

Water Quality Monitor

Q46C4 4E Conductivity Monitor

OVERVIEW

Reliable Conductivity Measurement with Self-Checking Sensor

While the theory of monitoring conductivity is simple, in practice it can be very frustrating. While simple 2-electrode sensors are inexpensive and can provide accurate data, continuous monitoring of even relatively clean water can foul the electrodes and degrade the measurement. Maintaining accuracy is made more difficult when the amount of solids dissolved in the process varies over a wide concentration range.

The Badger Meter Q46C4 4-Electrode conductivity monitor is the answer for monitoring almost any water-based process. Drinking water, plating bath solutions, cooling water, process wash water or virtually any other aqueous system can be monitored accurately and reliably. The unique drive/control scheme used in the 4-electrode system allows a single sensor to be used in conductivity ranged from 0...2000 μ S to as high as 0...2,000 mS (0...2 S). For chemical mixing applications, a concentration display can be selected.

DESCRIPTION

In a traditional 2-electrode sensor, each electrode performs two functions. The electrodes are used to carry the AC drive voltage and also measure the current flow due to the conductivity of the water. This type of sensor has a limited conductivity range and is affected by electrode coating. In addition, changes in cable resistance and capacitance can cause measurement errors.

A 4-electrode sensor provides two sets of electrodes: one set to carry the AC drive voltage and a separate set to sense the strength of the electric field between electrodes. This allows the drive voltage to be automatically adjusted for changes in electrode condition and allows the monitor to automatically correct for the effects of electrode fouling. It also allows the sensor to measure accurately over a very wide range of conductivity and eliminates errors due to changes in cable length.

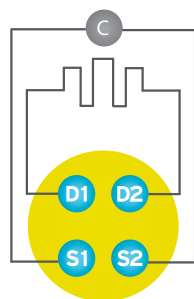


Figure 1: 4-electrode sensor



FEATURES

- **Adapatability.** Concentration version for direct display of chemical concentrations.
- **Analog Output Options.** Two isolated 4...20 mA outputs are standard with an option for a third output, if required. Default setting provides analog outputs for conductivity and temperature.
- **Extra Outputs.** Expansion board to add a third 4...20 mA analog output.
- **Flexibility.** Wide range capability, with selectable ranges of 0-2000 μ S up to 0-2,000 S, provides maximum application flexibility.
- **AC or DC Power Options.** Power options include universal 100...240V AC $\pm$ 10% or 12...24V DC.
- **PID Output.** Standard PID control function assignable to one analog output.
- **Digital Communications.** Available in Profibus DP, Modbus RTU, Modbus TCP/IP, Ethernet/IP or Datalogger.
- **Relay Contacts.** Three SPDT relays are standard, with relay functions programmable for alarm, control or trouble indication. Three additional low power relays available as an option.
- **Flexible Mounting.** NEMA 4X (IP66) enclosure is suitable for wall, pipe or panel mounting.
- **Clear Display.** Backlit large LCD display provides clear visibility in any lighting conditions. A scrolling second line on the display provides additional information and programming prompts.

SENSOR CONFIGURATIONS

Sensors for the Q46C4 system are available in a variety of mounting configurations: convertible-style (Figure 2) with 1 inch NPT threads for pipe or tank mounting, 1-1/2 or 2 inch sanitary-style (Figure 3) fittings in 316 stainless steel, and insertion-style (Figure 4) for 1-1/4 inch NPT hot-tap assemblies that allow the sensor to be removed from service without shutting down the process. For low flow bypass applications, a Noryl sensor with quick-disconnect cable and acrylic flow cell (Figure 5) is available.



Figure 2: Convertible sensor



Figure 3: Sanitary sensor



Figure 4: Insertion sensor



Figure 5: Flow cell sensor

INSTALLATION

4-Electrode conductivity sensors can be installed in a variety of ways, including simple 1 inch pipe tees, union-mount pipe assemblies, sanitary pipe clamps and hot-tap insertion assemblies (CPVC or 316SS). The method used depends on specific application requirements.

Regardless of the mounting method, 4-electrode sensors should always be mounted so that the sensing electrodes at the tip of the sensor are no closer than 2 inches to pipe or tank walls. It is best to have sample flow directed at the sensor, but in all cases the sensor should not be mounted at the top of a horizontal pipe run to avoid entrained air problems.

CONCENTRATION MONITOR

Conductivity monitors can be used to measure and display the concentration of acids or bases used in various chemical process applications. The Q46C4 is available with pre-loaded tables allowing direct display of concentration for solutions of sodium chloride (NaCl), hydrochloric acid (HCl), potassium hydroxide (KOH), and sodium hydroxide (NaOH).

In addition to these standard tables, the user may enter their own table data for other chemicals, or may edit the standard tables supplied by Badger Meter. Custom tables require data on both concentration vs. conductivity and temperature vs. conductivity for the chemical of interest.

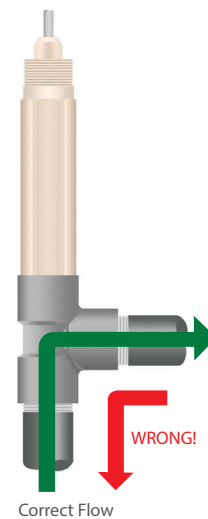


Figure 6: Correct flow

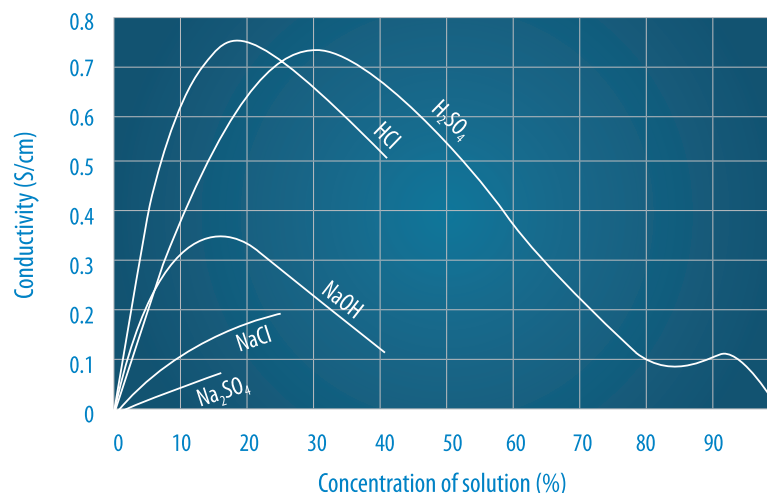


Figure 7: Relationship between concentration of solutions and conductivity at 18°C

SPECIFICATIONS

Electronic Monitor

Display Range	0...2000 μ S, 0...2.000 / 20.00 / 200.0 / 2000 mS, 0...2.000 S
Accuracy	0.5% of selected range
Repeatability	0.3% of selected range
Non-Linearity	0.1% of selected range
Temperature Drift	0.01% of span/ $^{\circ}$ C
Power	100...240V AC, $\pm$ 10%, 50/60 Hz, 10 VA max. 12...24V DC, 500 mA max.
Analog Outputs	Two isolated 4...20 mA, 500 Ω load max. (3rd output optional)
Relays	Three SPDT contacts rated 6 amp @ 250V AC, 5 amp @ 24V DC (3 additional low power SPST non-isolated relays optional)
Display	4-digit, 0.75 in. numeric LCD with 12-digital second line, LED backlight
Enclosure	NEMA 4X polycarbonate V-0 flammability
Operating Conditions	-4...140 $^{\circ}$ F (-20...60 $^{\circ}$ C)
Weight	6 lb (2.7 kg) with sensor
Sensitivity	0.05% of span
Digital Output	Profibus DP, Modbus RTU, Modbus TCP/IP, Ethernet/IP, Datalogger
Mounting	Wall mounting kit standard; panel mount bracket and pipe U-bolts available
Size	5.6 in. W $\times$ 4.9 in. H $\times$ 6.4 in. D (142.2 mm $\times$ 124.5 mm $\times$ 162.6 mm)

Sensor

Sensor Type	4-electrode
Materials	PEEK with titanium electrodes
Cable Length	15 ft (4.6 m) standard, 60 ft (18.3 m) max. with junction box
Temperature Limits	14...257 $^{\circ}$ F (0...125 $^{\circ}$ C)
Pressure Limit	100 psig max.
Connection	1 in. NPT for convertible style
Flow Cell Sensor	1-1/4 in. NPT with quick disconnect cable
Temperature Element	Pt1000 RTD

NOTE: Flow sensor used in sealed flow cell is Noryl. Temp limit is 70 $^{\circ}$ C

QB-A-B-C-D-E-F 4-Electrode Conductivity Monitor

Suffix A - Power	
1	100...240V AC, $\pm 10\%$, 50/60 Hz
2	12...24V DC (requires 300 mA)
Suffix B - Sensor Type	
WW	None
C1	Convertible, Peek body
C2	Insertion, 316 SS body
C3	Sanitary style, 1-1/2 in., 316 SS body
C4	Sanitary style, 2 in., 316 SS body
C5	Convertible, PEEK body with connector (requires 03-0029 cable)
C6	Flow sensor with connector, Noryl
Suffix C - Cable Length	
WW	None
AC	Standard cable, 15 ft.
AF	Standard cable, 30 ft.

Suffix D - Digital Output	
1	None
2	Profibus DP
3	Modbus RTU
4	Ethernet/IP
5	Modbus TCP/IP
6	Datalogger
Suffix E - Optional Output	
A	None
B	One additional 4...20 mA output
C	Three additional low power relays
Suffix F - Measurement Type	
1	Conductivity
2	Concentration

ACCESSORIES

07-0100	Universal Junction Box, NEMA 4X
31-0057	Sensor Interconnect cable
03-0029	Sensor Cable with Connector (25 ft)
00-0628	Mounting Bracket Kit for Submersible Sensor
00-1522	Sealed Flowcell (60 PSI Max)
05-0094	Panel Mount Bracket Kit
47-0005	2 in. U-bolt, 304SS
07-0203	Insertion Assembly without Assist, 1-1/4 in. NPT, 316SS
07-0228	Insertion Assembly with Assist, 1-1/4 in. NPT, 316SS
07-0223	Insertion Assembly without Assist, 1-1/4 in. NPT, CPVC
09-0047	Conductivity Standard - 447 mS, 500 mL
09-0048	Conductivity Standard - 1,500 mS, 500 mL
09-0049	Conductivity Standard - 8,974 mS, 500 mL
09-0050	Conductivity Standard - 80,000 mS, 500 mL

CERTIFICATION