

Water Quality Monitor

Model Q46UV UV-254/Turbidity Monitor



CONTENTS

- Introduction5
 - General5
 - Standard System5
 - Features5
 - Q46UV System Specifications6
 - Q46UV Performance Specifications6
- Analyzer Mounting7
 - General7
 - Wall or Pipe Mount8
 - Panel Mount, AC Powered Monitor10
- Sensor Installation11
 - General11
 - Flowcell Mounting12
 - Calibration Tubing System14
 - Submersible Installation15
- Electrical Installation16
 - General16
 - Electrical Connections16
 - Relay Connection18
 - Optional Output/Relay Connection18
 - Direct Sensor Wiring19
 - Remote Sensor Wiring20
- Configuration21
 - User Interface21
 - Keys21
 - Display22
 - Software23
 - Software Navigation23
 - Measure Menu [MEASURE]25
 - Calibration Menu [CAL]26
 - Configuration Menu [CONFIG]26
 - Control Menu [CONTROL]27
 - Diagnostics Menu [DIAG]31
 - Hidden Menu33

Calibration	33
UVA/Turbidity Calibration	33
Cal UVA Zero	33
Cal UVA Span.	34
Cal Turbidity Zero	34
Cal Turbidity Span.	35
Temperature Calibration	35
PID Controller Details	36
PID Description	36
PID Algorithm.	36
Classical PID Tuning	37
Manual PID Override Control	37
Common PID Pitfalls.	37
System Maintenance	39
General	39
Analyzer Maintenance	39
Sensor Maintenance.	39
Troubleshooting	39
General	39
External Sources of Problems	39
Analyzer Tests	40
Display Messages	40
Spare Parts	42
Flowcell.	42
Analyzer & Accessories	43

INTRODUCTION

General

The Model Q46UV is an on-line monitoring system designed for the continuous measurement UVA (Absorbance) or UVT (Transmittance) in water or wastewater systems. In addition, the monitor also measures turbidity, providing simultaneous measurement of two important water quality indicators.

The full scale operating range for UVA measurement is 0...1.3 ABS and for UVT is 0...100% T. The overall range of the turbidity measurement is 0.2...1000 NTU. Analog outputs for both UV and turbidity may be scaled for much lower overall ranges depending on application requirements.

Q46UV Monitors are available in two electronic versions, an AC powered monitor with integral alarm relays and dual 4...20 mA output capability, and a 12...24V DC unit with dual output and relays. Options are available to add either a third 4...20 mA output or 3 additional low power SPST relays. Low power relays are required for installations using ATI's automatic chemical cleaning system. In addition, a digital output option for Profibus, Modbus, or Ethernet is available.

Monitors may also display DOC (Dissolved Organic Carbon) instead of UVA or UVT. A table is provided in the monitor that converts the UV absorption measurement into equivalent DOC. The table is based on mixed DOC standards using potassium acid phthalate, which is a common standard for UVA measurement. Note that this table may be modified by the user for applications where the UV absorption of the organic carbon may be quite different than the standard.

Standard System

The standard model Q46UV system includes two components, the Q46 analyzer and an optical sensor with 30 ft cable. While the sensor may be submerged in tanks or channels, a flowcell is available for applications requiring higher sensitivity measurements. The flow chamber eliminates the possibility of interference from external light.

For connection of the sensor to the electronics, a 30 ft cable is supplied. Up to an additional 100 feet of interconnect cable may be added using #07-0100 junction box.

Features

- Standard Q46 electronic transmitters are designed to be a fully isolated instruments for operation from either 90...260V AC or 12...24V DC power supplies.
- Two 4...20 mA analog outputs are standard, and a third analog output is available as an option. One output may be configured for PID control, while other output is programmable to track either Turbidity, UVA, Temperature, or DOC.
- Digital communication option for Profibus-DP, Modbus-RTU, Modbus TCP/IP, or Ethernet-IP.
- Output Hold, Output Simulate, Output Alarm, and Output Delay Functions. All forced changes in output condition include bumpless transfer to provide gradual return to on-line signal levels and to avoid system control shocks on both analog outputs.
- Units provide three SPDT relay outputs and two isolated analog outputs. Software settings for relay control include setpoint, deadband, phase, delay, and failsafe.
- Selectable Output Fail Alarm feature on Relay C allows system diagnostic failures to be sent to external monitoring systems.
- Large, high contrast, custom LCD display with LED back light provides excellent readability in any light conditions. The secondary line of display utilizes 5×7 dot matrix characters for clear message display two of four measured parameters may be on the display simultaneously.
- Diagnostic messages provide a clear description of any problem with no confusing error codes to look up. Messages are also included for diagnosing calibration problems.
- Security lock feature to prevent unauthorized tampering with transmitter settings. All settings can be viewed while locked, but they cannot be changed.



Equipment bearing this marking may not be discarded by traditional methods in the European community after August 12 2005 per EU Directive 2002/96/EC. End users must return old equipment to the manufacturer for proper disposal.

Q46UV System Specifications

Displayed Parameters	UVA, 0...1.300 ABS, or UVT, 0...100% T Turbidity, 0.2...1000 NTU Sensor temperature, -10.0...50.0° C (23...122° F) Loop current, 4.00...20.00 mA Sensor slope/offset Model number and software version PID Controller Status
Main Parameter Ranges	UV Absorption, 0...1.300 A Turbidity: 0...40.00, 0...400.0, 0...4000 NTU
Power	90...260V AC, 50/60 Hz., 10 VA max. or 12...24V DC, 500 mA max.
Display	0.75 in. (19.1 mm) high 4-digit main display with sign 12-digit secondary display, 0.3 in. (7.6 mm) 5 × 7 dot matrix Integral LED back-light for visibility in the dark
Enclosure	NEMA 4X, polycarbonate, stainless steel hardware,
Mounting Options	Wall, pipe, or panel mount standard Wall bracket suitable for either 1.5 in. or 2 in. I.D. U-Bolts for pipe mounting
Conduit Openings	Five 1/2 in. NPT openings Adapter can be removed to provide a 1 in. NPT opening in the bottom of the enclosure Gland seals provided but not installed
Relays, Electromechanical	Three SPDT, 6 Amp @ 250V AC, 5 Amp @ 24V DC contacts Software selection for setpoint, phase, delay, deadband, hi-lo alarm, and failsafe A-B indicators on main LCD, and C indicator on lower display
Analog Outputs	Two 4...20 mA outputs. Output one programmable for UVA or PID. Output 2 programmable for UVA, DOC, NTU or Temperature. Max load 450 Ohms for output 1 and 1000 Ohms for output 2. Outputs ground isolated and isolated from each other. An additional 3rd analog option is available
Output Isolation	600 V galvanic isolation
Optional Relays:	Three SPST, 1 Amp @ 24V DC. Software selection for setpoint, phase, delay, deadband, hi-lo alarm, and failsafe
Sensor Cleaner	Optional automatic chemical cleaning system available for applications where iron and manganese fouling is common
Ambient Temperature	Analyzer Service, -20...60° C (-4...140° F) Sensor Service, 0...55° C (23...131° F) Storage, -30...70° C (-22...158° F)
Ambient Humidity	0...95%, indoor/outdoor use, non-condensing to rated ambient temperature range
Altitude	Up to 2000 m (6562 ft)
Electrical Certification	Ordinary Location, cCSAus (Certified to both CSA and UL standards), pollution degree 2, installation category 2
EMI/RFI Influence	Designed to EN 61326-1
Weight	2.4 lb (1.1 kg)
UV Sensor	20 mm UV absorption path, 254 nm wavelength
Turbidity Sensor	90° Scatter, 860 nm IR source
Sensor Materials	Anodized aluminum with sapphire optics
Sensor Cable	Submersible: 30 ft (10 m)
Max. Sensor Cable Length	100 ft (30 m), with junction box

Q46UV Performance Specifications

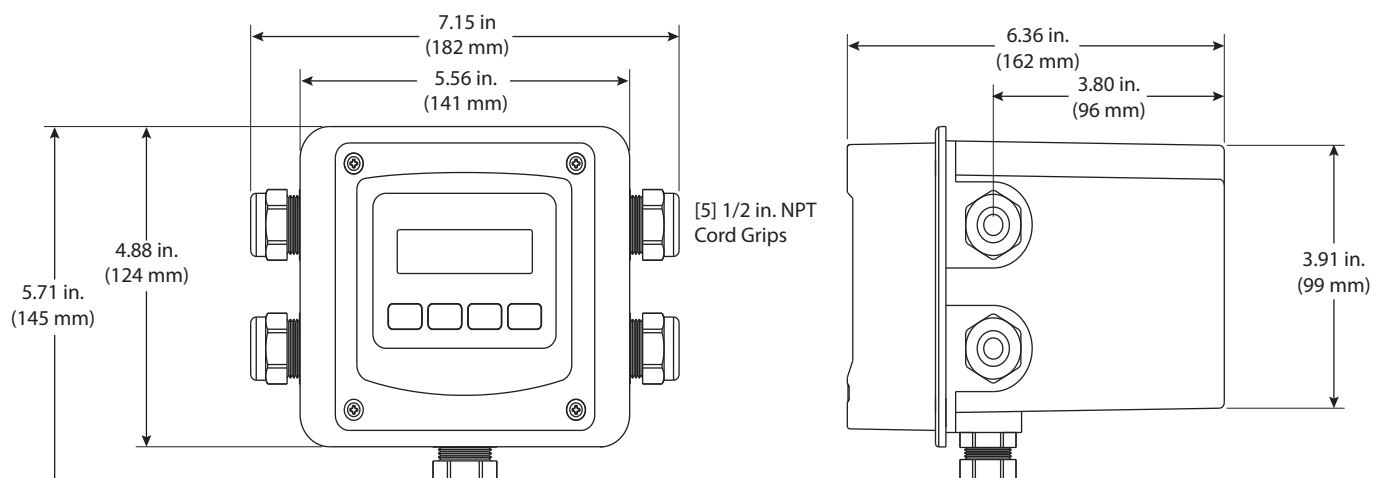
Accuracy	1% UV Transmittance
Repeatability	0.5% UV Transmittance
Sensitivity	0.1% UV Transmittance
Warm-up Time	30 seconds to rated performance (electronics only)
Supply Voltage Effects	± 0.1% span
Instrument Response Time	120 seconds to 90% of step input at lowest damping

ANALYZER MOUNTING

General

All Q46 Series instruments offer maximum mounting flexibility. A bracket is included with each unit that allows mounting to walls or pipes. Choose a location that is readily accessible for calibrations and keep in mind that it will be necessary to use solutions during the calibration process. To take full advantage of the high contrast display, mount the instrument in a location where the display can be viewed from various angles and long distances.

Locate the instrument in close proximity to the point of sensor installation, which will allow easy access during calibration. The sensor-to-instrument distance should not exceed 100 ft (30 m). To maximize signal-to-noise ratio however, work with the shortest sensor cable possible. The standard cable length of the turbidity sensor is 30 ft.



Wall or Pipe Mount

A PVC mounting bracket with attachment screws is supplied with each transmitter (see [Figure 2](#) for dimensions). The multi-purpose bracket is attached to the rear of the enclosure using the four flat head screws. The instrument is then attached to the wall using the four outer mounting holes in the bracket. These holes are slotted to accommodate two sizes of U-bolt that may be used to pipe mount the unit. Slots will accommodate U-bolts designed for 1-1/2 in. or 2 in. pipe. The actual center-to-center dimensions for the U-bolts are shown in the drawing. Note that these slots are for U-bolts with 1/4-20 threads. The 1-1/2 in. pipe U-bolt (2 in. ID clearance) is available from ATi in type 304 stainless steel under part number 47-0005.

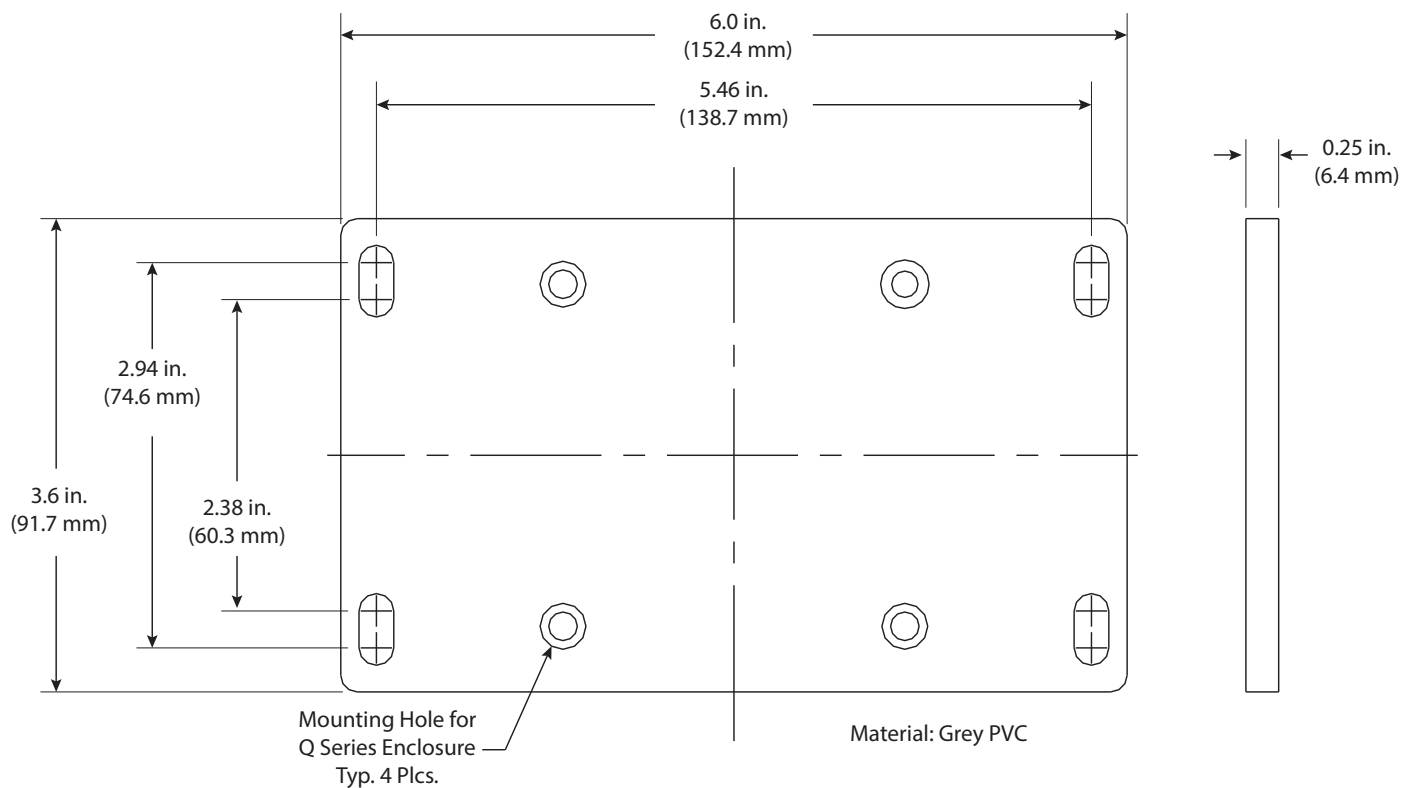


Figure 2: Wall or pipe mount bracket

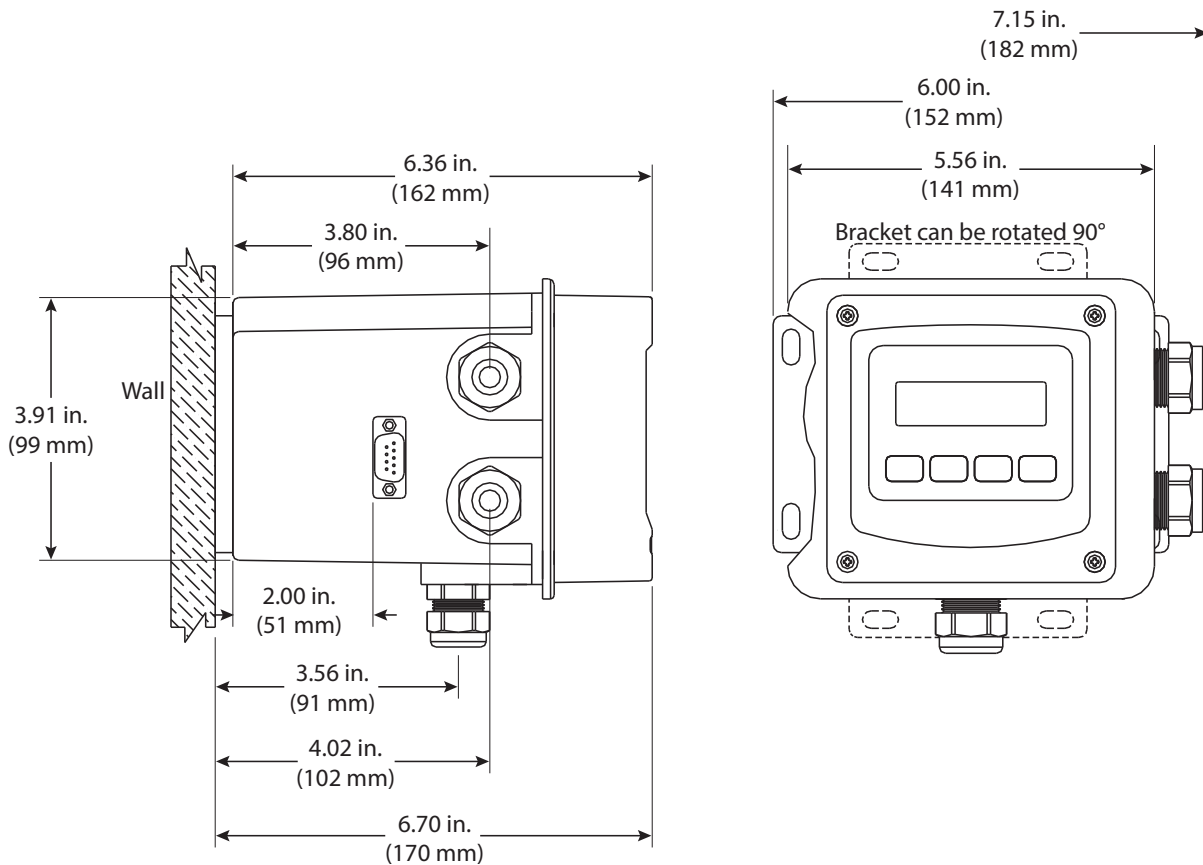
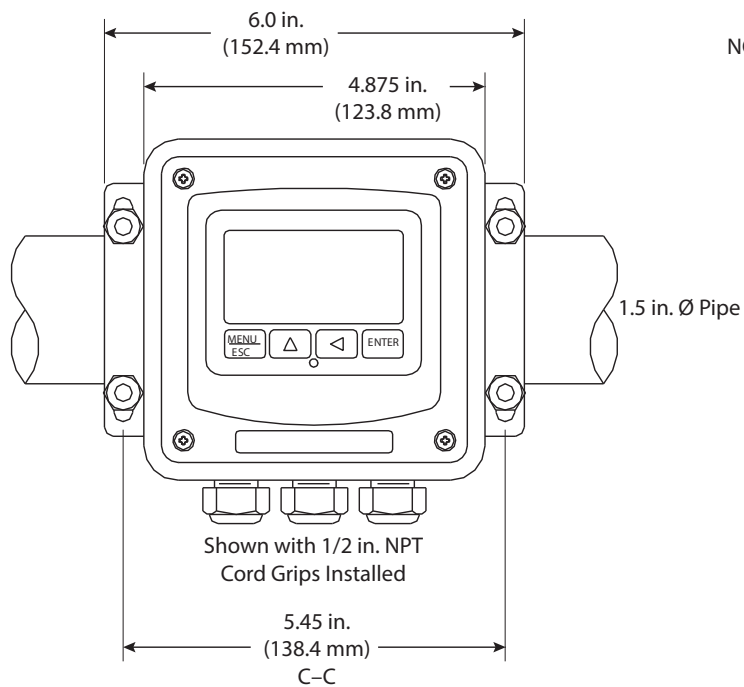


Figure 3: Wall mounting diagram



NOTE: Mounting plate hole spacing can support up to 2 in. Ø pipe max.

Figure 4: Pipe mounting diagram

Panel Mount, AC Powered Monitor

Panel mounting of an AC powered monitor uses the panel mounting flange molded into the rear section of the enclosure.

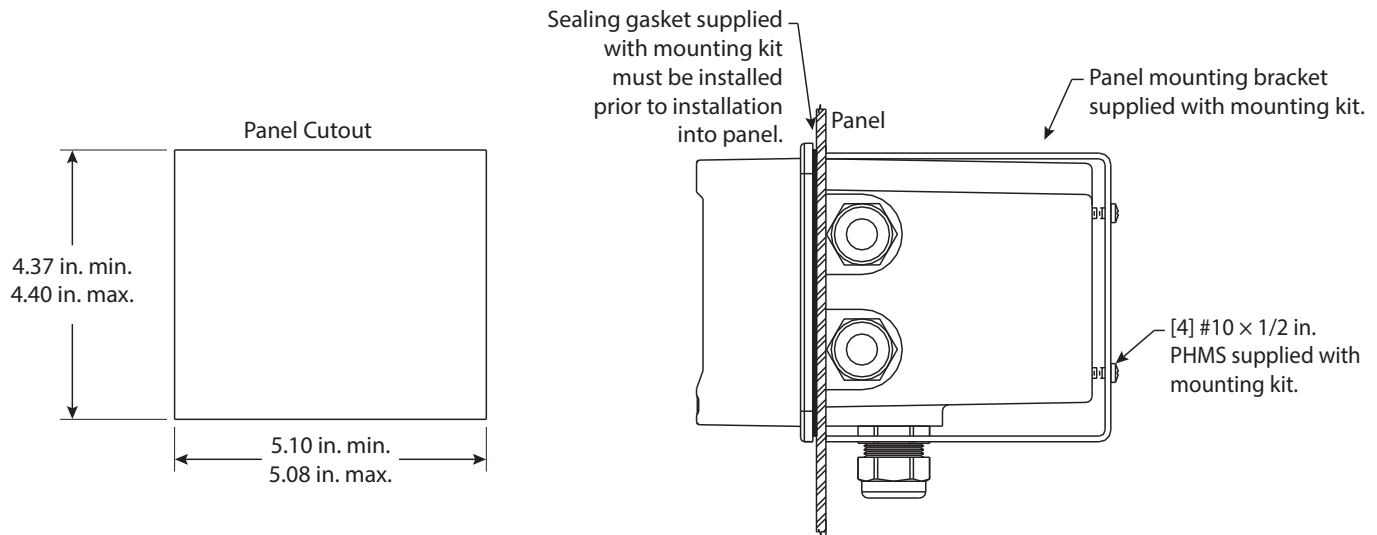


Figure 5: Panel mount diagram

Figure 5 provides dimensions for the panel cutout required for mounting. The panel mounting bracket kit must be ordered separately (part number 05-0068). This kit contains a metal retainer bracket that attaches to the rear of the enclosure, 4 screws for attachment of this bracket, and a sealing gasket to insure that the monitor flange provides a watertight seal when mounted to a panel.

The sealing gasket must first be attached to the enclosure. The gasket contains an adhesive on one side so that it remains in place. Remove the protective paper from the adhesive side of the gasket and slide the gasket over the back of the enclosure so that the adhesive side lines up with the back of the enclosure flange. Once in place, you can proceed to mount the monitor in the panel.

SENSOR INSTALLATION

General

The UV/Turbidity sensor may be used either in a flowcell or submerged in a tank or channel. The flowcell used with the system is designed to eliminate ambient light effects and to allow sample pressure to be maintained through the flowcell minimizing air bubble formation that can cause measurement errors. A bracket is supplied for mounting the flowcell to any flat surface. The flowcell should be used for all finished water applications and is best for raw water use as well.

NOTE: UV sensor flow cells are shipped with two sets of fittings for sample connection. The factory installed fittings are intended for clean water applications (NTU less than 10) and accept 0.25 in. OD tubing. The outlet fitting contains a fixed-flow regulator that will maintain sample flow at 4 GPH (0.25 LPM). Sample inlet pressure should be in the range of 1...50 PSIG. A second set of fittings are supplied for raw water applications where high turbidity might be expected periodically. These fittings accept 3/8 in. OD tubing and there is no flow regulator in the outlet. These fittings should be used when needed and flow regulation should be installed on the outlet tubing. A ball valve is best for this as it is easy to clean by opening completely.

Dimensions of the UV-254/Turbidity sensor are shown in [Figure 6](#).

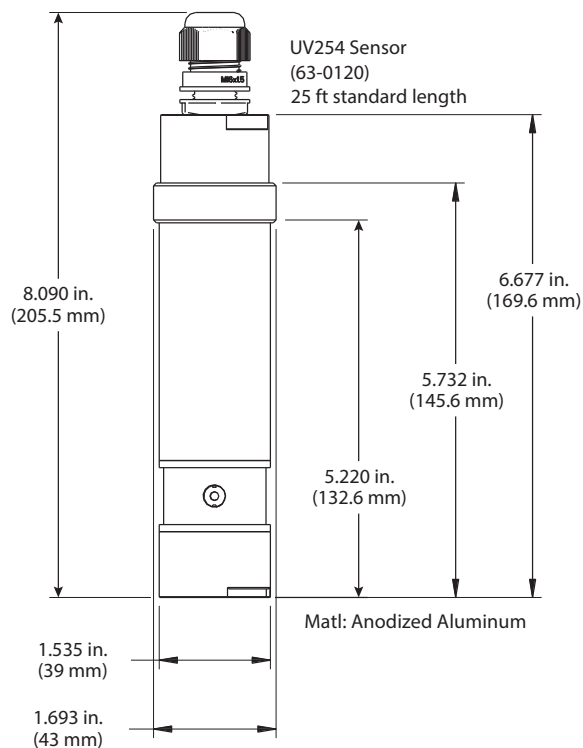


Figure 6: Sensor dimensions

Flowcell Mounting

Figure 7 provides flowcell dimensions. Note that the flowcell should always be mounted horizontally with the inlet on the bottom and outlet on the top.

Select a flowcell location with sufficient clearance below to allow installation of the inlet calibration valve to facilitate adjustment of the system after installation. See Figure 9 on page 14 for the suggested tubing arrangement when using the calibration valve system supplied with the unit.

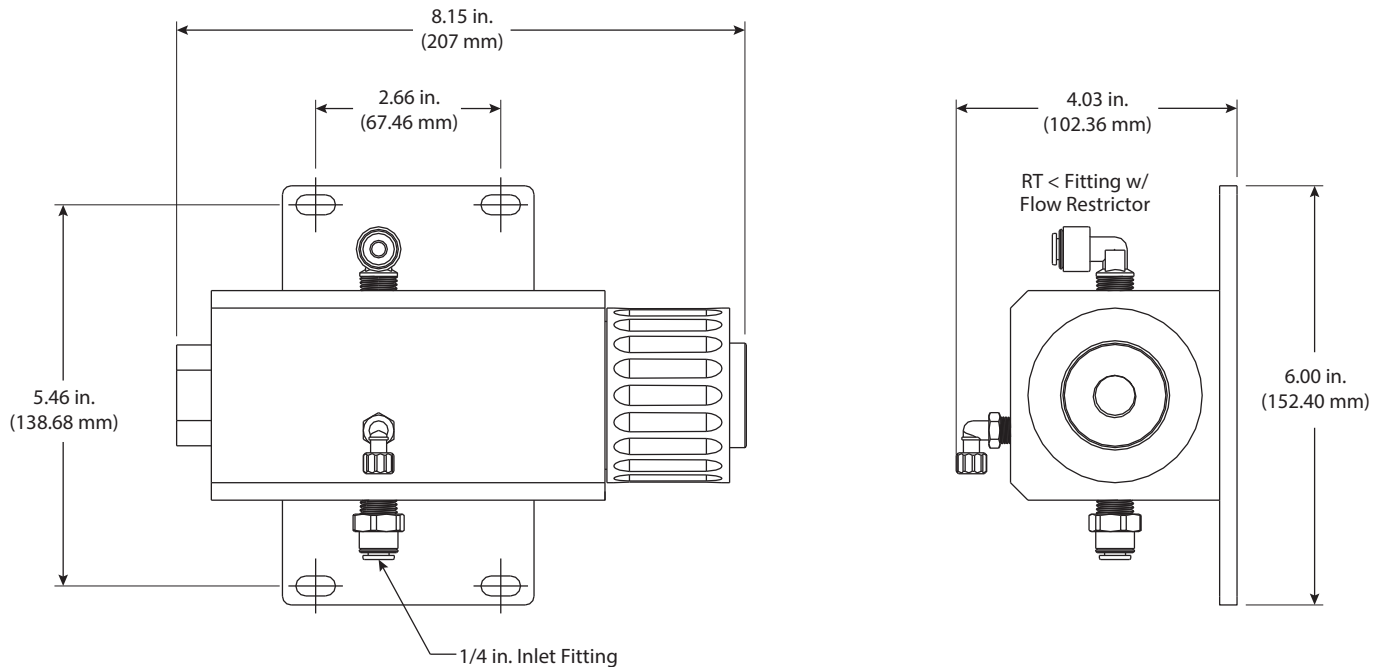


Figure 7: Flowcell dimensions

Figure 8 on page 13 provides a detail of how the UV sensor is installed in the flowcell assembly. During installation of the sensor, be sure that the O-ring is seated properly in the groove at the end of the flowcell assembly. Proper seating of that O-ring is critical to avoiding water leakage.

NOTE: The sensor has an orange marking label on the back. The white lines on the label should be aligned with the inlet and outlet fittings so that the sensor sits in the proper position inside the flowcell.

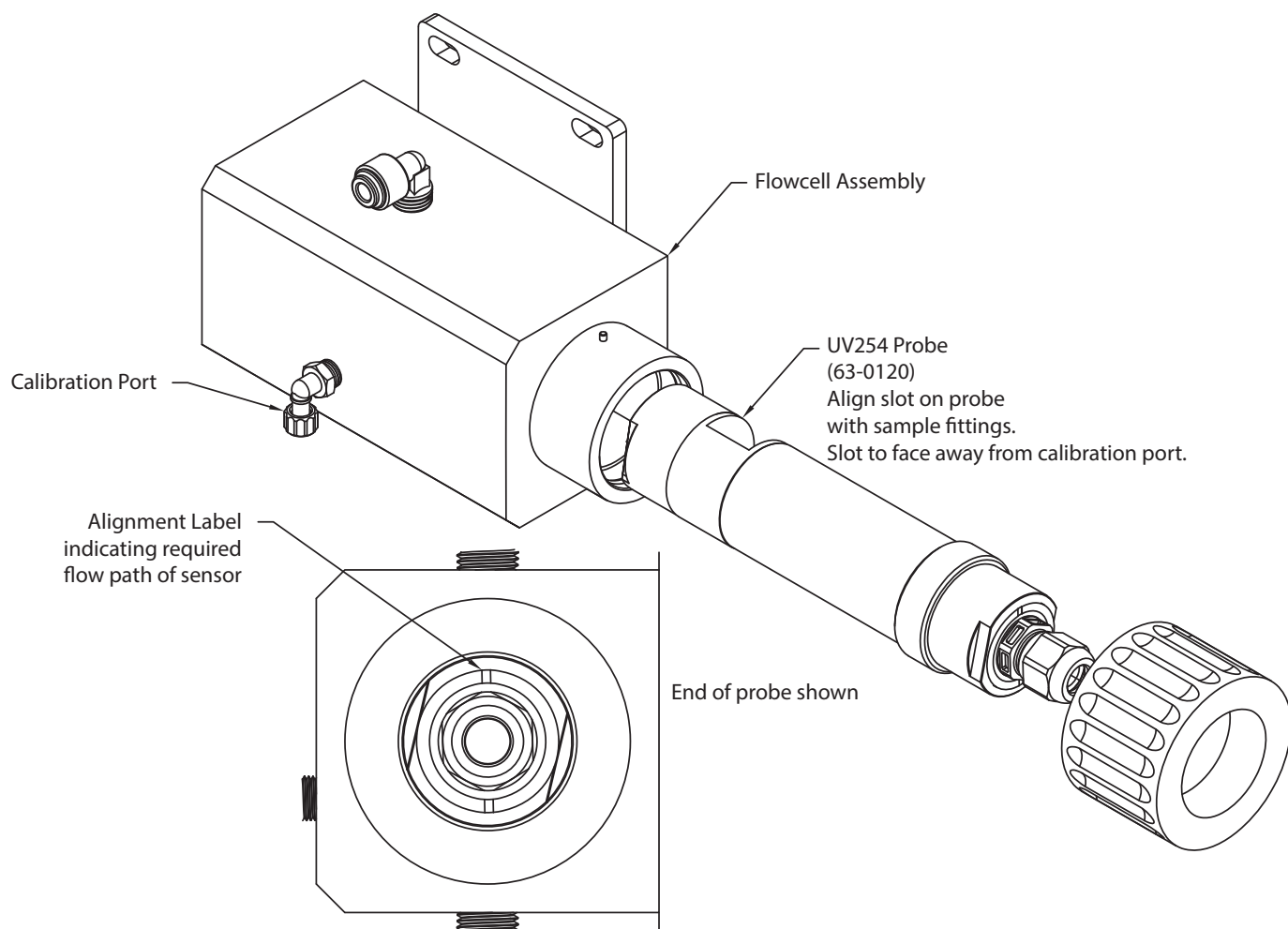


Figure 8: Sensor insertion/alignment

Calibration Tubing System

Supplied with the UV254/Turbidity system is a 3-way valve, some tubing, and a syringe that facilitates zeroing and calibration of the measurements. Shown below is a diagram of how the tubing and valve should be installed. This arrangement will allow introduction of zero and span solutions using the 60 ml syringe without disturbing the sample piping.

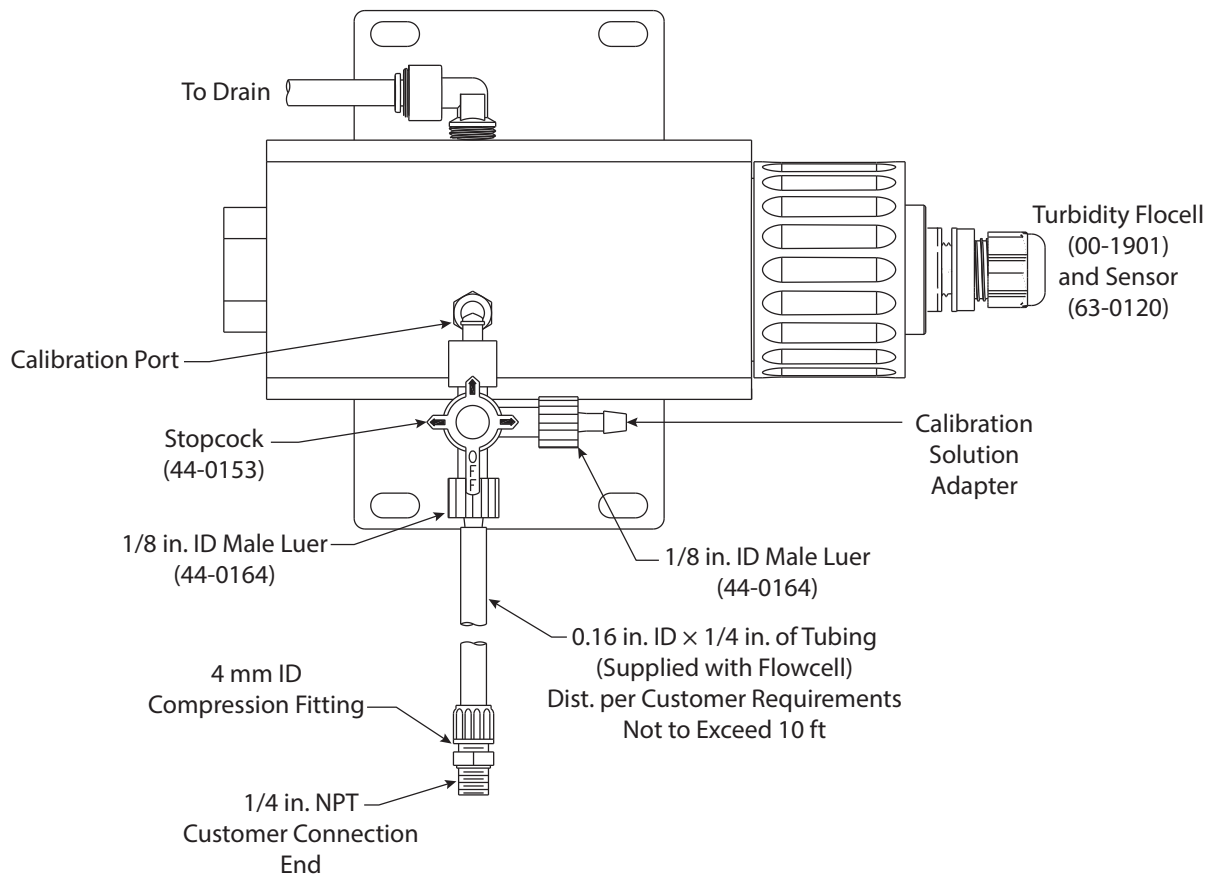


Figure 9: Calibration tap diagram

Submersible Installation

The standard UV sensor may also be used for submersion installations. Note that the turbidity measurement may be affected by bright ambient light conditions. Submerged sensors **MUST** be located in dark areas but the submersion mounting assembly contains a light shield to minimize stray light effects.

[Figure 10](#) shows a typical submersion mounting using ATI's 00-2003 submersion mounting kit. This complete kit adapts to typical handrails. The pipe adapter only is part number 00-2002 and is available separately when the handrail mounting kit is not required.

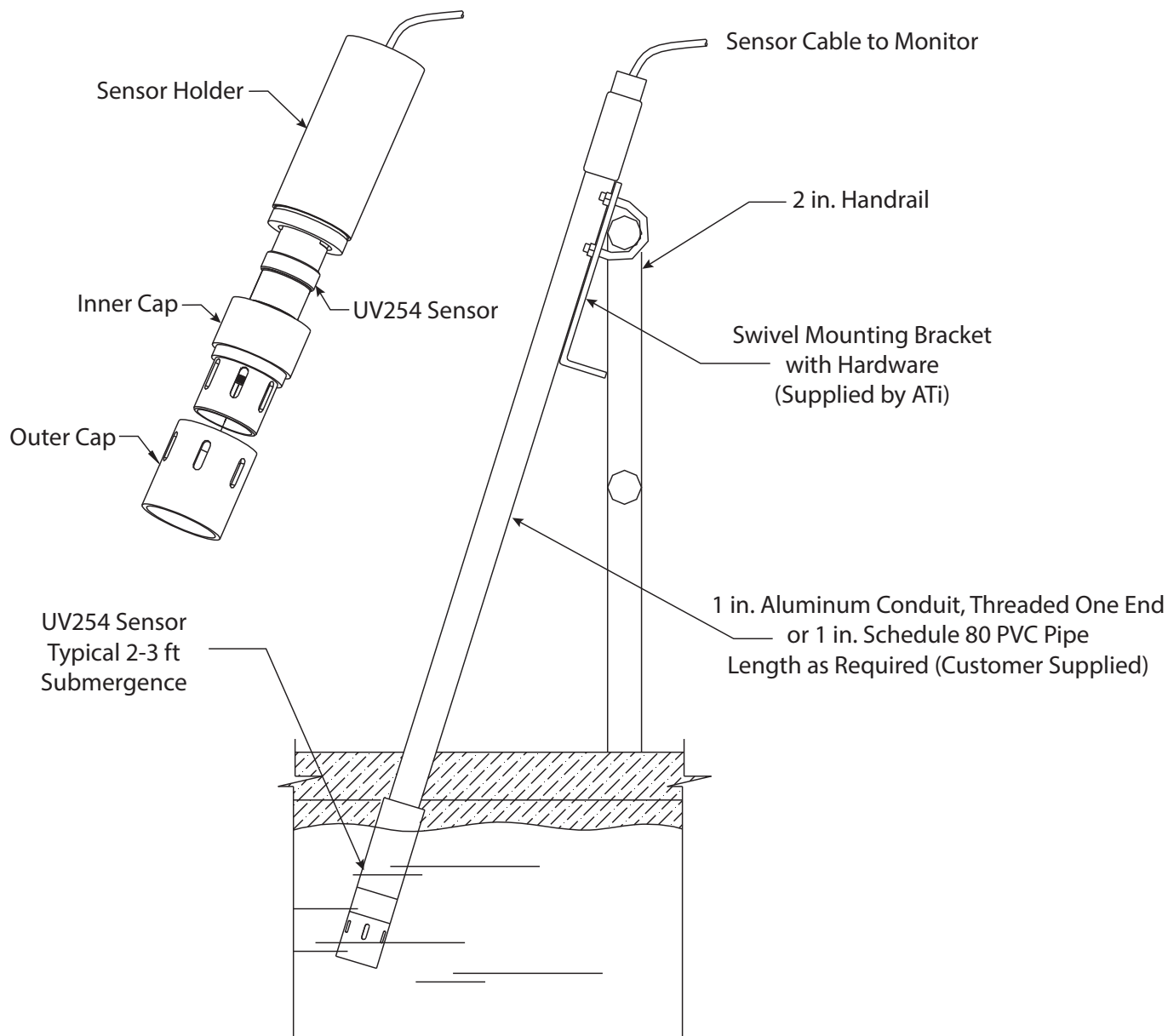


Figure 10: Submersion mounting assembly

ELECTRICAL INSTALLATION

General

The Q46 is powered in one of two ways, depending on the version purchased. The 12...24V DC powered analyzer requires a customer supplied DC power supply. The 90...260V AC version requires line power. Please verify the type of unit before connecting any power.

WARNING

DO NOT CONNECT AC LINE POWER TO THE DC VERSION. SEVERE DAMAGE WILL RESULT.

IMPORTANT NOTES:

1. Use wiring practices that conform to national, state and local electrical codes. For proper safety as well as stable measuring performance, it is important that the earth ground connection be made to a solid ground point on TB7. The AC power supply in the transmitter contains a single 630 mA slo-blo fuse (Wickmann/Littlefuse #372-0630). The fuse F1 is located adjacent to TB7 and is easily replaceable.
2. Do NOT run sensor cables or instrument 4...20 mA output wiring in the same conduit that contains AC power wiring. AC power wiring should be run in a dedicated conduit to prevent electrical noise from coupling with the instrumentation signals.
3. This analyzer must be installed by specifically trained personnel in accordance with relevant local codes and instructions contained in this operating manual. Observe the analyzer's technical specifications and input ratings. Proper electrical disconnection means must be provided prior to the electrical power connected to this instrument, such as a circuit breaker rated 250V AC, 2 A minimum. If one line of the line power mains is not neutral, use a double-pole mains switch to disconnect the analyzer.
4. Repeated problems with lightning strikes damaging sensitive instrumentation are often attributed to poorly bonded earth grounds in the instrument power source. The protection schemes incorporated into this analyzer cannot operate to maximum efficiency unless the ground connection is at its' absolute lowest impedance.

There is no standard ground resistance universally recognized. Many agencies recommend a ground resistance value of 5 Ohms or less. The NEC recommends an impedance to ground of less than 25 Ohms, and less than 5 Ohms where sensitive equipment is installed. Power sources feeding sensitive instruments like the Q46H/79PR should have the lowest possible impedance to ground.

Electrical Connections

Verify the power supply requirement before installing. Also verify that power is fully disconnected before attempting to wire.

Q46 systems are supplied with 5 cable gland fittings for sealing cable entries. Connect appropriate power to the matching designations on terminal strip TB7.

The analog outputs from the system are present at terminals TB1 and TB2. The loop-load limitation in this configuration is 450 Ohms maximum for output 1 and 1000 Ohms maximum for output 2. Also note that these two outputs are completely isolated from each other to insure that ground loops do not result from the connection of both outputs to the same device such as a PLC or DCS.

A ribbon cable connects the power supply assembly with the microprocessor assembly located in the front section of the enclosure. This cable may be unplugged from the front section of the monitor if service is needed, but should normally be left in place during installation.

The power strip, TB7, allows up to 12 AWG wire. A wire gauge of 16 AWG is recommended to allow for an easy pass-through into the 1/2 in. NPT ports when wiring.

AC or DC power should be brought into the enclosures through the bottom gland seal on the right side of the enclosure. This entry is directly above the power terminal blocks. Terminal blocks are pluggable, and can be removed for easy wire connection. See [Figure 13 on page 18](#) for TB7 Terminal Locations.

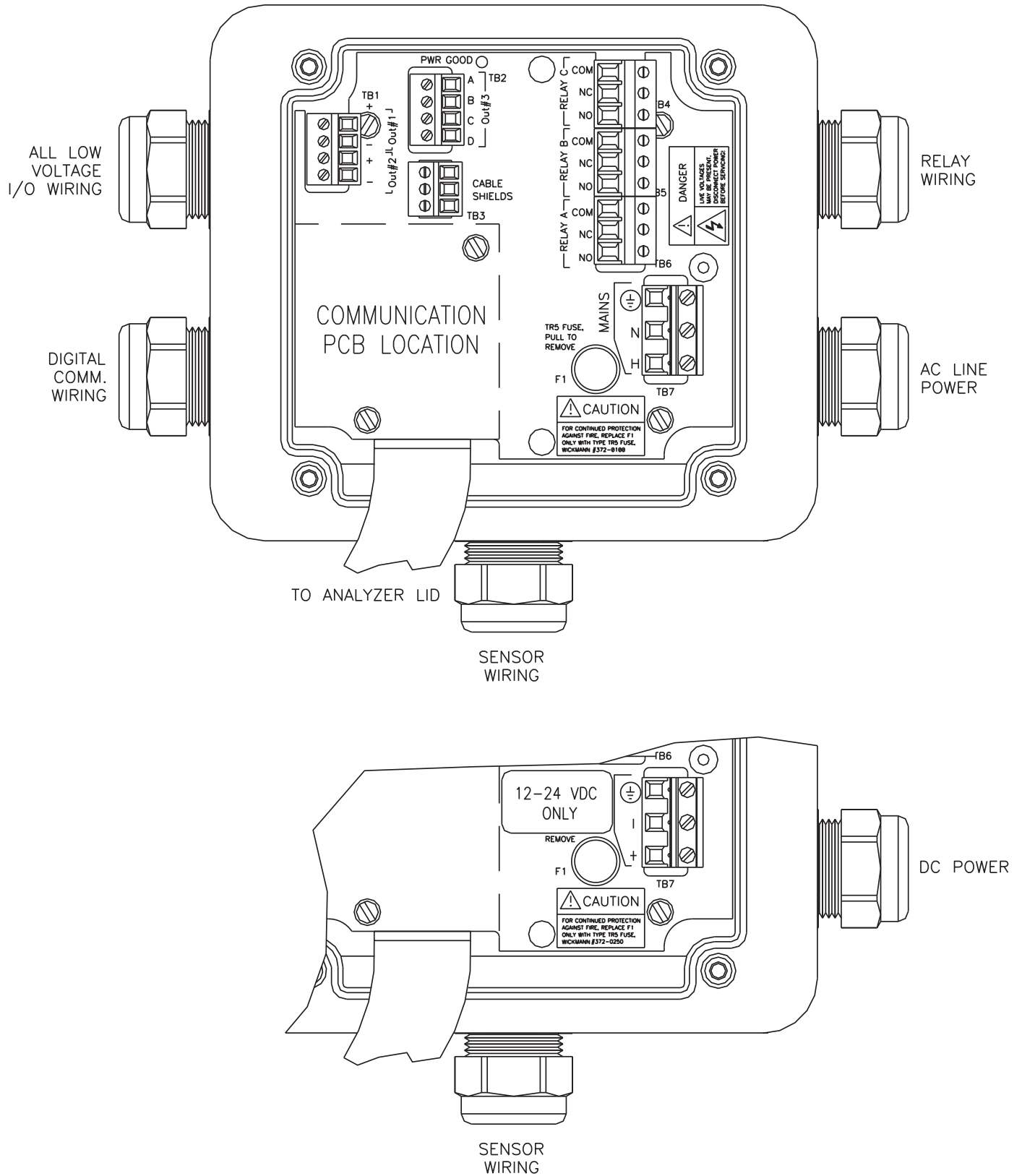


Figure 11: AC Power Connections

Relay Connection

Three SPDT relays are provided on the power supply board. None of the relay contacts are powered. The user must supply the proper power to the contacts. For applications that require the same switched operating voltage as the Q46 (115 or 230 V), power may be jumped from the power input terminals at TB7. Relay wiring is connected at TB4, TB5, and TB6 as shown below. Note that the relay contact markings are shown in the NORMAL mode. Programming a relay for “Failsafe” operation reverses the NO and NC positions in [Figure 12](#).

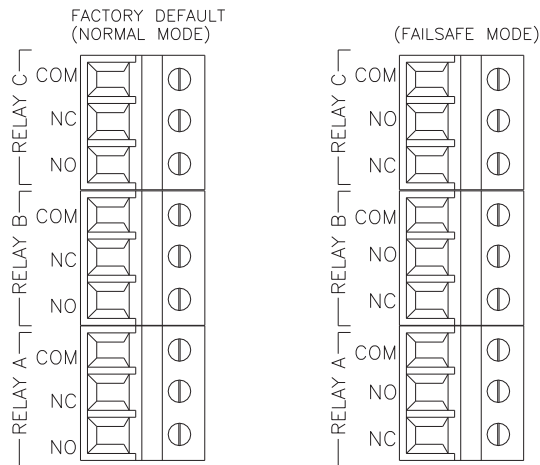


Figure 12: Relay Contacts

Optional Output/Relay Connection

TB2 is used to connect the optional 3-relay card (see [Figure 13](#)) OR the optional third analog output Out#3 (see [Figure 14](#)). The Q46 can be configured for only one of these features, and the hardware for either option must be factory installed. The 3-relay option is required for systems with the automatic sensor cleaning system. Note that the optional 3 relays are for switching LOW POWER DC ONLY.

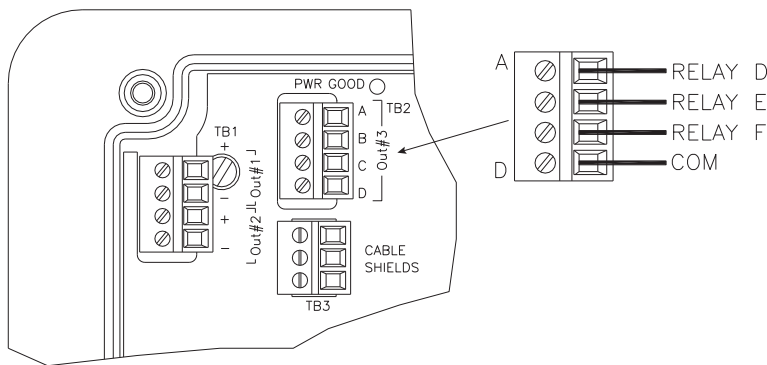


Figure 13: Optional Low Power Relay Wiring

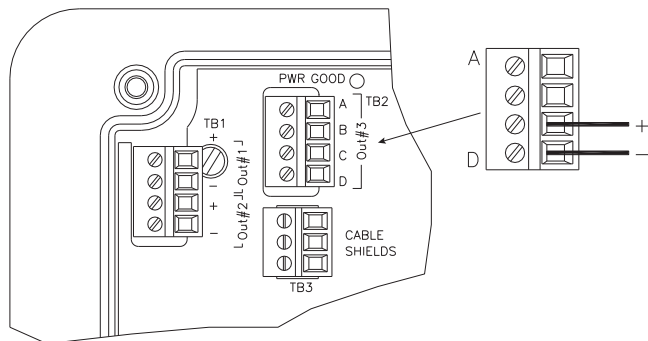


Figure 14: Optional 3rd Analog Output Wiring

Direct Sensor Wiring

Sensor connections are made to a terminal block mounted on the front section of the monitor. The sensor cable can be quickly connected to the Q46 terminal strip by matching the wire colors on the cable to the color designations on the label in the monitor. Route signal cable away from AC power lines, adjustable frequency drives, motors, or other noisy electrical signal lines. Do not run sensor or signal cables in conduit that contains AC power lines or motor wiring.

NOTE: There are 3 additional wires in the sensor cable that should not be connected. These wires allow sensor firmware to be upgraded should that be needed in the future.

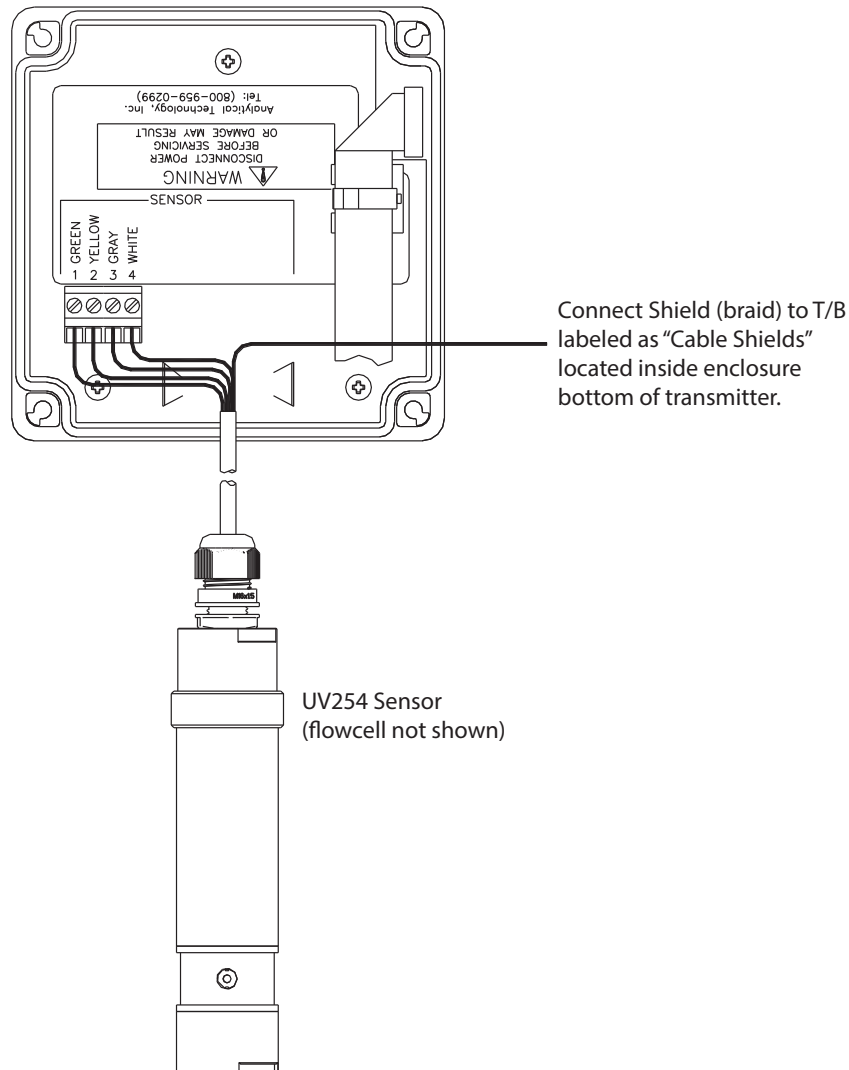


Figure 15: Sensor connection

Remote Sensor Wiring

Generally it is best to keep the sensor close to the monitor. However, it is possible to mount the sensor as much as 100 feet from the monitor using a junction box and additional interconnect cable.

Note that the wire used for remote sensor connection does not contain the same conductor colors as the sensor wire. The wiring diagram below provides the information needed to connect a remote sensor using no. 07-0100 junction box.

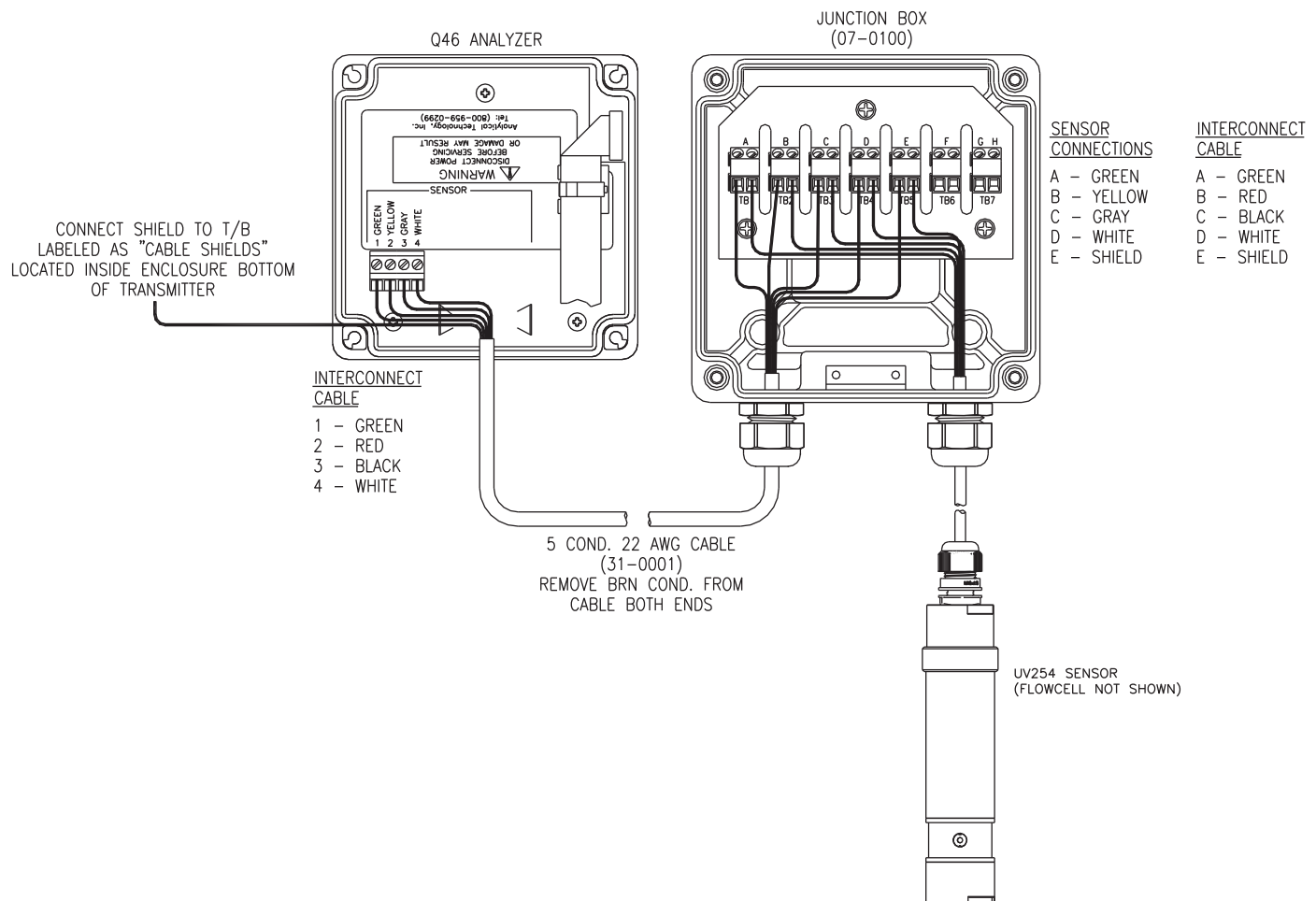


Figure 16: Remote sensor wiring

CONFIGURATION

User Interface

The user interface for the Q46 Series instrument consists of a custom display and a membrane keypad. All functions are accessed from this user interface (no internal jumpers or pots, for example).

When power is first applied, you may notice that the display does not come on immediately. This is normal. There is a 5-second start routine that runs before the display illuminates. In addition, you will notice an occasional “flicker” of the display, occurring about twice an hour. This is the result of a display processor refresh program that insures long-term display integrity, and will always occur during normal operation of the instrument.

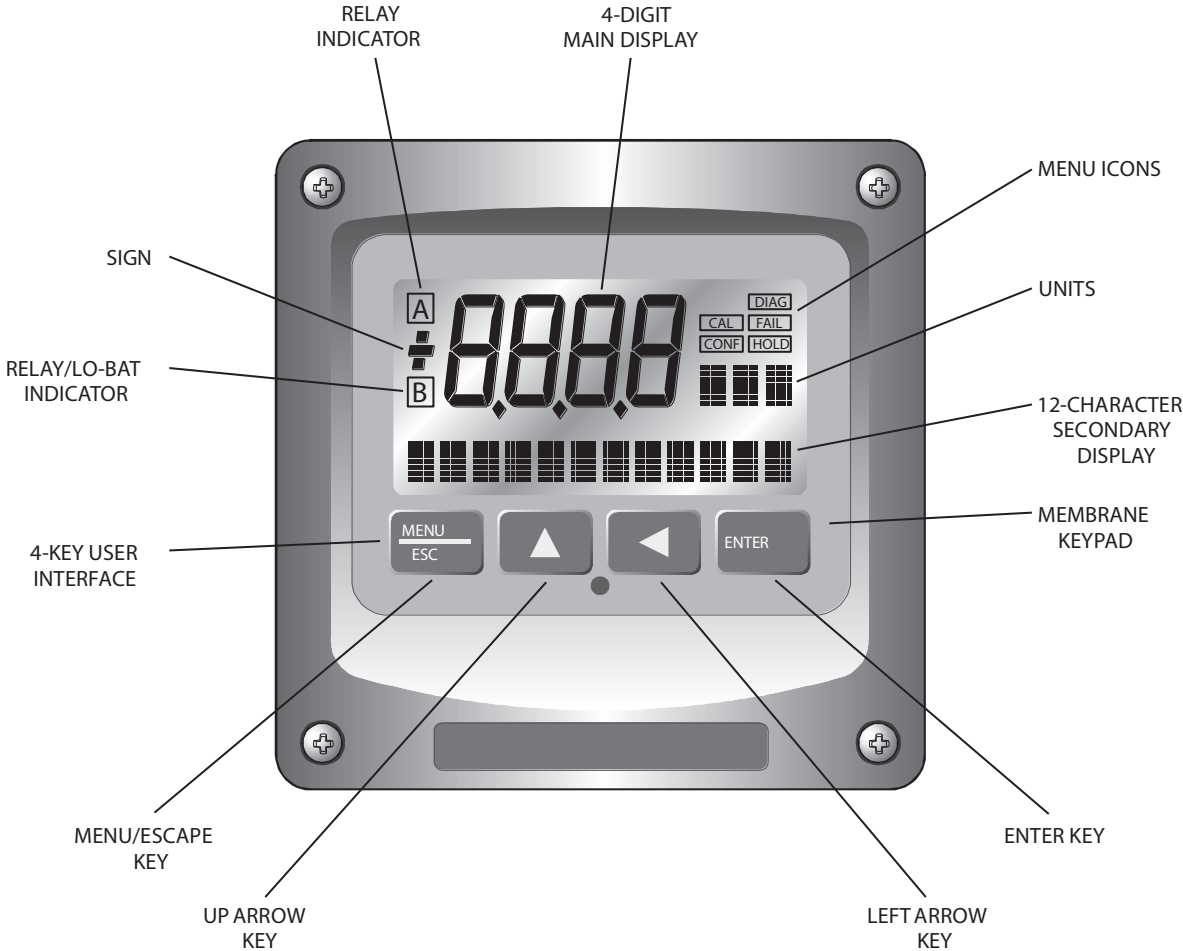


Figure 17: User Interface

Keys

All user configurations occur through the use of four membrane keys. These keys are used as follows:

MENU/ESC	To scroll through the menu section headers or to escape from anywhere in software. The escape sequence allows the user to back out of any changes in a logical manner. Using the escape key aborts all changes to the current screen and backs the user out one level in the software tree. The manual will refer to this key as either MENU or ESC, depending upon its particular function. In the battery-powered version of the Q46, this is also the ON button.
UP (arrow)	To scroll through individual list or display items and to change number values.
LEFT (arrow)	To move the cursor from right to left during changes to a number value.
ENTER	To select a menu section or list item for change and to store any change.

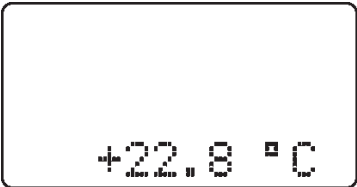
Display

The large custom display provides clear information for general measurement use and user configuration. There are three main areas of the display: the main parameter display, the secondary message line, and the icon area.

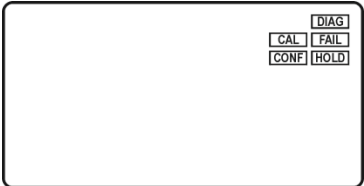
Main Parameter During normal operation, the main parameter display indicates the present process input with sign and units. This main display may be configured to display any of the main measurements that the system provides. During configuration, this area displays other useful setup information to the user.



Lower Line During normal operation, the lower line of the display indicates user-selected secondary measurements that the system is making. This also includes calibration data from the last calibration sequence and the transmitter model number and software version. During configuration, the lower line displays menu items and setup prompts to the user. Finally, the lower line will display error messages when necessary. For a description of all display messages, see ["Display Messages" on page 40](#).



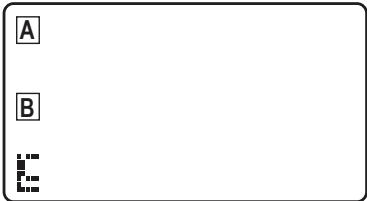
Icon Area The icon area contains display icons that assist the user in setup and indicate important states of system functions. The CAL, CONFIG, and DIAG icons are used to tell the user what branch of the software tree the user is in while scrolling through the menu items. This improves software map navigation dramatically. Upon entry into a menu, the title is displayed (such as CAL), and then the title disappears to make way for the actual menu item. However, the icon stays on.



HOLD The HOLD icon indicates that the current output of the transmitter has been put into output hold. In this case, the output is locked to the last input value measured when the HOLD function was entered. HOLD values are retained even if the unit power is cycled.

FAIL The FAIL icon indicates that the system diagnostic function has detected a problem that requires immediate attention. This icon is automatically cleared once the problem has been resolved.

Relay Area A/B The relay area contains two icons that indicate the state of the system relays. Relay C is normally configured for FAIL indication, so it is only displayed on the lower MEASURE display line.



Software

The software of the Q46T is organized in an easy to follow menu-based system. All user settings are organized under five menu sections: Measure, Calibration [CAL], Configuration [CONFIG], Control [CONTROL] and Diagnostics [DIAG].

NOTE: The default Measure Menu is display-only and has no menu icon.

Software Navigation

Within the CAL, CONFIG, CONTROL, and DIAG menu sections is a list of selectable items. Once a menu section (such as CONFIG) has been selected with the MENU key, the user can access the item list in this section by pressing either the ENTER key or the UP arrow key. The list items can then be scrolled through using the UP arrow key. Once the last item is reached, the list wraps around and the first list item is shown again. The items in the menu sections are organized such that more frequently used functions are first, while more permanent function settings are later in the list. See ["Software Map" on page 24](#) for a visual description of the software.

Each list item allows a change to a stored system variable. List items are designed in one of two forms: simple single variable, or multiple variable sequences. In the single variable format, the user can quickly modify one parameter - for example, changing temperature display units from °F to °C. In the multiple variable sequence, variables are changed as the result of some process.

Any data that may be changed will be flashing. This flashing indicates user entry mode and is initiated by pressing the ENTER key. The UP arrow key will increase a flashing digit from 0...9. The LEFT arrow key moves the flashing digit from right to left. Once the change has been completed, pressing ENTER again stores the variable and stops the flashing. Pressing ESC aborts the change and also exits user entry mode.

The starting (default) screen is always the Measure Menu. The UP arrow key is used to select the desired display. From anywhere in this section the user can press the MENU key to select one of the four Menu Sections.

The UP arrow icon next to all list items on the display is a reminder to scroll through the list using the UP arrow key.

To select a list item for modification, first select the proper menu with the MENU key. Scroll to the list item with the UP arrow key and then press the ENTER key. This tells the system that the user wishes to perform a change on that item. For single item type screens, once the user presses the ENTER key, part or all of the variable will begin to flash, indicating that the user may modify that variable using the arrow keys. However, if the instrument is locked, the transmitter will display the message **Locked!** and will not enter user entry mode. The instrument must be unlocked by entering the proper code value to allow authorized changes to user entered values. Once the variable has been reset, pressing the ENTER key again causes the change to be stored and the flashing to stop. The message **Accepted!** will be displayed if the change is within pre-defined variable limits. If the user decides not to modify the value after it has already been partially changed, pressing the ESC key aborts the modification and returns the entry to its original stored value.

In a menu item which is a multiple variable sequence type, once the ENTER key is pressed there may be several prompts and sequences that are run to complete the modification. The ESC key can always be used to abort the sequence without changing any stored variables.

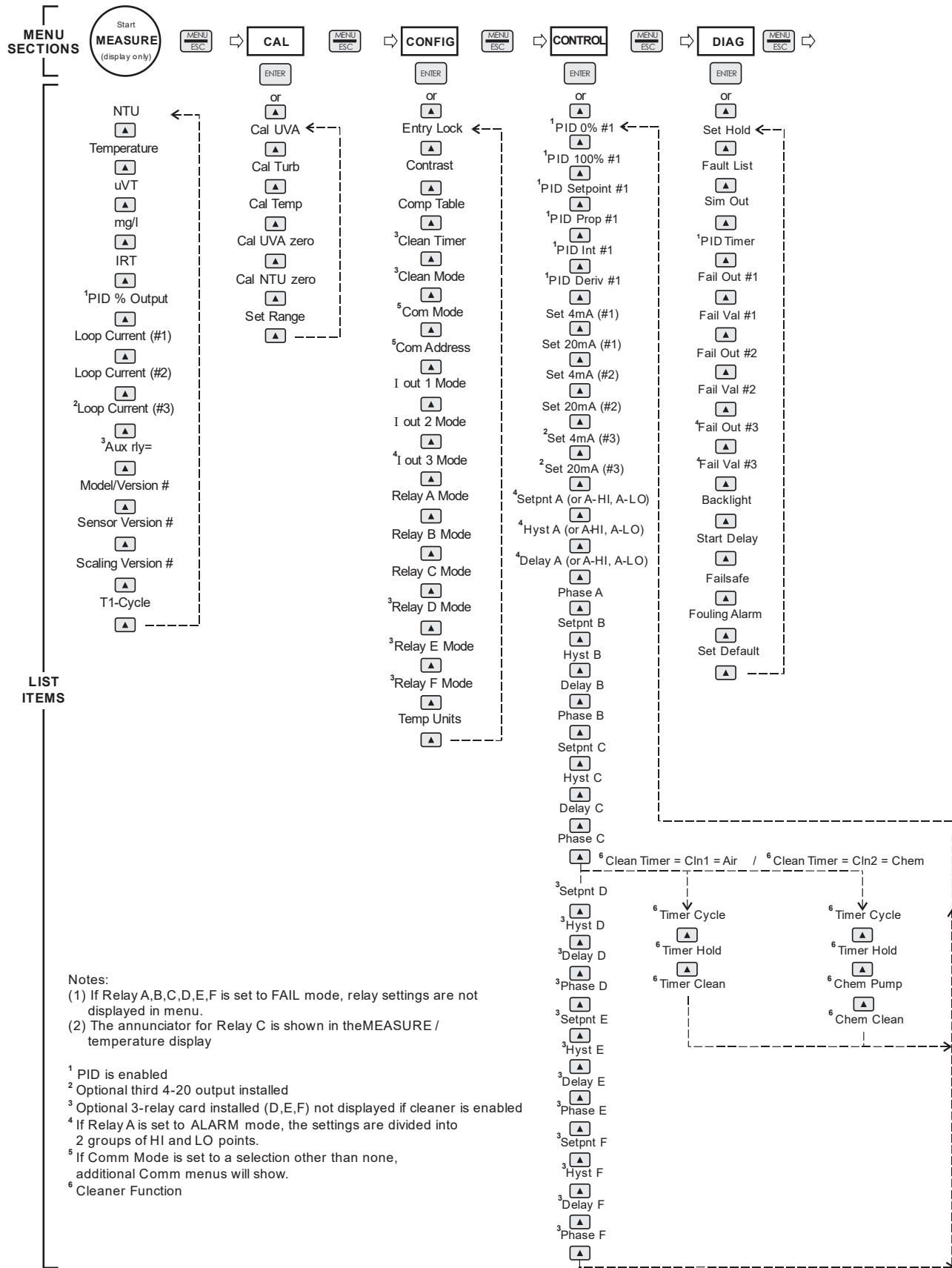


Figure 18: Software Map

Measure Menu [MEASURE]

The default menu for the system is the display-only menu MEASURE. This menu is a display-only measurement menu, and has no changeable list items. When left alone, the instrument will automatically return to this menu after approximately 30 minutes. While in the default menu, the UP arrow allows the user to scroll through the secondary variables on the lower line of the display. A brief description of the fields in the basic transmitter version is as follows:

TRANSMITTER MEAS SCREENS:

XX.X NTU	Displays the measured turbidity value. Sensors contain both UV and IR sensors. IR sensors are used to measure 90 degree scatter turbidity.
25.7°	Temperature display. Can be displayed in °C or °F, depending on user selection. A small “m” on the left side of the screen indicates the transmitter has automatically jumped to a manual 25C setting due to a failure with the temperature signal input.
XX.X UVT	Displays the UV Transmittance value, which another way of expressing UV measurement. As UVA increases, UVT will decrease but they are not linear functions.
XX.X mg/l	This display shows the equivalent dissolved organic carbon related to the UVA measurement. It is based on a default table programmed in instrument memory.
XX.X IRT	Displays the value of Infrared indicates the background ambient light level detected by the sensor. This value is not meaningful when the sensor is inside the flowcell, but is useful when submersible turbidity sensors are used in open channels. Extremely high ambient light levels will trigger an alarm.
100% 20.00 mA	PID Status screen (if enabled.) Shows the present controller output level on left, and actual transmitter current on the right. The controller can be placed in manual while viewing this screen by pressing and holding the ENTER key for 5 seconds until a small flashing “m” appears on the screen. At that point the controller output can be adjusted up or down using the UP and LEFT arrow keys. To return to automatic operation, press and hold the ENTER key for 5 seconds and the “M” will disappear.
#1 4.00 mA	Analyzer output current # 1 (normally NTU)
#2 12.00 mA	Analyzer output current # 2 (normally Temperature)
#3 20.00 mA	Analyzer output current # 3 (if option included.)
Aux relay= D,E,F	Auxiliary relay annunciators (if option included.)
Q46UVA vX.XX	Transmitter software version number.
UV-1 VerXXXX	Sensor firmware version number.
I/F vX.XX	Transmitter scaling card firmware version number.
Tcyc 24.0 hr	Automatic sensor cleaning frequency (displayed only when enabled in CONFIG Menu.

NOTE: A display test (all segments ON) can be actuated by pressing and holding the ENTER key while viewing the model/ version number on the lower line of the display.

The MEASURE screens are intended to be used as a very quick means of looking up critical values during operation or troubleshooting.

Calibration Menu [CAL]

The calibration menu contains items for frequent calibration of user parameters. There are five items in this list: Cal Span, Cal Temp, Cal Zero, Cal Signal, and Set Range.

Cal UVA	Provides adjustment of the UV absorption value based on a standard solution. This function is not normally required but may be used after 6...12 months to compensate for minor optical component drift. See "Calibration" on page 33 for more details.
Cal Turb	Provides adjustment of the turbidity value to match the standard being used for calibration. A 20 NTU standard is recommended. See "Calibration" on page 33 for more details.
Cal Temp	The temperature calibration function allows the user to adjust the offset of the temperature response by a small factor of $\pm 5^{\circ}\text{C}$.
Cal UVAZero	Provides adjustment of the UV absorption sensor zero, normally using distilled water as a reference. See "Calibration" on page 33 for more details.
Cal NTUZero	Provides adjustment of the turbidity sensor zero, normally using distilled water as a reference. See "Calibration" on page 33 for more details.
Set Range	Provides selection of the turbidity operating range. Ranges of 0...40, 0...400, or 0...4000 NTU can be selected. The default range is 0...40, which is suitable for most filter outlet applications.

Configuration Menu [CONFIG]

The Configuration Menu contains all of the general user settings:

Entry Lock	This function allows the user to lock out unauthorized tampering with instrument settings. When locked, all settings may be viewed but they cannot be modified. The Entry Lock is a toggle-type setting; that is, entering the correct code will lock the transmitter and entering the correct code again will unlock it. The code is preset at a fixed value. Press ENTER to initiate user entry mode and the first digit will flash. Use arrow keys to modify value. See "Spare Parts" on page 42 for the Q46T lock/unlock code. Press ENTER to toggle lock setting once code is correct. Incorrect codes do not change state of lock condition.
Contrast	This function sets the contrast level for the display. The custom display is designed with a wide temperature range and contains an LED back light so that the display can be seen in the dark. Press ENTER to initiate user entry mode, and the value will flash. Use arrow keys to modify the value; range is 0...8 (0 being lightest). Press ENTER to update and store the new value.
Comp Table	Allows modification of the table that converts UVA measurements into DOC values in mg/l. Default table may be adjusted using UVA vs DOC measurements derived by the user.
Clean Timer	Allows activation of an automatic sensor cleaning system.
Clean Mode	Allows selection of the type of cleaning system in use. Options are Cln1- Air for air cleaning and Cln2-Chem for the chemical cleaning system.
Com Mode	Sets digital communication mode of analyzer. Optional digital communication card must be plugged into the power supply slot for this function to work. Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify the desired value; selections include 1-None, 2- P-DP for Profibus DP, 3 – Modbus RTU, 4 – Ethernet IP, or 5 – Modbus TCP/IP. Press ENTER to store the new value.
Com Address	Sets bus address for digital communication mode of analyzer. Optional digital communication card must be plugged into the power supply slot for this function to work. Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify the desired value. Range is 1...125. Press ENTER to store the new value.
Iout#1 Mode	This function sets analog output #1 to either track UVA or enables the PID controller to operate on the UVA input. Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify the desired value; selections include 1- UVA or 2-PID for PID control. Press ENTER to store the new value. Note that output 1 is assigned to the main display variable. If the unit is configured for UVT or DOC as the main display, then output 1 will track that measurement.

lout#2 Mode	This function sets analog output #2 for either temperature (default), or NTU turbidity, or for DOC/TOC Units (mg/l. Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify the desired value; selections include 1-C/F for temperature, 2- NTU, 3- UVA or 4-mg/l DOC. Press ENTER to store the new value.
lout#3 Mode	OPTIONAL. This function sets analog output #3 for either UVT, NTU, UVA, or DOC. Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify the desired value; selections include 1- UVT, 2-NTU, 3-UVA, or 4-mg/l DOC. Press ENTER to store the new value.
Rly A Mode	Relay A can be used in three different ways: as a setpoint control, as a fail alarm, or as a HI-LO alarm band. The three settings for Rly A Mode are CON , FAIL and AL . The CON setting enables normal control operation for Relay A, with settings for setpoint, hysteresis, delay and phasing appearing in the CONTROL menu automatically. See Figure 22 on page 41 for further details. The AL setting allows two setpoints to be selected for the same relay, producing a HI-LO alarm band. In this mode, Relay A will trip inside or outside of the band, depending upon the Phase selected. See Figure 22 on page 41 for further details. The FAIL setting enables the fail alarm mode for Relay A. Relay A will then trip on any condition that causes the FAIL icon to be displayed on the LCD. Using this mode allows the User to send alarm indications to other remote devices.
Relay B Mode	Relay B can be used in two ways: as a setpoint control or as a fail alarm. The settings for Relay B Mode are CON , FAIL and they are the same as those modes in relay A. *Relay D Mode OPTIONAL. Relays D, E, and F can be used in two ways: as a setpoint control, or as a fail alarm. The two settings for Relay D, E, & F Mode are CON and FAIL . This function sets the display units for temperature measurement. Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify the desired display value. The choices are °F and °C. Press ENTER to store the new value. *Relay E Mode *Relay F Mode Temp Units
Relay C Mode	
*Relay D Mode	
*Relay E Mode	
*Relay F Mode	
Temp Units	

Control Menu [CONTROL]

The Control Menu contains all of the output control user settings. Note that PID menu items will not appear unless output 1 is configured for PID mode in the CONFIG menu.

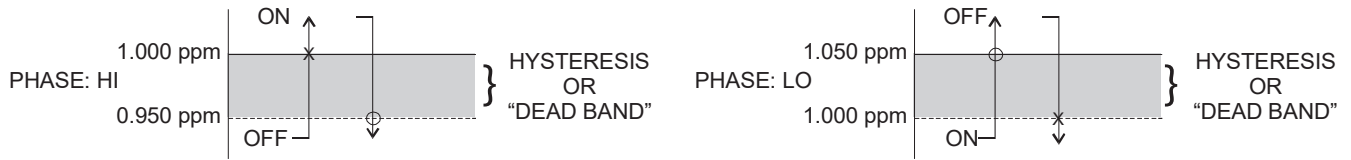
Set PID 0% Set PID 100% [lout1=PID]	If the PID is enabled, this function sets the minimum and maximum controller end points. Unlike the standard 4...20 mA output, the controller does not “scale” output values across the endpoints. Rather, the endpoints determine where the controller would normally force minimum or maximum output in an attempt to recover the setpoint (even though the controller can achieve 0% or 100% anywhere within the range.) If the 0% point is lower than the 100% point, then the controller action will be “reverse” acting. That is, the output of the controller will increase if the measured value is less than the setpoint, and the output will decrease if the measured value is larger than the setpoint. Flipping the stored values in these points will reverse the action of the controller to “direct” mode. The entry value is limited to a value within the range specified in “Set Range”, and the 0% and the 100% point must be separated by at least 1% of this range Use the LEFT arrow key to select the first digit to be modified. Then use the UP and LEFT arrow keys to select the desired numerical value. Press ENTER to store the new value.
PID Setpnt [lout1=PID]	The measured value which the controller is attempting to maintain by adjusting output value. It is the nature of the PID controller that it never actually gets to the exact value and stops. The controller is continually making smaller and smaller adjustments as the measured value gets near the setpoint.
PID Prop [lout1=PID]	Proportional gain factor. The proportional gain value is a multiplier on the controller error (difference between measured value and setpoint value.) Increasing this value will make the controller more responsive.
PID Int [lout1=PID]	Integral is the number of “repeats-per-minute” of the action of the controller. It is the number of times per minute that the controller acts on the input error. At a setting of 2.0 rpm, there are two repeats every minute. If the integral is set to zero, a fixed offset value is added to the controller (manual reset.) Increasing this value will make the controller more responsive.

PID Deriv [Iout1=PID]	Derivative is a second order implementation of Integral, used to suppress “second-order” effects from process variables. These variables may include items like pumps or mixers that may have minor impacts on the measured value. The derivative factor is rarely used in water treatment process, and therefore, it is best in most cases to leave it at the default value. Increasing this value will make the controller more responsive.
Set 4 mA Set 20 mA [Iout1=UVA]	These functions set the main 4...20 mA output for the transmitter. The 20 mA output value for UVA should not be set higher than 1.300. The value stored for the 4 mA point may be higher or lower than the value stored for the 20 mA point. Use the LEFT arrow key to select the first digit to be modified. Then use the UP and LEFT arrow keys to select the desired numerical value. Press ENTER to store the new value.
*Set 4 mA #2 *Set 20 mA #2 [temp/D.O.]	These functions set the second 4...20 mA output for the transmitter. The output may be set to track temperature (default), Turbidity (NTU), UVA or DOC (mg/l). The values stored for the 4 mA point may be higher or lower than the value stored for the 20 mA point. The 4 mA and the 20 mA point must be at least 20 units away from each other. Press ENTER to initiate user entry mode, and the value will flash. Use arrow keys to modify value. Press ENTER to store the new value.
*Set 4 mA #3 *Set 20 mA #3 [temp/NTU/Aux]	OPTIONAL. These functions set the optional third 4...20 mA output for the analyzer. The output may be set to track UVT, NTU, UVA, or DOC. The values stored for the 4 mA point may be higher or lower than the value stored for the 20 mA point. The 4 mA and the 20 mA point must be at least 20 units away from each other. Press ENTER to initiate user entry mode, and the value will flash. Use arrow keys to modify value. Press ENTER to store the new value.
*A Setpoint	This function establishes the trip point for relay A. The entry value is limited to a value within the range specified in “Set Range”. Use the LEFT arrow key to select the first digit to be modified. Then use the UP and LEFT arrow keys to select the desired numerical value. Press ENTER to store the new value.
*A Hysteresis	This function establishes the hysteresis, or “deadband”, for Relay A. Hysteresis is most often used to control relay chattering; however, it may also be used in control schemes to separate the ON/OFF trip points of the relay. Press ENTER to initiate user entry mode, and the value will flash. Use the arrow keys to modify value. Press ENTER to store the new value.
*A Delay	This function places an additional amount of time delay on the trip point for relay A. This delay is in addition to the main delay setting for the controller. The entry value is limited to a value between 0 and 999 seconds. Press ENTER to initiate user entry mode, and the value will flash. Use arrow keys to modify value; range is 0 to 999 seconds. Press ENTER to store the new value.
*A Phasing	This function establishes the direction of the relay trip. When phase is HI, the relay operates in a direct mode. Therefore, the relay energizes and the LCD indicator illuminates when the oxygen value exceeds the setpoint. When the phase is LO, the relay energizes and the LCD indicator illuminates when the oxygen level drops below the setpoint. The failsafe setting does have an impact on this logic. The description here assumes the failsafe setting is OFF. Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify the desired value; selections include HI for direct operation or LO for reverse operation. Press ENTER to store the new value.

See [Figure 19 on page 29](#) for a visual description of a typical control relay application.

When value rises to ≥ 1.000 ppm, relay closes.

When value rises to ≥ 1.050 ppm, relay opens.



When value falls to ≤ 0.950 ppm, relay opens.

When value falls to ≤ 1.000 ppm, relay closes.

Settings: Setpoint: 1.000 ppm
Hyst: 0.050
Delay: 000
Failsafe: OFF

Figure 19: Control relay example, hysteresis & phase options

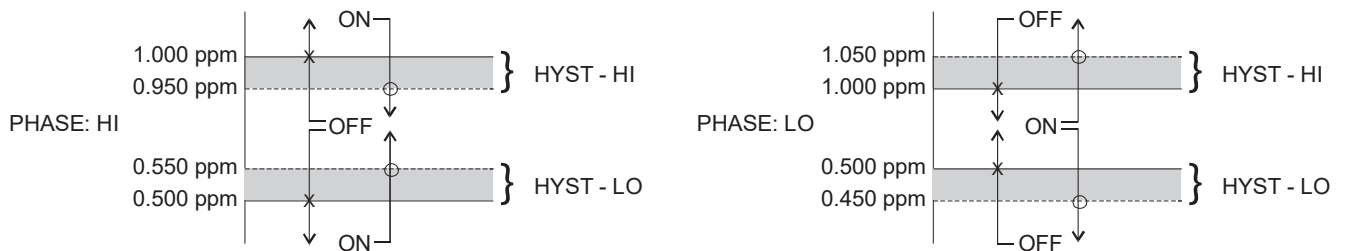
*Setpnt A-HI
*Hyst A-HI
*Delay A-HI
*Setpnt A-LO
*Hyst A-LO
*Delay A-LO

If Relay A Mode is set to Alarm Mode, **AL**, then the following settings will appear in the Config Menu list automatically. In this mode, two setpoints can be selected on the same relay, to create an alarm band. Phase HI selection causes the relay to energize outside of the band, and Phase LO causes the relay to energize inside of the band. This feature enables one relay to be used as a control relay while the other is used as a HI-LO Alarm relay at the same time. Setpoint A-LO must be set lower than Setpoint A-HI. When AL mode is first selected, Setpoint A-LO is defaulted to 0.

Figure 20 is a visual description of a typical alarm relay application.

When value rises to ≥ 1.000 ppm, relay closes, until value falls back to ≤ 0.950 ppm.

When value falls to ≤ 1.000 ppm, relay closes, until rises back to ≥ 1.050 ppm.



When value falls to ≤ 0.500 ppm, relay closes until value rises to ≥ 0.550 ppm

When value rises to ≥ 0.500 , relay closes until value falls to ≤ 0.450

Settings: Setpoint A-HI: 1.000 ppm Setpoint A-LO: .500 ppm
Hyst A-HI: 0.050 Hyst A-LO: .050
Delay A-HI: 000 Delay A-LO: 000

Figure 20: Alarm relay example

***B Setpoint**
***B Hysteresis**
***B Delay**
***B Phasing**

If Relay B Mode is set to **CON**, then Relay B will function identically to Relay A. Relay B settings appear in the CONFIG menu list automatically.

C Setpoint
C Hysteresis
C Delay
C Phasing

If Relay C Mode is set to **CON** (see Relay C Mode), then Relay C will function identically to Relay A. Relay C settings appear in the CONFIG menu list automatically.

D,E,F Setpoint
D,E,F Hyster
D,E,F Delay
D,E,F Phasing

If Relay D, E, or F Mode is set to **CON** (see Relay D,E,F Modes), then the Relay will function identically to Relay A. Relay settings appear in the CONFIG menu list automatically.

Timer Cycle

When the Clean Timer is set to ON in the Config menu, this routine selects the cleaning frequency. Range is 1...999 hours but cleaning should not be done more than every 8 hours, especially when chemical cleaning is used.

Timer Hold

This routine sets the amount of time signals will be held after completion of a cleaning cycle. Range is 1...999 minutes.

Timer Clean or Chem Pump

If Cln1 was selected, Timer Clean allows programming of the number of air cleaning pulses delivered during a clean cycle. Range is 1...9 and default is 3. If Cln2 was selected, Chem Pump controls the run time for the chemical feed pump. Range is 1...99 seconds and default is 30 seconds.

Chem Clean

For chemical cleaning systems, this routine sets the amount of time that cleaning chemical is left in the flow chamber. Range is 1...99 minutes and default is 15 minutes.

Diagnostics Menu [DIAG]

The diagnostics menu contains all of the user settings that are specific to the system diagnostic functions, as well as functions that aid in troubleshooting application problems.

- Set Hold** The Set Hold function locks the current loop output values on the present process value and holds relays in current status. This function can be used prior to calibration, or when removing the sensor from the process, to hold the output in a known state. Once HOLD is released, the outputs return to their normal state of following the process input. The transfer out of HOLD is bumpless on the both analog outputs - that is, the transfer occurs in a smooth manner rather than as an abrupt change. An icon on the display indicates the HOLD state, and the HOLD state is retained even if power is cycled. Press ENTER to initiate user entry mode, and entire value will flash. Use the UP arrow key to modify the desired value, selections are ON for engaging the HOLD function, and OFF to disengage the function. Press ENTER to store the new value.
- The Set Hold function can also hold at an output value specified by the user. To customize the hold value, first turn the HOLD function on. Press the ESC key to go to the DIAG Menu and scroll to Sim Output using the UP arrow key. Press ENTER. Follow the instructions under Sim Output (see following page).
- Fault List** The Fault List screen is a read-only screen that allows the user to display the cause of the highest priority failure. The screen indicates the number of faults present in the system and a message detailing the highest priority fault present. Note that some faults can result in multiple displayed failures due to the high number of internal tests occurring. As faults are corrected, they are immediately cleared.
- Since faults are not stored, they are immediately removed if power is cycled. If the problem causing the fault still exists, faults will be displayed again after power is re-applied and a period of time elapses during which the diagnostic system re-detects them. An exception to this rule is calibration failure. When a calibration fails, no corrupt data is stored. After 30 minutes or if power to the transmitter is cycled, the failure for calibration will be cleared until calibration is attempted again. If the problem still exists, the calibration failure will re-occur. Press ENTER to initiate view of the highest priority failure. The display will automatically return to normal after a few seconds.
- PID Timer** This function sets a timer to monitor the amount of time the PID controller remains at 0% or 100%. This function only appears if the PID controller is enabled. If the timer is set to 0000, the feature is effectively disabled. If the timer value is set to any number other zero, a FAIL condition will occur if the PID controller remains at 0% or 100% for the timer value. If one of the relays is set to FAIL mode, this failure condition can be signaled by a changing relay contact.
- Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify desired value; range of value is 0-9999 seconds. Press ENTER to store the new value.
- Sim Out** The Sim Out function allows the user to simulate the specific analog output value. The user enters a value directly onto the screen, and the output responds as if it were actually receiving the signal from the sensor. This allows the user to check the function of attached monitoring equipment during set-up or troubleshooting. Escaping this screen returns the unit to normal operation. Press ENTER to initiate the user entry mode, and the right-most digit of the value will flash. Use arrow keys to modify desired value.
- The starting display value will be the last read value of the input. The output will be under control of the SIM screen until the ESC key is pressed.
- Note: If the HOLD function is engaged before the Sim Output function is engaged, the simulated output will remain the same even when the ESC key is pressed. Disengage the HOLD function to return to normal output.

Fail Out #1	This function enables the user to define a specified value that the main current output will go to under fault conditions. When the Relay Option Board is installed, the display will read Fail Out #1 . When enabled to ON , the output may be forced to the current value set in Fail Val (next item.) With the Fail Out setting of ON, and a Fail Val setting of 6.5 mA, any alarm condition will cause the current loop output to drop outside the normal operating range to exactly 6.5 mA, indicating a system failure that requires attention. Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify desired value; selections are ON , OFF . Press ENTER to store the new value.
Fail Val #1	Sets the output failure value for lout#1. When Fail Out above is set to ON , this function sets value of the current loop under a FAIL condition. The output may be forced to any value between 4 and 20 mA. Press ENTER to initiate user entry mode, and the entire value will flash. Use the UP arrow key to modify desired value; selections are between 4 mA , and 20 mA . Press ENTER to store the new value.
Fail Out #2	This function sets the fail-mode of current loop output #2 under a FAIL condition. The settings and operation are identical to Fail Out for output #1.
Fail Val #2	This function sets the value of current loop output #2 under a FAIL condition. The settings and operation are identical to Fail Out for output #1.
*Fail Out #3	OPTIONAL. This function sets the fail-mode of current loop output #3 under a FAIL condition. The settings and operation are identical to Fail Out for output #1.
*Fail Val #3	OPTIONAL. This function sets the value of current loop output #3 under a FAIL condition. The settings and operation are identical to Fail Out for output #1.
Backlight	This function has three options. ON – On all the time, OFF – Off all the time, AL – Alarm (Default). This function flashes the backlight on and off whenever the Fail icon is displayed.
Start Delay	This function is designed to minimize control or alarm issues arising from temporary power loss. When power goes down, the monitor records the analog output values and the status of relays and PID functions. When power is restored, the analog values and relays will be held at the pre- power loss values for a defined period of time. This “start delay” may be programmed for periods from 0...9.9 minutes. This function is set to 0.0 minutes by default and must be activated by the user if desired by setting a positive time value.
*Failsafe	<p>This function allows the user to set the optional system relays to a failsafe condition. In a failsafe condition, the relay logic is reversed so that the relay is electrically energized in a normal operating state. By doing this, the relay will not only change state when, for example, an oxygen limit is exceeded, but also when power is lost to the controller.</p> <p>When failsafe is ON, the normally-open contacts of the relay will be closed during normal operation. In an attempt to make this configuration less confusing, the LCD icon logic is reversed with this setting, and the icon is OFF under this normal condition. Therefore, when the trip condition occurs, the closed N.O. contacts will be opened (relay de- energized), and the LCD icon will illuminate. In addition, a power fail would also cause the same contacts to open.</p>
Set Default	The Set Default function allows the user to return the instrument back to factory default data for all user settings or for just the calibration default. All user settings or the calibration settings are returned to the original factory values. Hidden factory calibration data remains unchanged. Press ENTER to initiate user entry mode and select either CAL or ALL with the UP arrow key. The default CAL routine will reset the zero offset to 0.0 nA and reset the slope to 100%. The default ALL routine will reset all program variables to factory default and should be used with care since it will change any user settings that were programmed in the field.

Hidden Menu

The Q46 UV/Turbidity Monitor has the ability to display the UV254 measurement in one of 3 ways. The main display can indicate UV Absorbance (UVA), UV Transmittance (UVT), or Dissolved Organic Carbon (DOC/TOC/COD) in mg/l. The selection of the main display parameter is located in a "Hidden Menu" that is not normally accessible.

Monitors are shipped with a default setting of UVA. To change to either UVT or DOC, proceed as follows:

1. Press Menu until the lower line indicates "DIAG MENU".
2. Press and hold the ◀ key for about 3 seconds. The lower line of the display will change to "Hidden Menu".
3. Press the ▲ key once and the lower line will indicate "Main Display" and the upper line will indicate "1 – UVA".
4. Press Enter and the display will flash. Use the ▲ key to select "2 – UVT" or "3 – DOC". Then press Enter to store your selection.
5. Press the Menu key a few times to return to the measure menu.

NOTE: All 3 variables will always be displayed. The large character part of the display will show whatever main variable you select but the other two variables will show up on the lower line display.

CALIBRATION

UVA/Turbidity Calibration

UVA monitors will start to measure aqueous samples as soon as power is applied and sample is flowing through the flow chamber. Calibration of a UVA sensor is normally not required. The UV absorbance curve is stored in the sensor and changes only very slowly. A zero adjustment should be done every 6 months to compensate for small changes in optical components with time. Span calibration of the UV channel is possible if you have the necessary standard.

The turbidity measurement in the sensor is adjusted at the factory and user adjustment is normally not required at startup. It is possible to adjust the zero of the turbidity measurement by filling the flowcell with distilled water and allowing the reading to stabilize. In this condition, the UV-254 reading will also normally read zero. Turbidity calibration is done using Formazin standards.

Supplied with the Q46 UVA system is a kit to conveniently fill the flowcell with distilled water or either UVA or turbidity standards. [Figure 9 on page 14](#) shows the arrangement of the sample delivery system.

Cal UVA Zero

Prior to attempting a zero calibration, it is best to remove the sensor from the flowcell and wipe the optical surfaces with a soft cloth to remove any buildup that could affect sensor performance. After the sensor is clean, put it back into the flowcell. If necessary, also clean the inside of the flowcell. Proceed as follows.

1. Refer to [Figure 9 on page 14](#). The 3-way valve supplied with the flowcell provides a convenient port for draining the flowcell and introducing a calibration standard into the flowcell. As part of the system, a 60 cc syringe and 18 in. of silicon tubing is provided for use in feeding standard into the flowcell.
2. Prior to feeding zero solution, the flowcell must be drained. Turn the yellow valve handle so that the OFF position is facing the sample inlet tube. This will stop sample flow and open the side port. Allow water from the flowcell to drain out this port. Note that you may need to disconnect the outlet tube for water to flow out of the open port.
3. With the syringe is a short length of tubing and a luer fitting that mates with the end of the syringe. Place the end of the tube into a bottle of distilled water and pull the plunger back to fill the syringe with 40...50 cc. Connect to the open side of the 3-way valve and depress the plunger to fill the flowcell with distilled water. Pull the plunger back out to suck out the distilled water and discard that first fill. Refill the syringe with fresh distilled water and fill the flowcell a second time. The first fill is meant to rinse out any contaminants that might remain in the flowcell.
4. Allow the sensor to sit in the distilled water for 5 minutes to get a stable reading. Once a stable reading is displayed, press the Menu key to get to the CAL menu. Use the ▲ key to access "Cal UVA Zero".
5. Press the Enter key and the message "Wait" will flash. Note that the message will flash for 3...4 minutes while the sensor makes all of its internal adjustments. If the zero offset is too high, a "Cal Fail" message will appear and the "Fail" icon on the display will light up.

6. Once the zero adjustment is complete, pull the syringe plunger back again to suck out the distilled water or simply move the valve to the normal operate position and allow the standard to flow to drain. If the outlet tube was disconnected, be sure to reconnect prior to turning on flow. At this point, a span check or calibration can be done if desired.

Cal UVA Span

Prior to attempting a span calibration, it is best to remove the sensor from the flowcell and wipe the optical surfaces with a soft cloth to remove any buildup that could affect sensor performance. After the sensor is clean, put it back into the flowcell. If necessary, also clean the inside of the flowcell. Proceed as follows.

1. [Figure 9 on page 14](#). The 3-way valve supplied with the flowcell provides a convenient port for draining the flowcell and introducing a calibration standard into the flowcell. As part of the system, a 60 cc syringe and 18 in. of silicon tubing is provided for use in feeding standard into the flowcell.
2. Prior to feeding span solution, the flowcell must be drained. Turn the yellow valve handle so that the OFF position is facing the sample inlet tube. This will stop sample flow and open the side port. Allow water from the flowcell to drain out this port. Note that you may need to disconnect the outlet tube for water to flow out of the open port.
3. With the syringe is a short length of tubing and a luer fitting that mates with the end of the syringe. Place the end of the tube into a bottle of UVA standard solution. UVA standard can be obtained from a third party.
4. Pull the plunger back to fill the syringe with 40...50 cc. Connect to the open side of the 3-way valve and depress the plunger to fill the flowcell.
5. Allow the sensor to sit in the UVA standard for 5 minutes to get a stable reading. Once a stable reading is displayed, press the Menu key to get to the CAL menu. Use the ▲ key to access "Cal UVA".
6. Press Enter and you will be prompted to enter the value of the standard you are using for calibration. Enter the value of your third-party standard solution. Use the ▲ key to adjust the flashing digit and the ◀ key to move to the next digit.
7. Press the Enter key and the message "Wait" will flash. Note that the message will flash for 3- 4 minutes while the sensor makes all of its internal adjustments. If the sensor is not able to adjust to the value entered, a "Cal Fail" message will appear and the "Fail" icon on the display will light up.
8. Once the span adjustment is complete, pull the syringe plunger back again to suck out the standard or simply move the valve to the normal operate position and allow the standard to flow to drain. If the outlet tube was disconnected, be sure to reconnect prior to turning on flow.

Cal Turbidity Zero

Adjustment of the turbidity measurement in the UVA/Turbidity sensor requires the use of distilled water for zero and a Formazin standard for span. To zero the sensor, proceed as follows. Note that the procedures for turbidity zero and turbidity span are essentially the same as for UVA zero and span adjustments.

1. Refer to [Figure 9 on page 14](#). The 3-way valve supplied with the flowcell provides a convenient port for draining the flowcell and introducing a calibration standard into the flowcell. As part of the system, a 60 cc syringe and a short length of silicon tubing is provided for use in feeding standard into the flowcell.
2. Prior to feeding zero solution, the flowcell must be drained. Turn the yellow valve handle so that the OFF position is facing the sample inlet tube. This will stop sample flow and open the side port. Allow water from the flowcell to drain out this port. Note that you may need to disconnect the outlet tube for water to flow out of the open port.
3. With the syringe is a short length of tubing and a luer fitting that mates with the end of the syringe. Place the end of the tube into a bottle of distilled water and pull the plunger back to fill the syringe with 40...50 cc. Connect to the open side of the 3-way valve and depress the plunger to fill the flowcell with distilled water. Pull the plunger back out to suck out the distilled water and discard that first fill. Refill the syringe with fresh distilled water and fill the flowcell a second time. The first fill is meant to rinse out any contaminants that might remain in the flowcell.
4. Press Menu to access the Cal Menu. Press the ↑ arrow to access "Cal NTU Zero".
5. Press the Enter key and you will be prompted enter a zero value for turbidity. Since turbidity values of exactly zero are only theoretical, enter a value of 00.04 NTU. Use the ↑ key to adjust the flashing digit and then use the ◀ key to move to the next digit. Press Enter and a "Wait" message will appear. As with the UVA adjustments, this message will flash for 3...4 minutes.
6. Once the zero adjustment is complete, pull the syringe plunger back again to suck out the distilled water or simply move the valve to the normal operate position and allow the standard to flow to drain. If the outlet tube was disconnected, be sure to reconnect prior to turning on flow. At this point, a span check or calibration can be done if desired.

Cal Turbidity Span

Adjustment of the turbidity measurement in the UVA/Turbidity sensor requires the use of a turbidity standard. Formazin standards are commonly used. Standards less than 10 NTU are not recommended. Standards from third party suppliers may be used for Q46 turbidity calibrations or solutions are available from ATi.

Stock turbidity solution of 4000 NTU is available from ATi (part #51-0077). This stock solution is good for 1 year and may be diluted to 20 NTU for calibration. A 1 liter volumetric flask and an accurate 5 ml pipette should be used for dilution of the 4000 NTU standard.

To set the span of the turbidity monitor, dilute the 4000 NTU stock solution by 200:1 to give you a 20 NTU standard or dilute the 400 NTU standard by 20:1. Once your standard is prepared, proceed as follows.

1. Refer to [Figure 9 on page 14](#). The 3-way valve supplied with the flowcell provides a convenient port for draining the flowcell and introducing a calibration standard into the flowcell. As part of the system, a 60 cc syringe and 18" of silicon tubing is provided for use in feeding standard into the flowcell.
2. Prior to feeding calibration solution, the flowcell must be drained. Turn the yellow valve handle so that the OFF position is facing the sample inlet tube. This will stop sample flow and open the side port. Allow water from the flowcell to drain out this port. Note that you may need to disconnect the outlet tube for water to flow out of the open port.
3. With the syringe is a short length of tubing and a luer fitting that mates with the end of the syringe. Place the end of the tube into a bottle of Turbidity standard solution. Pull the plunger back to fill the syringe with 40...50 cc. Connect to the open side of the 3-way valve and depress the plunger to fill the flowcell.
4. Allow the sensor to sit in the Turbidity standard for 5 minutes to get a stable reading. Once a stable reading is displayed, press the Menu key to get to the CAL menu. Use the **▲** key to access "Cal NTU".
5. Press Enter and you will be prompted to enter the value of the standard you are using for calibration. Enter either the value of your third party standard or the value from your ATi calibration solution. Use the **▲** key to adjust the flashing digit and the **◀** key to move to the next digit.
6. Press the Enter key and the message "Wait" will flash. Note that the message will flash for 3- 4 minutes while the sensor makes all of its internal adjustments. If the sensor is not able to adjust to the value entered, a "Cal Fail" message will appear and the "Fail" icon on the display will light up.
7. Once the span adjustment is complete, pull the syringe plunger back again to suck out the standard or simply move the valve to the normal operate position and allow the standard to flow to drain. If the outlet tube was disconnected, be sure to reconnect prior to turning on flow.

Temperature Calibration

The temperature calibration sequence is essentially a 1-point offset calibration that allows adjustments of approximately $\pm 5^{\circ}\text{C}$.

The sensor temperature may be calibrated on line, or the sensor can be removed from the process and placed into a known solution temperature reference. In any case, it is critical that the sensor be allowed to reach temperature equilibrium with the solution in order to provide the highest accuracy. When moving the sensor between widely different temperature conditions, it may be necessary to allow the sensor to stabilize as much as one hour before the calibration sequence is initiated. If the sensor is on-line, the user may want to set the output HOLD feature prior to calibration to lock out any output fluctuations.

1. Scroll to the CAL menu section using the MENU key and press ENTER or the UP arrow key.
2. Press the UP arrow key until **Cal Temp** is displayed.
3. Press the ENTER key. The message **Place sensor in solution then press ENTER** will be displayed. Move the sensor into the calibration reference (if it hasn't been moved already) and wait for temperature equilibrium to be achieved. Press ENTER to begin the calibration sequence.
4. The calibration data gathering process will begin. The message **Wait** will flash as data is accumulated and analyzed. The **°C** or **°F** symbol may flash periodically if the reading is too unstable.
5. The message **Adjust value - press ENTER** will be displayed, and the right-most digit will begin to flash, indicating that the value can be modified. Using the UP and LEFT arrow keys, modify the value to the known ref solution temperature. Adjustments up to $\pm 5^{\circ}\text{C}$ from the factory calibrated temperature are allowed. Press ENTER.

Once completed, the display will indicate **PASS** or **FAIL**. If the unit fails, the temperature adjustment may be out of range, the sensor may not have achieved complete temperature equilibrium, or there may be a problem with the temperature element. In the event of calibration failure, it is recommended to attempt the calibration again immediately.

PID CONTROLLER DETAILS

PID Description

PID control, like many other control schemes, is used in chemical control to improve the efficiency of chemical addition or control. By properly tuning the control loop that controls chemical addition, only the amount of chemical that is truly required is added to the system, saving money. The savings can be substantial when compared to a system which may be simply adding chemical at a constant rate to maintain some minimal addition under even the worst case conditions. The PID output controller is highly advantageous over simple control schemes that just utilize direct (proportional only) 4...20 mA output connections for control, since the PID controller can automatically adjust the "rate" of recovery based on the error between the setpoint and the measured value, which can be a substantial efficiency improvement.

The PID controller is basically designed to provide a "servo" action on the 4...20 mA output to control a process. If the user requires that a measured process stay as close as possible to a specific setpoint value, the controller output will change from 0...100% in an effort to keep the process at the setpoint. To affect this control, the controller must be used with properly selected control elements (valves, proper chemicals, for example) that enable the controller to add or subtract chemical rapidly enough. This is not only specific to pumps and valves, but also to line sizes and delays in the system.

This section is included to give a brief description of tuning details for the PID controller, and is not intended to be an exhaustive analysis of the complexities of PID loop tuning. Numerous sources are available for specialized methods of tuning that are appropriate for a specific application.

PID Algorithm

As most users of PID controllers realize, the terminology for the actual algorithm terms and even the algorithms themselves can vary between different manufacturers. This is important to recognize as early as possible, since just plugging in similar values from one controller into another can result in dramatically different results. There are various basic forms of PID algorithms that are commonly seen, and the implementation here is the most common version; The ISA algorithm (commonly referred to as the "ideal" algorithm).

$$\text{output} = P \left[e(t) + \frac{1}{I} \int e(t) dt + D \frac{de(t)}{dt} \right]$$

Where:

output =	controller output
P =	proportional gain
I =	integral gain
D =	derivative gain
t =	time
e(t) =	controller error (e=measured variable – setpoint)

Figure 21: ISA PID equation

The most notable feature of the algorithm is the fact the proportional gain term affects all components directly (unlike some other algorithms, like the "series" form.) If a pre-existing controller utilizes the same form of the algorithm shown above, it is likely similar settings can be made if the units on the settings are exactly the same. Be careful of this, as many times the units are the reciprocals of each other (that is, reps-per-min, sec-per-rep.)

PID stands for "proportional, integral, derivative." These terms describe the three elements of the complete controller action, and each contributes a specific reaction in the control process. The PID controller is designed to be primarily used in a "closed-loop" control scheme, where the output of the controller directly affects the input through some control device, such as a pump, valve, etc.

Although the three components of the PID are described in the setting area, here are more general descriptions of what each of the PID elements contribute to the overall action of the controller.

- P** Proportional gain. With no “I” or “D” contribution, the controller output is simply a factor of the proportional gain multiplied by the input error (difference between the measured input and the controller setpoint.) Because a typical chemical control loop cannot react instantaneously to a correction signal, proportional gain is typically not efficient by itself – it must be combined with some integral action to be useful. Set the P term to a number between 2...4 to start. Higher numbers will cause the controller action to be quicker.
- I** Integral gain. Integral gain is what allows the controller to eventually drive the input error to zero, providing accuracy to the control loop. It must be used to affect the accuracy in the servo action of the controller. Like proportional gain, increasing integral gain results in the control action happening quicker. Set the I term to a number between 3...5 to start (1...2 more than P). Like proportional gain, increasing the integral term will cause the controller action to be quicker.
- D** Derivative gain. The addition of derivative control can be problematic in many applications, because it greatly contributes to oscillatory behavior. In inherently slow chemical control process, differential control is generally added in very small amounts to suppress erratic actions in the process that are non-continuous, such as pumps and valves clicking on and off. However, as a starting point for chemical process control, its best to leave the “D” term set to 0.

Based on these descriptions, the focus on tuning for chemical applications really only involves adjustment of “P” and “I” in most cases. However, increasing both increases the response of the controller. The difference is in the time of recovery. Although combinations of high “P’s” and low “I” will appear to operate the same as combinations of low “P’s” and high “I’s”, there will be a difference in rate of recovery and stability. Because of the way the algorithm is structured, large “P’s” can have a larger impact to instability, because the proportional gain term impacts all the other terms directly. Therefore, keep proportional gain lower to start and increase integral gain to achieve the effect required.

Many of the classical tuning techniques have the user start with all values at 0, and then increase the P term until oscillations occur. The P value is then reduced to ½ of the oscillatory value, and the I term is increased to give the desired response. This can be done with the Q46D controller, with the exception that the I term should start no lower than 1.0.

If it appears that even large amounts of integral gain (>20) don’t appreciably increase the desired response, drop I back to about 1.0, and increase P by 1.00, and start increasing I again. In most chemical control schemes, it will be approximately 3 times the value of P.

Classical PID Tuning

Unlike many high speed position applications where PID loops are commonly used, the chemical feed application employed by this instrument does not require intense mathematical exercise to determine tuning parameters for the PID. In fact, the risk of instability is far greater with overly tuned PID control schemes. In addition, many of the classical mathematical exercises can be damaging or wasteful in the use of chemicals when the process is bumped with large amounts of input error to seek a response curve. Because of this, the general adjustment guidelines described in ["Analyzer Maintenance" on page 39](#) are sufficient for almost all application tuning for this instrument. Beyond this, many sources are available for classical tuning methods.

Manual PID Override Control

The Q46 electronics is equipped designed to allow the user to take manual control of the PID output. This is often useful when starting up a control loop, or in the event that you wish to bump the system manually to measure system response time.

To access the manual PID control, you must be in the MEASURE mode of operation and you must have the PID output displayed on the lower line. This line will indicate “XX.X% XX.X mA” with the X values simply indicating the current values. With this display on the screen, press and hold the ENTER key for about 5 seconds. You will see a small “m” show up between the % value and the mA value. This indicates you are now in manual mode.

Once in manual, you may increase the PID output by pressing the UP arrow or you may decrease the output by pressing the LEFT arrow. This will allow you to drive the PID output to any desired setting.

To revert to normal PID control, press and hold the ENTER key again until the “m” indicator disappears.

Common PID Pitfalls

The most common problem occurring in PID control applications involves the false belief that proper settings on only the PID controller can balance any process to an efficient level.

Close-loop control can only be effective if all elements in the loop are properly selected for the application, and the process behavior is properly understood. Luckily, the nature of simple chemical control process are generally slow in nature. Therefore, even a de-tuned controller (one that responds somewhat slow) can still provide substantial improvements to setpoint control. In fact, damaging oscillatory behavior is far more likely in tightly tuned controllers where the user attempted to increase response too much.

When deciding on a PID control scheme, it is important to initially review all elements of the process. Sticking valves, undersized pumps, or delays in reaction times associated with chemical addition can have a dramatic effect on the stability of the control loop. When controlling a chemical mix or reaction, the sensor should be placed in a location that ensures proper mixing or reaction time has occurred.

The easiest process' to control with closed-loop schemes are generally linear, and symmetrical, in nature. For example, controlling level in tank where the opening of valve for a fixed period of time corresponds linearly to the amount that flows into a tank. Chemical control process' can be more problematic when the nature of the setpoint value is non-linear relative to the input of chemical added. For example, D.O. control of a process may appear linear only in a certain range of operation, and become highly exponential at the extreme ranges of the measuring scale. In addition, if a chemical process is not symmetrical, that means it responds differentially to the addition and subtraction of chemical. It is important in these applications to study steady-state impact as well as step-change impact to process changes. In other words, once the process has apparently been tuned under normal operating conditions, the user should attempt to force a dramatic change to the input to study how the output reacts. If this is difficult to do with the actual process input (the recommended method), the user can place the control in manual at an extreme control point such as 5% or 95%, and release it in manual. The recovery should not be overly oscillatory. If so, the loop needs to be de-tuned to deal with that condition (reduce P and/or I.)

SYSTEM MAINTENANCE

General

The Q46 UV/Turbidity Monitor will generally provide unattended operation over long periods of time. With proper care, the system should continue to provide measurements indefinitely. For reliable operation, maintenance on the system must be done on a regular schedule. Keep in mind that preventive maintenance on a regular schedule is much less troublesome than emergency maintenance that always seems to come at the wrong time.

Analyzer Maintenance

No unusual maintenance of the analyzer is required if installed according to the guidelines of this operating manual. If the enclosure door is frequently opened and closed, it would be wise to periodically inspect the enclosure sealing gasket for breaks or tears.

Sensor Maintenance

Sensor maintenance is limited to simple cleaning of the optical surfaces. In general, wiping with a soft cloth is all that's needed. The optical surfaces can also be cleaned with a household glass cleaner or a surface cleaner. Never use abrasive pads on the optical surfaces.

In some applications, the sensor might accumulate iron and manganese deposits that precipitate from the water after chlorination. Should this occur, cleaning the sensor by soaking in solution of a commercial iron remover such as "Red-B-Gone" will quickly remove deposits.

The lenses on the sensor are made of sapphire and do not scratch easily but the side wall surfaces need to be cleaned only with soft cloth to avoid scratches that might affect the turbidity measurement. Severe scratches can cause irreparable damage.

TROUBLESHOOTING

General

The information included in this section is intended to be used in an attempt to quickly resolve an operational problem with the system. During any troubleshooting process, it will save the most time if the operator can first determine if the problem is related to the analyzer, sensor, or some external source. Therefore, this section is organized from the approach of excluding any likely external sources, isolating the analyzer, and finally isolating the sensor. If these procedures still do not resolve the operational problems, any results the operator may have noted here will be very helpful when discussing the problem with the factory technical support group.

External Sources of Problems

To begin this process, review the connections of the system to all external connections.

1. Verify the analyzer is earth grounded. For all configurations of the analyzer, an earth ground connection **MUST** be present for the shielding systems in the electronics to be active. Grounded conduit provides no earth connection to the plastic enclosure, so an earth ground wiring connection must be made at the power input terminal strip. Use the special "shield terminal" stub on the power supply board for optimum sensor cable shield grounding.
2. Verify the proper power input is present. Check instrument label to verify your unit is either 100...240V AC or 12...24V DC.
3. Verify the loads on any 4...20 mA outputs do not exceed the limits in the Instrument Specifications. During troubleshooting, it is many times helpful to disconnect all these outputs and place wire-shorts across the terminals in the instrument to isolate the system and evaluate any problems which may be coming down the analog output connections.
4. Do not run sensor cables or analog output wiring in the same conduits as power wiring. If low voltage signal cables must come near power wiring, cross them at 90° to minimize coupling.
5. If rigid conduit has been run directly to the Q46 enclosure, check for signs that moisture has followed conduit into the enclosure.

6. Check for ground loops. Although the sensor is electrically isolated from the process water, high frequency sources of electrical noise may still cause erratic behavior in extreme conditions. If readings are very erratic after wiring has been checked, check for a possible AC ground loop by temporarily placing the sensor into a bucket of water.
7. Check the load connected to relay contacts. Verify the load is within the contact rating of the relays. Relay contacts which have been used for higher power AC current loads may become unsuitable for very low signal DC loads later on because a small amount of pitting can form on the contacts. If the load is highly inductive (solenoids, motor starters, large aux relays), note that the contact rating will be de-rated to a lower level. Also, due to the large amount of energy present in circuits driving these types of loads when they are switched on and off, the relay wiring placement can result in electrical interference for other devices. This can be quickly resolved by moving wiring, or by adding very inexpensive snubbers (such as Quencharcs) to the load.
8. Carefully examine any junction box connections for loose wiring or bad wire stripping. If possible, connect the sensor directly to the analyzer for testing.
9. Check sensor for fouling. Look closely for signs of grease or oil which may be present. Sensor fouling can be corrected by cleaning optical surfaces with a soft cloth.

Analyzer Tests

1. Disconnect power and completely disconnect all output wiring coming from the analyzer. Remove sensor wiring, relay wiring, and analog output wiring. Re-apply power to the analyzer. Verify proper voltage (115 or 230V AC) is present on the incoming power strip of the analyzer, and that the analyzer power label matches the proper voltage value.
2. If analyzer does not appear to power up (no display), remove power and check removable fuse for continuity with a DVM.
3. If analyzer does power up with a display, use the "Simulate" feature to check operation of the analog outputs (and relays contacts with a DVM.)
4. Check sensor power circuits. With a DVM, verify about 9.5V DC from sensor connection terminals GREEN (+) to WHITE (-).

Display Messages

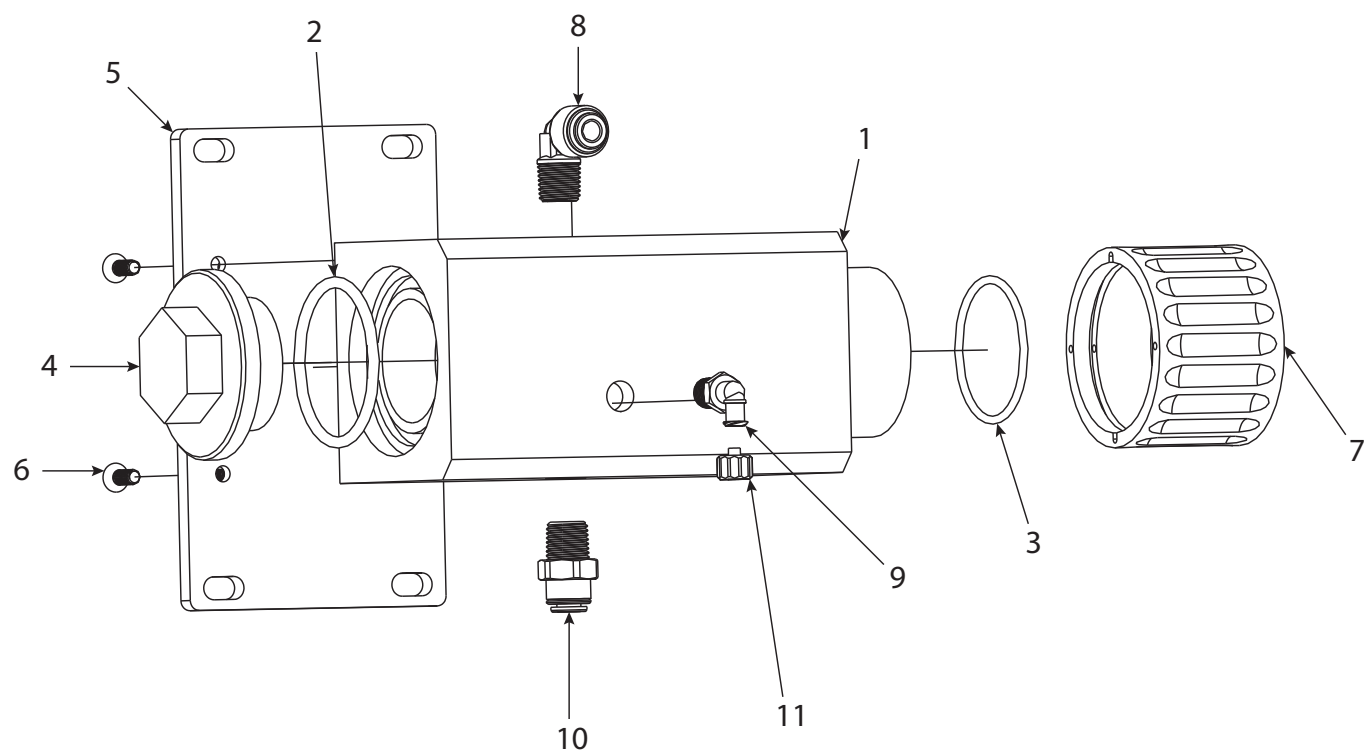
The Q46 instrument provides a number of diagnostic messages which indicate problems during normal operation and calibration. These messages appear as prompts on the secondary line of the display or as items on the Fault List.

Message	Description	Possible Correction
Max is 2000	Entry failed, maximum user value allowed is 2000.	Reduce value to ≤ 2000 .
Min is 20	Entry failed, minimum value allowed is 20.	Increase value to ≥ 20 .
Cal Unstable	Calibration problem, data too unstable to calibrate. Icons will not stop flashing if data is too unstable. User can bypass by pressing ENTER.	Clean sensor, get fresh calibration solutions, allow temperature readings to fully stabilize, do not handle sensor or cable during calibration.
Out of Range	Input value is outside selected range of the specific list item being configured.	Check manual for limits of the function to be configured.
Locked!	Transmitter security setting is locked.	Enter security code to allow modifications to settings.
Unlocked!	Transmitter security has just been unlocked.	Displayed just after security code has been entered.
Offset High	The sensor zero offset point is out of the acceptable range.	Check wiring connections to sensor. Check optical surfaces for fouling.
Sensor High	The raw signal from the sensor is too high and out of instrument range.	Check wiring connections to sensor.
Sensor Low	The raw signal from the sensor is too low.	Check wiring connections to sensor.
Temp High	The temperature reading is $> 55^{\circ}\text{C}$.	The temperature reading is over operating limits.
Temp Low	The temperature reading is $< -10^{\circ}\text{C}$	Same as "Temp High" above.
TC Error	TC may be open or shorted.	Check sensor wiring. Check j-box connections.
Cal Fail	Failure of UV or turbidity calibration. FAIL icon will not extinguish until successful calibration has been performed, or 30 minutes passes with no keys being pressed.	Clean sensor and redo span calibration. If still failure, sensor slope may be less than 80% or greater than 120%. Replace sensor if failure persists.
TC Cal Fail	Failure of temperature calibration. FAIL icon will not extinguish until successful calibration has been performed, or 30 minutes passes with no keys being pressed.	Clean sensor, check calibration solution temperature and repeat sensor temp calibration. TC calibration function only allows adjustments of $\pm 6^{\circ}\text{C}$. Replace sensor if failure.
EPROM Fail	Internal nonvolatile memory failure	System failure, consult factory.
Checksum Fail	Internal software storage error.	System failure, consult factory.
Display Fail	Internal display driver fail.	System failure, consult factory.

Figure 22: Display messages

SPARE PARTS

Flowcell



Item Number	ATI_PN	Title	Quantity
1	45-0408	Flowcell w/Cleaner Option	1
2	42-0037	Flowcell O-Ring	1
3	42-0131	Adapter O-Ring, 2-131	1
4	45-0398	Clean Out Plug	1
5	45-0211	Mounting Plate	1
6	92-0101	#10-32 × 1/2 in. FHMS	4
7	45-0397	Flowcell Cap	1
8	44-0296	1/4 in. NPT × 1/4 OD Instant Elbow Fitting	1
9	44-0387	Female Luer × 0.125 in. NPT	1
10	44-0270	1/4 in. NPT × 1/4 in. OD Instant Fitting	1
11	44-0171	Male Luer Cap	1

Analyzer & Accessories

Part No.	Description
*	AC Powered monitor electronics assembly, 100...240V AC
*	Powered monitor electronics assembly 12...24V DC
*	AC Powered monitor electronics assembly w/Profibus, 100...240V AC
*	DC Powered monitor electronics assembly w/Profibus, 12...24V DC
03-0445	Q46 Front Lid electronics assembly
03-0407	P/S Assy, 100...240V AC
03-0408	P/S Assy, 100...240V AC with 3rd 4...20mA output
03-0409	P/S Assy, 100...240V AC with 3 relay exp. Board
03-0410	P/S Assy, 12...24V DC
03-0411	P/S Assy, 12...24V DC with 3rd 4...20 mA output
03-0412	P/S Assy, 12...24V DC with 3 relay exp. Board
23-0029	Fuse, 630 mA, 250V, TR-5 (for AC and DC Analyzers)
07-0100	Junction box
31-0001	Interconnect cable for junction box to monitor wiring
38-0072	Terminal block plug, 3 position (Relays)
38-0073	Terminal block plug, 4 position (Outputs)
38-0074	Terminal block plug, 3 position (Cable Shields)
38-0081	Terminal block plug, 3 position (Power)
38-0084	Terminal block plug, 3 position (power) – VDC version*
NOTE: Prior to Dec 2018, VDC (power) Terminal block used the 38-0081.	
63-0048	1-1/2 in. Pipe tee adapter
00-1217	1-1/2 in. Flow tee assembly

* Consult factory for item numbers of replacement electronic assemblies.

Lock/Unlock Code: 1472

