output. See **Figure 11**.
5. Double check the flex cable connections.
6. Screw the keypad on the black metal brackets.
7. Double check the flex cable connections.
8. Measure to ensure appropriate number of panels has been removed.
9. Align decorative panel against four stand-offs and reattach with Phillips screws. Decorative panel should not cover any optional module.

Warning: For safety reasons, the Series 1800 Monitor should not be operated without the decorative panel in place. Failure to replace the panel could expose the user to dangerous voltages..

Table 4
Outputs Of Signal Conditioner Terminals

Output		Terminals
Voltage	(+)	1
	(–)	2
Current	(–)	7
	(+)	8

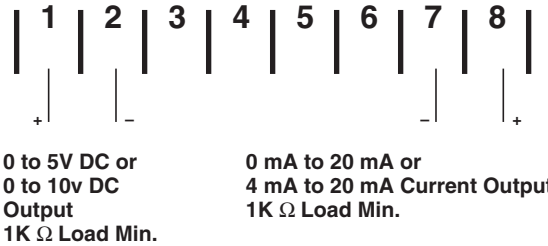


Figure 11:
Wiring Diagram of Signal Conditioner

Description Of Signal Conditioner

Set zero — Sets lower level concentration output. In this mode LED above **set zero** is active. To set output to either linear or logarithmic, hold key down to toggle between these two output forms.

Set full scale — Sets upper level concentration output. In this mode LED above **set full scale** is active.

Test — Generates zero or full scale output to set up an external recording device. **Test** key deactivates signal conditioner module and either **set zero** or **full scale LED** will be active. After pressing **test** key, there will be an output delay of up to three seconds. Press **sample** key to reactivate module.

Mode indicating LED — (located on left of module keypad). Indicates linear or logarithmic signal output. When **set zero** key is held, the mode toggles between these output forms.

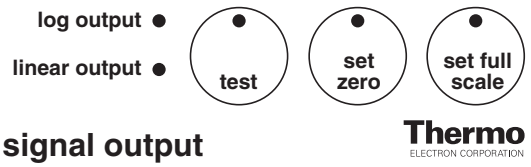


Figure 12:
Signal Conditioner Keypad

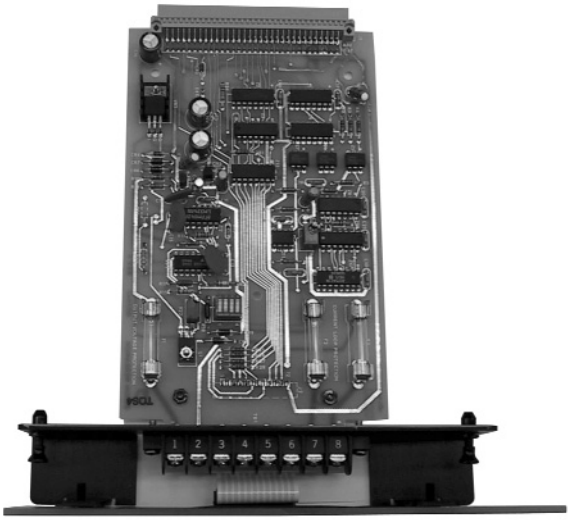


Figure 13:
Wiring Diagram of Signal Conditioner Module

Programming Measuring Range

1. Press **set zero** key. LED above set zero will activate and LCD will display current programmed value. Preset default value is 0.1 ppb for log range and 0.1 ppb for linear range.
2. Alter value by using ▲ and ▼ keys. Lowest possible value is 0.1 ppb.
3. Press **enter/done** key when the correct value is displayed.
4. Set upper range by pressing **set full scale** then follow above procedure. Preset default value is 100 ppm. Note that it is not possible to set zero value higher than full scale, and a range of at least two decades should be used.
5. To send 0% and 100% of full scale signal to an external recording device, press **test** key on signal conditioner module. The first time causes 0% signal to be sent, the second time causes full scale signal. Remember, there may be up to a three second delay when **test** key is pressed.
6. To alternate from log to linear mode:

   Press set **zero** key. The output mode will toggle between log and linear, indicated by the LED. The log and linear zero and full scale are independent and should be set separately. Press **enter/done** when in desired mode.

Table 5
Default Values — Orion 1817LL

P0 Off-line CAL Value	000
P1 Low Range Slope	- 0.57
P2 STD 2	100 ppb
P3 STD 3	1 ppm
P4 STD 1	0 ppb
Set Zero (log)	0.1 ppb
Set Zero (linear)	0.1 ppb
Set Full Scale (log)	100 ppm
Set Full Scale (linear)	100 ppm
Set Alarm 1	100 ppb
Set Alarm 2	1.00 ppm
Slope	- 57 mV
E_0	118 mV

Optional Alarm Module (Orion 180011)

The Orion 1817LL alarm circuit is unique. If the instrument detects chloride concentration is increasing at such a rate that high alarm value will be reached within an hour, a warning signal is activated. This signal is a one second alarm every four seconds which increases in frequency as concentration approaches alarm level. Also, if absolute chloride concentration is 90% of high level alarm, an intermittent warning signal is activated to alert operator that high concentration limit is being approached. If this feature is not desired, the "low alarm" can be used to set external alarm. Alarms are rated at 10A, 250V.

Installation

The optional module is mounted in the instrument in the following manner:

1. Ensure power to the Orion 1817LL Monitor is turned off at power source.
2. Open door of electronic assembly. Use No. 2 Phillips screwdriver to remove four screws on decorative panel.
3. Remove optional module keypad assembly from shipping box.
4. Unscrew module keypad from the black brackets using the two screws on the keypad.
5. Make certain the plungers on the black metal frame are pulled back so that the grommet are in a closed position.

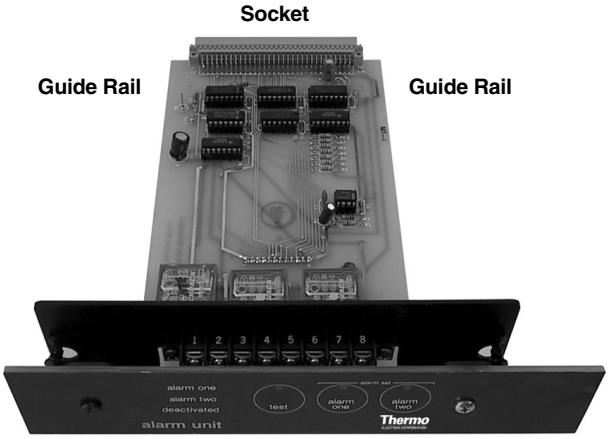


Figure 14:
Alarm Module

Setting Alarm Output

For both alarms 1 and 2, NO and NC conditions are available simultaneously. For "alarms disabled" condition, either NO (factory set) or NC is available. To change factory setting, perform the following steps:

1. Soldered the appropriate jumper, to change between the NO and NC mode for an "alarms disabled" remote indication (terminals 7 and 8). See **Figure 15**.
2. Place PC Board (see **Figure 14**) onto instrument guide rails. Rear of PC Board should touch backplane and plug should fit securely into its socket. Check that module bracket is against both rails. Press the two plastic plungers down to lock module in place.
3. Make certain flex cable is attached to keypad and to PC Board. If not, carefully slide header into socket.

Table 6
Terminals 7 and 8 Alarms Disabled

Mode	Jumper
NO	E7 to E8 (factory set)
NC	E6 to E8

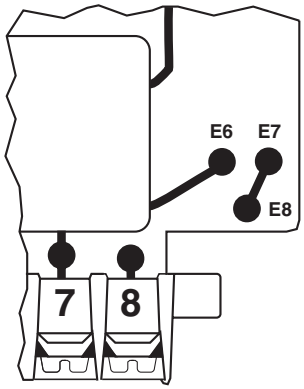


Figure 15:
Jumper Connections on Alarm Module PC Board

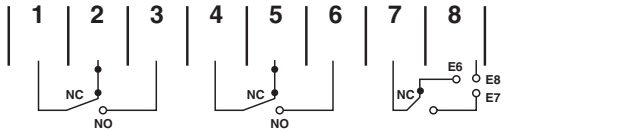
Electrical Connections for Alarm Module

1. Feed wire through hole in chassis bottom.
2. Run wire along wire trough to alarm module.
3. Connect output wires as required. See **Table 7**.
4. Double check the flex cable connections.
5. Screw the keypad on the black metal brackets.
6. Double check the flex cable connections.
7. Measure to ensure appropriate number of panels have been removed from protective cover.
8. Align protective cover decorative panel against four stand-offs and re-attach with Phillips screws. Protective cover should not obscure any optional module.

WARNING: For safety reasons, the Series 1800 Monitor should not operate without the protective cover in place. Failure to replace the cover could expose the user to dangerous voltages.

Table 7
Outputs Of Alarm Module Terminals

	Outputs	Terminals
Alarm 1	Comm	1
	NC	2
	NO	3
Alarm 2	Comm	4
	NC	5
	NO	6
Disable	Comm	7
	NO/NC	8



ALARM 1
Alarm contacts
10A 250VAC max

ALARM 2
Alarm contacts
10A 250VAC max

Disable output contacts
Choose either NC or NO
contacts 10A 250VAC max

Figure 16:
Wiring Diagram of Alarm Module

Description of Alarm Module Controls

Set alarm 1 — Sets alarm 1 parameter. When set alarm 1 is pressed, LED on key is active. See **Table 5** for default values.

Set alarm 2 — Sets alarm 2 parameter. When set alarm 2 is pressed, LED on key is active. See **Table 5** for default values.

Test — Activates and deactivates alarm 1 and alarm 2 and deactivates relays. Test LED will be lit along with corresponding mode key. To reactivate module, press **sample** key on front panel keypad.

Mode indicating LED — (located to left of keypad.) Indicates if either alarm goes off. If alarms are not active, deactivated LED blinks; for example, during calibration. For both alarms, the LED indicating activation is on whenever concentration is above the set point. Since each alarm output has a normally open and normally closed position, any external alarm can be set to go off when concentration is either above or below the set point.

NOTE: The corresponding LED for either alarms turns on when the concentration exceeds the set point. Simultaneously, the relay closes and the NO position closes.

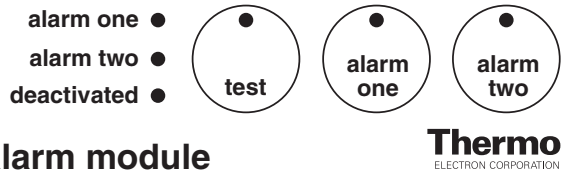


Figure 17:
Alarm Module Keypad

Alarm During Calibration

During calibration the alarm module is automatically deactivated. After the completion of calibration the Series 1800 Monitor automatically enters the sample mode, however, the alarm module remains deactivated. To reactivate, press **sample** key. The alarm module is deactivated to avoid the high concentration alarm that would result from the standards used to calibrate.

Alarm After Power Failure

After a power failure, the alarm module remains deactivated until **sample** key on the front panel keypad (see **Figure 9**) is pressed. The alarm settings are not affected by power provided for remote indication.

Setting Alarms 1 and 2

Alarm limits work on 5 decade ranges only. For example if an alarm is set to 1.0 ppb, the alarm will go off at 1.0 ppb and will continue to remain on until the 10 ppm value is reached. Anything above the 5 decade range will turn the alarm off.

1. Press set **alarm 1** key. LED above set alarm 1 will activate and LCD will display present alarm 1 value.
2. Change displayed value by use of ▲ and ▼ keys.
3. Press **enter/done** key when correct value is displayed. Alarm 1 value is now set.
4. Press set **alarm 2** key. LED above set alarm 2 will activate and LCD will display present alarm 2 value.
5. Change displayed value by use of ▲ and ▼ keys.
6. Press **enter/done** key when correct value is displayed. Alarm 2 value is now set.
7. If an external alarm circuit is to be tested, press **test** key. The first press of the **test** key deactivates both alarms, second press activates alarm 1, and third press activates alarm 2. Press **sample** key to exit test mode.

V. CALIBRATION

Note: Sample flow rate must be maintained at 40 mL/min during calibration.

Procedure for 3-Point Calibration:

1. Switch the sample line to “zero chloride” solution.
2. Place or mount the dynamic calibrator at a proper position near the monitor.
3. Load the 100 ppm chloride standard (Orion 941707) into a 20 mL syringe and expel air.
4. Connect calibration tubing to syringe and prepare the dynamic calibrator as instructed in the manual 226852-001.
5. Set up standard concentrations to be used for calibration:

   a. Press **program** key. The monitor will display the values of P0, P1, P2, P3, and P4, in this order, each time the **program** key is pressed. The meanings of the values are described in the table below.

	Meaning	Value
P0	1-point cal concentration	Default value 0 ppb; range from 0 to 1000 ppb.
P1	Low range slope	Default value - 0.57 mV/ppb; range from - 0.30 to - 1.1 mV/ppb.
P2	3-point cal standard 2 concentration	Default value 100 ppb; range from 75 to 125 ppb.
P3	3-point cal standard 3 concentration	Default value 1.0 ppm; range from 500 ppb to 10 ppm
P4	3-point cal standard 1 concentration	Default value 0 ppb; range from 0 to 20 ppb. Note this value is always in the unit of ppb even though no unit is shown on the monitor.

   b. When the monitor displays the value of P2, press the ▲ and ▼ keys, if required, to change the value to the desired standard 2 concentration value then press the **enter/done** key to accept the new value. A P2 value around 100 ppb is recommended.

   c. Press the **program** key until the value of P3 is displayed. Press the ▲ and ▼ keys, if required, to change the value to the desired standard 3 concentration value then press the **enter/done** key to accept the new value. A P3 value around 1000 ppb is recommended.

   d. Press the **program** key until the value of P4 is displayed. Press the ▲ and ▼ keys, if required, to change the value to the desired standard 1 concentration value then press the **enter/done** key to accept the new value. A P4 value around 0 ppb is recommended.

6. Press the **cal** key. LED **cal point 1** lights. If standard 1 has been set up to 0 ppb, pass only the zero chloride solution to the monitor. Allow 15 minutes for the meter to stabilize, or press **test** key to show potential reading. When a stable value is shown, press the **enter/done** key. LED **cal point 1** is off. Wait for the monitor to determine a stable reading.
7. When a stable reading has been determined, LED **cal point 2** lights. If standard 2 has been set to 100 ppb, turn calibrator to X1/100 position and set percentage dial to read 10.1%. Turn on the calibrator and turn the injection valve at the flow cell to standard. Allow 10 minutes for the meter to respond and stabilize. When a relatively stable potential value is shown, press **enter/done** key. LED **cal point 2** is off. Wait for the monitor to determine a stable reading.
8. When a stable reading has been determined, LED **cal point 3** lights. If standard 3 has been set up to 1.00 ppm, change the calibrator to X1/10 position and set percentage dial to read 10.2%. Allow 10 minutes for the meter to respond and stabilize. When a relatively stable potential value is shown, press **enter/done** key. LED **cal point 3** is off. Wait for the monitor to determine a reading.
9. When a stable reading has been determined, LED **three pt. cal. complete** lights. Press **enter/done** key to accept the new calibration.
10. Turn off the calibrator and close the standard injection valve at the flow cell.
11. The new values of calibration parameters can be viewed by pressing the “program” key to view P1 as the low range slope, and by pressing the “test” key to view high range slope and E0.

Off-Line Calibration Procedure

The off-line calibration feature is simply a one-point calibration, using an alternate method value for P0. The term “off-line calibration” refers only to the fact that a sample from Orion 1817LL bypass is taken “off-line” for laboratory analysis; in fact, no downtime is experienced and the instrument remains on-line throughout the procedure. Also, the zero chloride solution can be used for convenience. A known chloride concentration can also be generated by using the calibrator and the zero chloride solution. Therefore off-line chloride analysis may not be necessary, but can be done if desired.

Action	Orion 1817LL Monitor Response
1. Take grab sample from bypass of Orion 1817LL (**Figure 3**, No. 16). Make certain unit is in **sample** mode.	
2. Press **calibrate** key. Wait for cal point 1 LED to light.	Cal LED lights. Within three seconds fill/flow off LED will light.
3. Press **program** key.	Program LED lights. Activating the **program** key allows current mV values and concentration to be simultaneously stored in P0. For purposes of off-line calibration, only P0 is used. The unit returns automatically to sample mode. Program LED remains on indicating an off-line calibration has been initiated.
4. User returns with grab sample analysis value.	There is no time limit on this step; program LED remains on.
5. Press **program** key.	Allows user to view previously stored value of P0.
6. Press ▲, ▼ keys, if required, to adjust reading to the grab sample analysis value.	There are no set limits for off-line calibration value.
7. Press **enter/done** key.	The monitor will remain in program mode with the correctly adjusted P0 value from step 6 displayed, while internally the E0 is calculated. When calculations are completed, the monitor will return to sample mode.

VI. INSTRUMENT MAINTENANCE

Maintenance Schedule

The Orion 1817LL Monitor is designed for simple maintenance. Follow instructions in this section to ensure proper operation of your instrument. **Table 7** outlines our recommended maintenance schedule.

> ***IMPORTANT: To ensure proper maintenance and good analyzer performance, a service log book should be kept. Record date and type of maintenance done. Mark and date fluid levels of reagent and reference reservoir and date when replaced. Tag each electrode cable with installation date of electrode. This system has proven to be successful by Thermo Electron Service Department, and is especially useful to plants who rotate instrument operators.***

Thermo Electron's Service Department provides a periodic checkout, calibration, and operator training service on site to certify analyzer performance to published specifications. This service can be tailored to fit individual customer needs. If interested, please contact Thermo Electron Service toll-free at 1-800-225-1480.

Table 7
Recommended Maintenance Schedule

Frequency	Operation
Weekly	Check flow rate Visual inspection
Monthly	Calibrate Check reference electrode filling solution and refill if necessary Clean or replace filter element
2 Months	Replace reagent, diffusion tubing, and O-rings
12 Months	Replace reference electrode Replace chloride electrode Replace O-rings Replace restrictor tubing

Weekly Maintenance

1. Check that sample flow rate is between 35 and 45 mL/min. To alter flow rate, pull out black locking knob of pressure regulator, then rotate black knob to increase (clockwise) or decrease (counterclockwise) sample flow. Push in knob to set rate.
2. Inspect unit for leakage. Diffusion tubing leakage is indicated by a rise in level of reagent.
3. Check that there are no error indications and displayed concentration is reasonable.
4. Check that reference electrolyte solution is adequate. (One bottle lasts up to several months.)

Monthly Maintenance

Polish Chloride Electrode Using Orion 151713

Chloride electrode should be polished according to instructions on Polishing Strips (Orion 151713).

Calibration

Refer to Calibration for step-by-step calibration procedure.

Replacement of Reference Electrode Filling Solution Using Orion 150072

Discard 181073 KCl fill solution which comes with 100057 reference electrode. Fill solutions containing chloride cannot be used with Orion 1817LL monitor. Orion 900063 fill solution must be used with Orion 1817LL.

Filling solution is meant to be a two month supply. Therefore, if reservoir is less than half full, replace solution as follows:

1. Remove spent electrolyte bottle from clip. Unscrew cap and discard bottle.
2. Remove cap and seal from new electrolyte fill solution. Check that rubber gasket is properly aligned, then connect cap/tubing assembly to bottle. The 1/8" tubing should extend into the bottle.
3. Invert electrolyte bottle and snap into clip.
4. Use push pin to puncture three air vents in bottom of bottle.

Replacement/Cleaning of Sample Inlet Filter

1. Turn off sample flow.
2. Remove filter hex cap using 1-inch open-ended wrench.
3. Separate filter cap with bypass valve assembly from filter body.
4. Remove filter element and soft gasket (if necessary).
5. Replace gasket and press new sintered element into filter body.
6. Replace hex cap and bypass valve assembly and reposition bypass drain line into drain assembly.
7. Retighten hex cap to approximately 75 oz. in torque.
8. Turn on sample flow and check for leaks.
9. Readjust bypass flow.
10. To clean sintered filter element, clean with agitated dilute sulfuric acid.

Bi-Monthly Maintenance

Replacement of Reagent, Tubing and O-rings

1. Replace acid reagent and diffusion tubing. Shut off analyzer prior to inlet. Remove reagent diffusion bottle by unscrewing the black thumbscrew at top of the fluid connector block. Support bottle at its base, unsnap clip around middle, and remove bottle from analyzer.

   CAUTION: Wear protective goggles and gloves. Refer to bottle label for pre cautions and water in well ventilated area.

2. Remove cap, lift out gray insert, and remove old diffusion tubing from nipples. Rinse cap with deionized water. Replace five small O-rings on tubing connector barbs and one large O-ring on reagent bottle. Install new reagent and tubing. Re-install reagent bottle on analyzer, mark level and date. Restore sample flow to monitor. Wait at least one hour to allow analyzer to equilibrate prior to recalibration.

Yearly Preventive Maintenance

Replace Reference Electrode (Orion 100057)

1. See Instrument Preparation for step-by-step instructions.

Replace Sensing Electrode (Orion 100025)

1. See Instrument Preparation for step-by-step instructions.

Reagent Bottle Assembly O-Ring

1. When reagent bottle is removed, replace O-ring between bottle and adaptor.

Replacement of Restrictor Tubing

1. Close sample inlet valve.
2. Loosen fitting connector cap (5/8" white nut) on top of flow meter assembly and pull out restrictor adaptor and restrictor tube assembly.
3. Unscrew restrictor from fluid connector block by turning 5/8' white fitting counter-clockwise.
4. Replace old restrictor assembly with new assembly being careful not to cross thread flow cell manifold inlet. Tighten Phillips head screws holding flow cell to rear panel in step 5.
5. Push adaptor into fitting connector on top of flow meter assembly and to inlet of fluid connector block. Hand tighten both white 5/8" nuts.
6. Turn on sample inlet valve and check for leaks. Hand tighten where necessary.

Individual components can be ordered separately. See **Ordering Information** for part numbers.

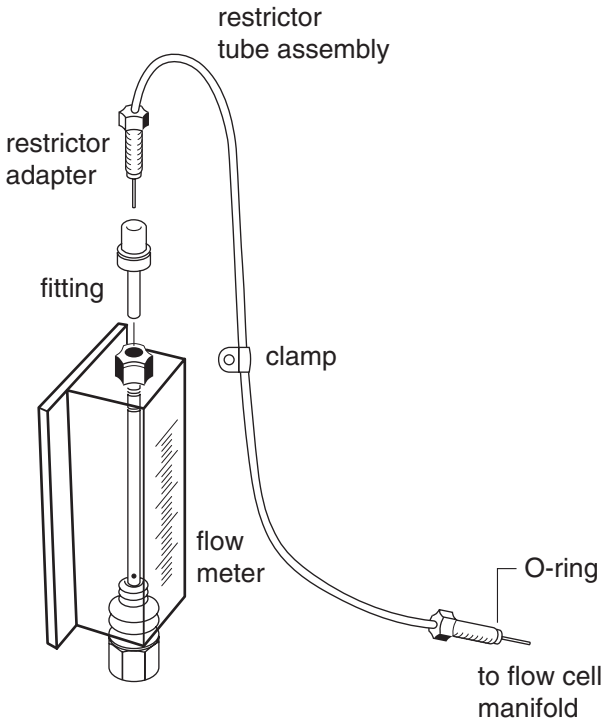


Figure 18:
Restrictor Tubing Assembly

VII. TROUBLESHOOTING

The following section covers troubleshooting that can be performed without special tools or skills. Note that in most installations, the temperature in the flow cell should read between 0 - 15 ˚C, millivolt reading between + 400 to + 100 should be observed. High range slopes between - 48 to - 2 mV/decade, low range slope slop between - 0.47 to - 0.67 mV/ppb should be obtained.

In the U.S., Thermo Electron Customer Support can be consulted for troubleshooting advice at 1-800-225-1480 except within Massachusetts, call 978-232-6000. Outside the U.S. contact your local Thermo Electron Dealer.

Malfunction	Possible Cause	Remedy
Low Slope	Improper calibration technique	Recalibrate
	Sensing electrode defective	Replace and recalibrate
	Calibration standards contaminated	Recalibrate with fresh standards
	Electronics failure	Contact Thermo Electron Corporation
	Zero-Chloride solution contaminated	Replace and recalibrate
	Pipet failure	Refer to pipet manual
	Standard 1,2 and Standard 3 interchanged	Recalibrate
	Electronics failure	Try resetting computer, or consult Thermo Electron
	Defective calibrator	Check dynamic calibrator flow rate
Slope positive	Reference & sensing cables interchanged	Swap cables
Hi Slope	Improper calibration technique	Recalibrate
	Sensing electrode defective	Replace
	Standards contaminated	Recalibrate with fresh standards
	Electronics failure	Try resetting computer, or consult Thermo Electron
	Background concentration too high for standards used	Use higher standards
	Slow responding sensing electrode Defective calibrator again	Polish sensing electrode and recalibrate
Noisy	Reference electrolyte not flowing	Make sure electrolyte bottle is flowing properly properly. Check bottle has been vented
	Electrode failure	Replace electrode
	Loose ground wire	Check ground wire at flow cell
	Monitor okay, recorder defective	Change recorder
	Signal Conditioner	Compare LCD output with module output. If LCD output is quiet while recorder is noisy, contact Thermo Electron

Malfunction	Possible Cause	Remedy
Noisy (con't.)	Temperature probe	Engage **test** key to check temperature stability. If noisy, replace probe
	Electronics failure	Try resetting computer, or consult Thermo Electron
Excessive Drift	Loose ground	Check ground wire connection at flow cell. Tighten if necessary
	Reference electrolyte not draining properly	Make sure electrolyte bottle is vented — check tubing to electrode for obstruction
	Reference electrode	Replace reference electrode
	Chloride electrode	Replace sensing electrode
	Temperature probe	Engage **test** key to check temperature stability. If noisy, replace probe
	Burst diffusion tubing	Monitor liquid level in reagent bottle. If liquid level rises, replace reagent & diffusion tubing. Tubing connector may need replacement if leaking
	Electronics failure	Try resetting computer, or consult Thermo Electron
Low Flow Rate	Sample pressure below 8 psi	Check sample pressure. If less than 8 psi, increase
	Pressure regulator set too low	Increase pressure by pulling on red locking ring and turning black knob clockwise
	Bypass filter clogged	Replace or clean filter
	Restrictor tubing crimped or clogged	Replace restrictor tubing
Does Not Calibrate Properly	Contaminated standards	Use new standard solutions
	Reagent spent	Replace reagent
	Flow cell contaminated	Rinse flow cell with DI water. Flush flow cell overnight with flow on at calibration liquid level
	Electrode failure	Replace one or both electrodes
	Temperature probe failure	Replace or consult Thermo Electron
	Electronics failure	Try resetting computer, or consult Thermo Electron
	Inaccurate Standards or defective calibrator	Use new standard solution, check dynamic calibrator flow rate

Malfunction	Possible Cause	Remedy
High Readings	Monitor out of calibration	Recalibrate
	Monitor flow cell contaminated	Rinse flow cell with DI water. Flush flow cell overnight with flow on at calibration liquid level
	Inlet filter just replaced	Flush one hour until reading stabilizes
		If off-line calibration performed, verify accuracy of alternate method value
Default	Power loss while back-up battery was not fully charged	Allow battery to charge overnight. Recalibrate and reprogram
	Battery failure	Consult Thermo Electron
	Electronics failure	Try resetting computer, or consult Thermo Electron
Incorrect Keyboard Display	Computer glitch	Turn main power off and on. Recalibrate
	Electronics failure	Try resetting computer, or consult Thermo Electron
Low Readings	Instrument okay	Verify that lab result is correct
	Electronics failure	Try resetting computer, or consult Thermo Electron
		If off-line calibration performed, verify accuracy of alternate method value
Reads 1....	Electrode cable failure, or not connected to computer board	Loosen four screws holding main keypad. Check that cables are attached securely
	Electronics failure	Try resetting computer, or consult Thermo Electron

VIII. REPAIR AND SERVICE

For the most current warranty information, visit www.thermo.com.

After troubleshooting all components of your measurement system, contact The Technical Edge℠ for Orion products. Within the United States call 1.800.225.1480, outside the United States call 978.232.6000 or fax 978.232.6031. In Europe, the Middle East and Africa, contact your local authorized dealer. For the most current contact information, visit www.thermo.com.

IX. NOTICE OF COMPLIANCE

This meter may generate radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type-tested and found to comply with the limits for a Class B computing device in accordance with specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If the meter does cause interference to radio or television reception, which can be determined by turning the unit off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna,
- Relocate the meter with respect to the receiver
- Move the meter away from the receiver
- Plug the meter into a different outlet so that the meter and receiver are on different branch circuits

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:

"How to Identify and Resolve Radio-TV Interference Problems."

This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402

Stock No. 004-000-00345-4.

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

"Le présent appareil numérique n' émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques (de la class A) prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada."

X. CERTIFICATE OF CONFORMITY

Manufacturer:

Thermo Electron Corporation
166 Cummings Center
Beverly, MA 01915

Hereby declares that the products

1809AO Fluoride Monitor
1810A0 Ammonia Monitor
1811A0 Cation Sodium Monitor
1811EL Low-Level Sodium Monitor
1817LL Low-Level Chloride Monitor
1817HL High-Level Chloride Monitor
1818AO Oxygen Scavenger Monitor
1820A0 Calcium Hardness Monitor

conform with the following standards and documents:

Emissions:	EN 55011 Emissions Class A FCC Part 15 Class A
Immunity:	EN 50082-1 Generic Immunity IEC 801-2 ESD Susceptibility IEC 801-3 Radiated Susceptibility IEC 801-4 Conducted Susceptibility
Safety:	EN 61010-1: 1993 w/Amendment No. 2 1995

These Orion products have been manufactured in compliance with the provisions of the relevant Thermo Electron manufacturing and test documents and processes. Further, these documents and processes are recognized as complying with ISO 9000:2000 by QMI, listed as File # 001911.

Place and date of issue:

Beverly, MA.

June, 2003

John Meserve
Quality Assurance Manager

XI. WARRANTY

The Orion 1817LL Monitor is warranted to be free from defects in material and workmanship for a period of twelve (12) months from the date of installation or eighteen (18) months from the date of shipment from Thermo Electron, whichever is earlier, when used under normal operating conditions and in accordance with the operating limitations and maintenance procedures in the instruction manual, and when not having been subjected to accident, alteration, misuse, or abuse. This warranty is also conditioned upon expendable and consumable items (diffusion tubing, electrodes, and all solutions) being stored at temperatures between 40 ˚F and 110 ˚F (5 ˚C and 45 ˚C) in a non-corrosive atmosphere.

Industrial electrodes are warranted to be free from defects in material and workmanship for a period of three (3) months from the date of installation or eighteen (18) months from the date of shipment when used under normal operating conditions and in accordance with the operating limitations and maintenance procedures given in the instruction manual and when not having been subjected to accident, alteration, misuse, or abuse.

In the event of failure within the warranty period, Thermo Electron, or its authorized dealer will, at Thermo Electron's option, repair or replace the product non-conforming to the above warranty, or will refund the purchase price of the unit.

THE WARRANTY DESCRIBED ABOVE IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER STATUTORY, EXPRESS OR IMPLIED INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND ALL WARRANTIES ARISING FROM THE COURSE OF DEALING OR USAGE OF TRADE. THE BUYER'S SOLE AND EXCLUSIVE REMEDY IS FOR REPAIR, OR REPLACEMENT OF THE NON-CONFORMING PRODUCT OR PART THEREOF, OR REFUND OF THE PURCHASE PRICE, BUT IN NO EVENT SHALL ORION (ITS CONTRACTORS AND SUPPLIERS OF ANY TIER) BE LIABLE TO THE BUYER OR ANY PERSON FOR ANY SPECIAL INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES WHETHER THE CLAIMS ARE USED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE) OR OTHERWISE WITH RESPECT TO OR ARISING OUT OF THE PRODUCT FURNISHED HEREUNDER.

Industrial products used at nuclear facilities are also subject to Thermo Electron nuclear terms and conditions. Contact Thermo Electron if you do not have a copy.

Representations and warranties made by any person, including its authorized dealers, distributors, representatives, and employees of Thermo Electron, which are inconsistent or in addition to the terms of this warranty shall not be binding upon Thermo Electron unless in writing and signed by one of its officers.

XII. ORDERING INFORMATION

Orion	Description
1817LL	Microprocessor Low-Level Chloride Analyzer with cooler, 115 V, complete with chloride electrode (Orion 100025), reference electrode (Orion 100057), temperature sensor (Orion 181127), internal fill solution (Orion 900063) for use with Orion 100057, signal output module (Orion 180001), and instruction manual. 4-20 or 0-20 mAmps, isolated maximum load 1000 ohms, and 0 - 5 or 0-10V AC, isolated minimum load 1000 ohms. Wired for 100/115/220/240V AC, 50/60 Hz.
1817LL230	Orion 1877LL with 230V AC/50 Hz cooler.
1817LL100	Orion 1877LL with 100V AC/50 - 60 Hz cooler.
100025	Chloride electrode for use with detachable cable.
100057	Reference electrode for use with detachable cable.
900063	Reference electrode internal filling solution, five 2-oz. bottles. For use with Orion 100057 average three month supply.
180001	Signal Conditioner.
180011	Optional Alarm Module.
180029	Electronic Test Kit.
181123	Pressure regulator.
181125	Restrictor tube assembly.
181127	Temperature sensor.
181170	Inlet filters, stainless steel, 60 micron filters with gaskets, pack of 2.
181171	Filter gaskets (for use with Orion 181170), pack of 2.
212732-A01	Shutoff valve (Orion 181172).
239860-A01	Flow cell assembly.
503922-A01	Flow meter assembly (Orion 181124).

Consumables

Orion	Description
181060	Diffusing tubing (four 2 ft. lengths).
182011*	Acid Reagent for 60 days operation (one liter bottle) with one 2 foot length thin-walled tubing and O-rings.
941707	100 ppm Chloride standard, 1 pint bottle.

* Contains Hazardous material.

QC Sampler and Spare Parts

Orion	Description
18GRAB	1800 Series QC Sampler, includes 1-liter sample bottle, tubing and power supply.
18GBTL	(4) 1-liter plastic bottle with cover.
18GTBK	QC Sampler replacement tubing kit.

For Three Point Calibration

Orion	Description
15DC15/15DC20	Dynamic calibrator for use with multiple instruments. Includes syringe kits (Orion 150096 and 180096) and mounting bracket.
180096	Syringe Kit with 20 cc syringe for use with Orion 1818 during two point calibration.
1817CAL	Includes Dynamic calibrator (Orion 15DC15), and 100 ppm Chloride Standard (Orion 941707) in an easy-to-use kit.
941707	100 ppm Chloride Standard, 1 pint bottle.

Spare Parts

Orion	Description
201815-001	Standard injection port.
204743-001	Power switch.
217135-A01	Connector block assembly with thumb screw and injection port.
240441-A01	PMA Board & E-PROM.
801349-A01	Tubing connector assembly with gray cap and barbs, and white reagent bottle cap.
802060-A01	Power board.
802062-A01	Power Supply Board.
802095-001	Ribbon cable.
1SMXXX	Thumbscrew (on fluid block) with three washers.

XIII. APPENDIX

Resetting Monitor

Resetting the monitor will clear any erroneous values that have been stored in memory. Resetting will also set all values back to the default values. The default values can be found in Table 5. Reprogram P2, P3 and P4 after resetting if required.

> ***WARNING: While low voltage is present on the computer board and in computer area, the following procedure should be performed by qualified personnel only.***

Check test values according to the procedure in **Use of Test Mode**. Temperature should read between 5 - 45 °C, millivolts typically are between + 225 mV and + 100 mV, slope should be between - 48 to - 62 mV range. If the reading is 1....., or always stays at the lowest possible reading, such as 0.1 ppm on the Orion 1817LL, it is over range.

If the keypad always displays the same reading and/or does not respond to touch commands by the user, the analyzer is “locked up.”

If an over range reading is noted, or if the analyzer is “locked up,” the PMA (main computer) board should be reset according to the following procedure.

Sometimes what appears to be an electronics problem really isn’t; instead the analyzer is merely “confused.” This type of problem often shows up during the calibration procedure.

For example, if a calibration is attempted with incorrect standards or defective electrodes, the electronics will attempt to determine slope and E_0 and may end up with abnormal values. Even if standards or electrodes are replaced with good ones, calibration may still be impossible. Reset the PMA board according to the following steps:

1. Turn power to analyzer OFF.
2. Loosen the four screws holding keypad and let it hang loose by its ribbon cable.
3. Reset button is located on left rear of PMA board directly behind keypad. The electrode cables connect to this board. Locate position of reset button using a flashlight. Turn power on.
4. Reset by holding button down for two seconds using a non-conductive tool such as the eraser end of a pencil.
5. Release button, then immediately lift up keypad. Display lights should go through normal power up sequence.
6. Re-install keypad.

By resetting the electronics, any erroneous values are replaced by the default for slope values for E_0 and are put into memory. P2, P3 and P4 should be reset if necessary. If no other problems exist with the analyzer, recalibrate according to Calibration.

After calibration, the test values should be in proper range and no error lights visible. If not, check **Troubleshooting Guide**.

Mounting Dimensions

NOTE: Three Point Calibration — If dynamic calibrator and optional mounting shelf are used, leave 12" clearance beneath analyzer.

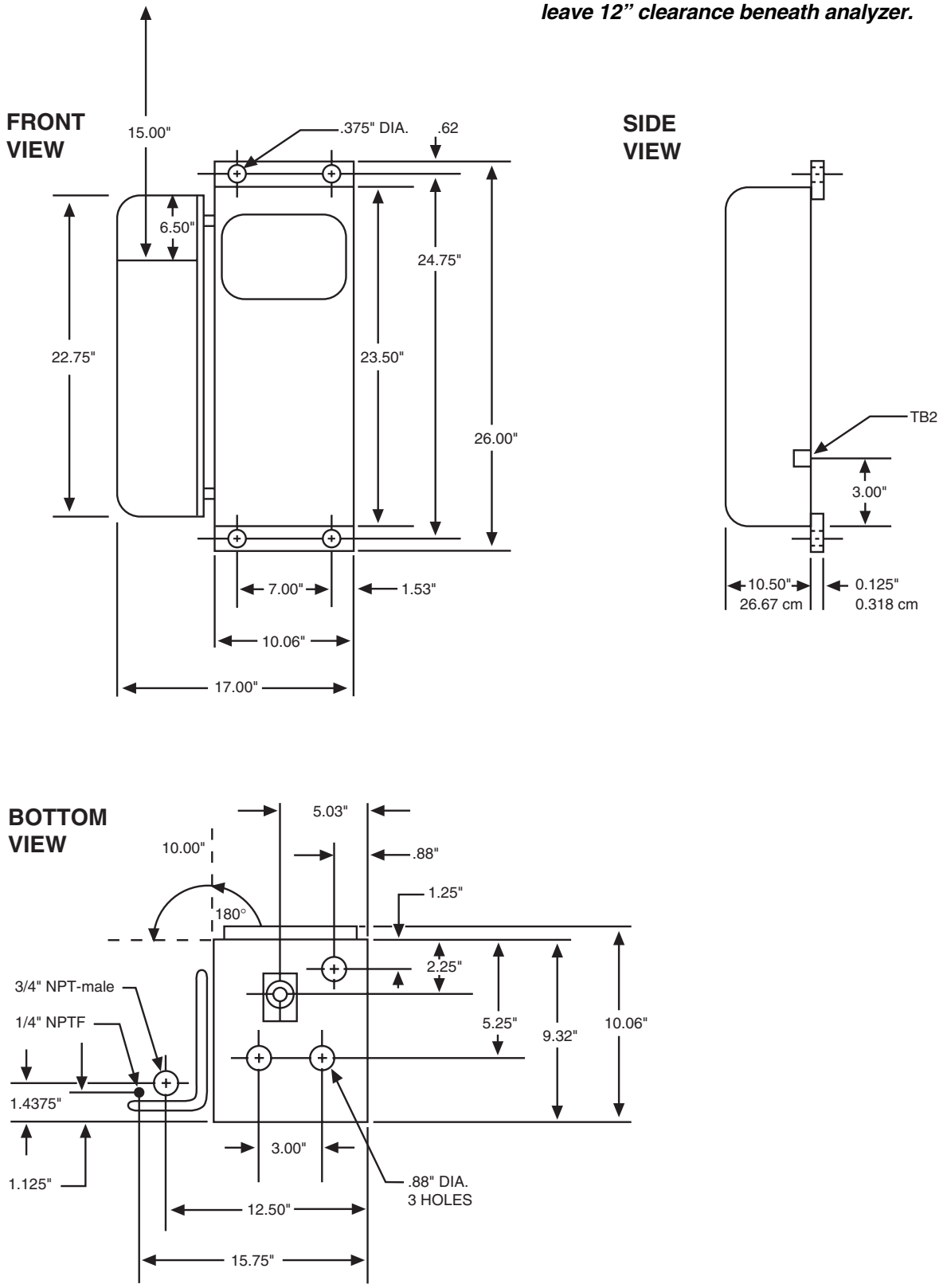


Figure 19: Mounting Dimensions

Mounting Recommendation and Dimensions

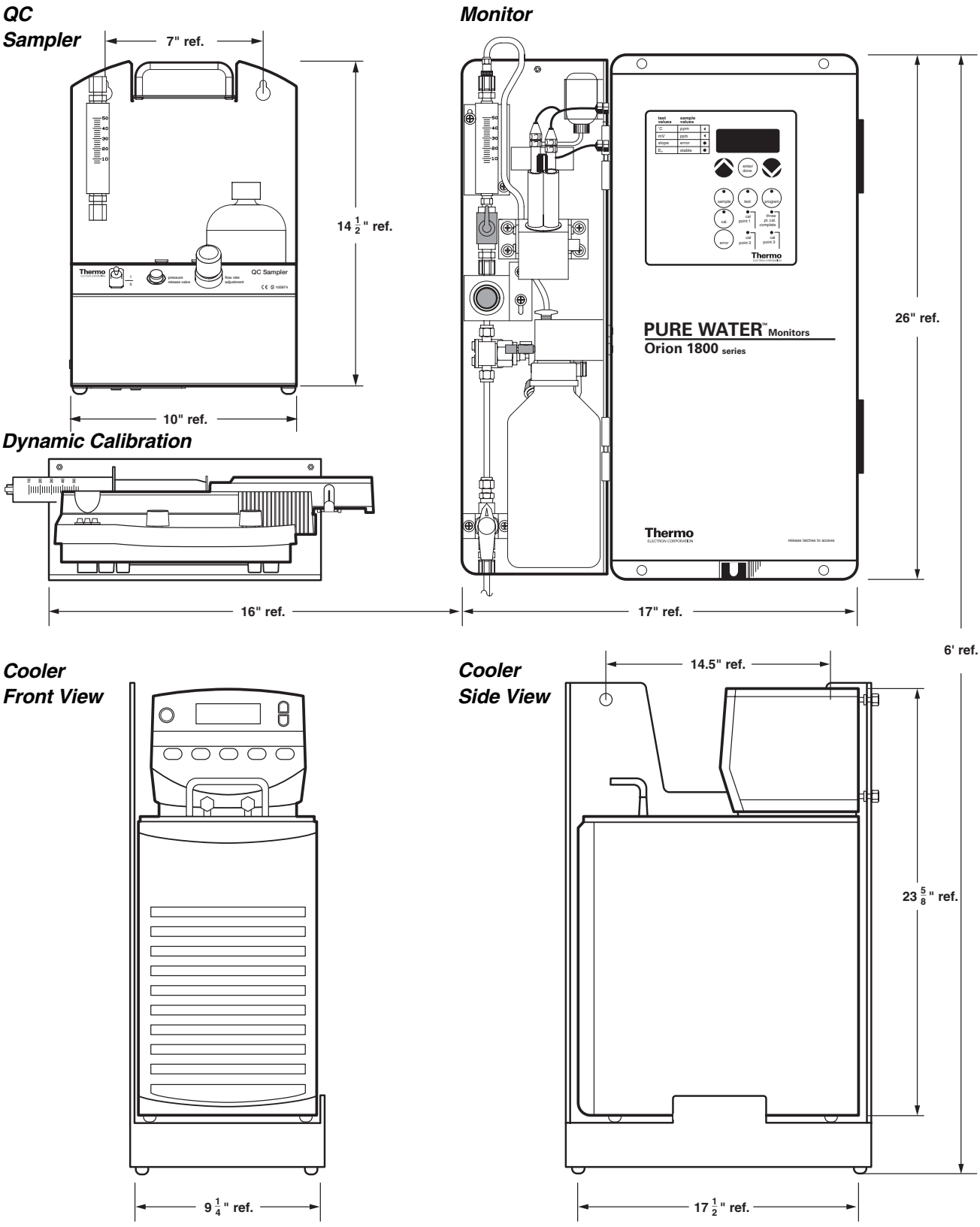


Figure 20: Mounting Recommendation and Dimensions

XIV. ORION QC SAMPLER INSTALLATION AND OPERATIONAL PROCEDURE

Introduction

The QC Sampler is a portable unit that connects to an 1800 Series monitor to provide for rapid verification of samples or standards. By pressurizing a bottle that feeds solution into the monitor in place of the normal sample, the QC Sampler can perform multiple monitor checks.

Principles of Operation

1. Turn a flow valve off on the 1800 Series monitor to stop the sample flow to the flow cell. Loosen the compression nut located on the top of the flow meter, and remove the restrictor tubing from the compression fitting. See **Figure** below.
2. Carefully remove the QC Sampler, and the wall adapter from the shipping box.
3. The QC Sampler may either be mounted next to the monitor or placed on top of the 1800 Series Monitor when in use.
4. Remove the protective bag around the Tee Fitting, **1**, connected to the end of the exit tubing, **2**.
5. Wrap a small piece of Teflon tape around the 1/8" pipe thread end of the fitting, **1**, and screw into the top of the 1800 Series flow meter, via the compression fittings, **3**.
6. Remove black plug and reinstall the restrictor tubing, **4**, on the top of the Tee Fitting.
7. Unscrew the cap from the 1-liter bottle, **5**, remove bottle and retrieve sample to be analyzed.
8. Replace bottle, screw cap tightly so that o-ring has compressed and made a tight seal.
9. Shut of the valve, **6**, to stop sample flow through the monitor.

   Note: this valve is lower than pictured on some 1800 series monitors.
10. A 24 Volt DC wall adapter powers the QC Sampler. Insert the power plug into the jack, **7**, provided on the left-hand-side of the unit, and then plug the wall adapter into any convenient electrical outlet.
11. Flip the switch, **8**, to the "on" position.
12. Check the cap for any leaks, retighten cap if necessary.
13. Pull out the black knob on the QC Sampler, **9**, to regulate the flow rate, turn knob clock-wise until flow meter reads 40 mL/min.
14. Push in the knob when the appropriate flow rate has been reached.
15. The sample will flow through the exit tubing of the QC Sampler into the analyzer. When the reading is stable on the monitor, record the value (Usually 5 to 10 minutes).
16. Shut off the QC Sampler and slowly release the pressure in the bottle by turning the cap counter-clockwise.
17. Remove the exit tubing by loosening the nut on the left-hand side of the Tee Fitting.
18. Insert the black plug that is provided, into the left hand side of the Tee Fitting and tighten with the compression fitting to resume normal operation of the monitor. The flow valve, **6**, can then be turned back on to resume sample flow to the flow cell.
19. The QC Sampler can then be moved to the next monitor if needed.

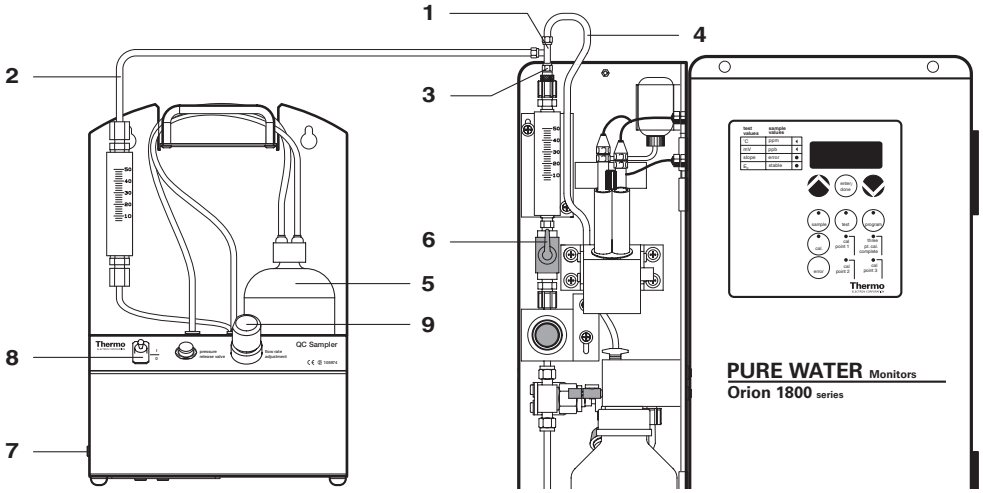


Figure 21: QC Sampler Installation

XV. SPECIFICATIONS OF ORION 1817LL

Measuring Range
5 ppb to 10 ppm chloride.

Display
Four and one half LCD digits for concentration, slope, zero-potential, mV, temperature, error codes and diagnostic information.

Signal Output
Provides selection of 4-20 or 0-20 mAmps, isolated max. load 1000 ohms, and 0-5 or 0-10V DC, isolated min. load 1000 ohms. Minimum range 2 decades.

Accuracy/Precision
10% of reading or ± 5 ppb, whichever is greater, within ± 5˚ C of calibration temperature.

Drift
0.1 ppm per month or 10% of reading whichever is greater.

Sample Conditions
Temperature: 5-45 ˚C
Total alkalinity: less than 50 ppm $CaCO_3$
Sulfite must not be present.

Response Time
90% within 2 minutes function of flow and volume.

Cooled Sample Temperature
5-12 ˚C

Sample Inlet
1/4” NPTF tube fitting.

Sample Outlet
3/4” NPT-male

Calibration
Three-point, off-line calibration, blank correction.

Flow
40 mL/min nominal set by pressure regulator.

Pressure
8 psig up to 100 psig.

Environment
Temperature: 5-45 ˚C
Humidity: 95% relative maximum, non-condensing protection; splash-water proof IP54.

Dimension
65 x 45 x 27 cm (h.w.d.)
26 x 17 x 11 in (h.w.d.)

Weight
20.9 kg/46 lbs

Shipping Weight
31.4 kg/69 lbs

Electrical Requirements
100/115/220 or 240V AC, ± 10%, 50/60 Hz, 100 watts.

XVI. SPECIFICATIONS OF QC SAMPLER

Product Performance Specification:

Electrical Requirements:
24 V DC, 50/60 Hz, 100 watts

Input:
110 VAC Adapter

Flow Rate:
40 mL/min nominal set by pressure regulator.

Compatibility:
All Orion 1800 Series Monitors.

Repeatability:
Within each monitor's specifications.

Dimensions:
14.5 x 10 x 6 in (h.w.d.);
36.8 x 25.4 x 15.2 cm (h.w.d.)

Weight:
10 pounds

Environmental Conditions:

Temperature:
5-45 °C

Humidity:
95% Relative Maximum, non-condensing.

Environmental Instruments
Water Analysis

North America
166 Cummings Center
Beverly, MA 01915 USA
Tel: 978-232-6000
Dom. Fax: 978-232-6015
Int'l. Fax: 978-232-6031

Europe
12-16 Sedgeway Business Park
Witchford, Cambridgeshire
England, CB6 2HY
Tel: 44-1353-666111
Fax: 44-1353-666001

Far East
Room 1205 China Resources Bldg.
26 Harbour Road
Wanchai, Hong Kong
Tel: 852-2885-4613
Fax: 852-2567-4447

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