Free Chlorine Measuring System

Complete system includes sensor, connecting cable, analyzer, and flow controller.

Continuous pH correction eliminates expensive and messy reagents and troublesome sample conditioning systems.

Measures free chlorine in samples having pH as high as 9.5.(1)

Variopol quick-disconnect fittings make replacing sensors easy.

Choose from two feature-packed analyzers

(1) In some cases, the sensor can be used in samples having pH as great as 10.0. Consult the factory.

Applications

The Model FCL free chlorine system is intended for the determination of free chlorine in fresh water. Unlike free chlorine analyzers from other manufacturers, the Model FCL does not use expensive sample conditioning systems or messy reagents to control pH. Instead, the analyzer automatically compensates for changes in the pH of the sample. The Model FCL is not intended for the determination of total chlorine or combined chlorine (like monochloramine). Nor, can the FCL be used for the deter- mination of chlorine in seawater.

Features

The Model FCL uses a membrane-covered amperometric sensor. A polarizing voltage applied to a platinum cathode behind the membrane destroys any chlorine that diffuses through the membrane, keeping the concentration of chlorine in the sensor equal to zero. The current generated by the cathode reaction is proportional to the rate of diffusion of chlorine through the membrane. Because the concentration of chlorine in the sensor is zero, the diffusion rate and the current are proportional to the concentration of chlorine in the sample.

All amperometric free chlorine sensors respond to changes in pH. Although free chlorine is a mixture of hypochlorous acid and hypochlorite ion, hypochlorous acid alone is responsible for the sensor current. Because the relative amounts of hypochlorous acid and hypochlorite ion depend on pH, a pH change will cause the current and the apparent free chlorine concentration to change, even though the true concentration remained con- stant. Most manufacturers solve the problem by treating the sample with acid, which lowers the pH and converts hypochlo- rite ion into hypochlorous acid. The Model FCL avoids the expense and inconvenience of sample conditioning by measur- ing the pH and applying a correction to the raw chlorine sensor signal. The correction is valid between pH 6.0 and 9.5. Below pH 6.0, no correction is needed. For samples having pH between 9.5 and 10.0, consult the factory.

The Model FCL is available in two options: Model FCL-01 with manual pH correction and Model FCL-02 with continuous pH correction. Choose the FCL-01 if the pH varies less than 0.2 or if pH changes are predictable or seasonal. Choose the FCL-02 if the pH varies more than 0.2. To provide the continuous pH correction, the Model FCL-02 requires a separate pH sensor.

Maintenance is fast and easy. Replacing a membrane requires no special tools or fixtures. A screw cap holds the pre-tensioned membrane in place. Replacing the electrolyte solution takes only minutes.

Valves, rotameters, and pressure regulators to control sample flow are things of the past with the Model FCL. A constant head overflow sampler ensures the correct sample flow to the sensors. To eliminate wiring hassles, quick-disconnect Variopol cable prewired to the analyzer is standard.

The Model FCL is available with the choice of two easy to use analyzers.

Stable free chlorine standards do not exist. The chlorine sensor must be calibrated using the results of a laboratory test run on a grab sample.

Specifications — General

Sample requirements:

Pressure: 3 to 65 psig (122 to 549 kPa abs). A check valve in the inlet prevents the sensor flow cells from going dry if sample flow is lost. The check valve opens at 3 psig (122 kPa abs). If the check valve is removed, minimum pressure is 1 psig (108 kPa abs).

Temperature: 32 to 122°F (0 to 50°)

Minimum Flow: 3 gal/hr (11 L/hr)

Maximum flow: 80 gal/hr (303 L/hr); high flow causes the overflow tube to back up.

Sample Conductivity: >50 µS/cm at 25°C

Process connection: 1/4-in OD tubing compression fitting (can be removed and replaced with a barbed fitting for use with soft tubing).

Drain connection: 3/4-in barbed fitting. Sample must drain to open atmosphere.

Wetted parts:

Overflow sampler and flow cell: acrylic, polycarbonate, polyester, Kynar®(1), nylon, silicone

Chlorine sensor: Noryl®(2), Viton®(3), wood, silicone, polyethersulfone, polyester, and platinum

pH sensor (3900VP): Stainless steel, glass, Teflon®(4), polyphenylene sulfide, EPDM, and silicone

Response time to step change in chlorine concentration: <80 sec to 95% of final reading for inlet sample flow of 3 gph (11 L/hr).

Weight/shipping weight:

Model FCL-01: 10 lb/13 lb (4.5 kg/6.0 kg)

Model FCL-02: 11 lb/14 lb (5.0 kg/6.5 kg)
[rounded to the nearest 1 lb. (0.5 kg)]

Specifications — Chlorine Sensor

Free chlorine range: 0 to 10 ppm as Cl_2. For higher ranges, consult the factory.

pH correction range: 6.0 to 9.5. For samples having pH between 9.5 and 10.0, consult the factory. Correction is not needed if pH < 6.0. For manual pH correction, choose option -01. For continuous pH correction choose option -02.

Accuracy: Accuracy depends on the accuracy of the chemical test used to calibrate the sensor.

Interferences: Monochloramine, permanganate, peroxides.

Electrolyte volume: 25 mL (approx.)

Electrolyte life: 3 months (approx.); for best results replace electrolyte monthly.

Specifications — Model 1056 Analyzer

Case: Polycarbonate NEMA 4X/CSA 4 (IP65).

Conduit openings: Accepts PG13.5 or 1/2 in. conduit fittings

Display: Monochromatic back-lit LCD. Main character height 0.6 in (15mm). Display is user-programmable

Languages: English, French, German, Italian, Spanish, Portuguese, and Chinese.

Ambient temperature and humidity: 32 to 131°F (0 to 55°C); RH 5 to 95% (con-condensing)

Storage temperature: -4 to 140°F (-20°C and 60°C)

Power: 84-265 Vac, 47.5 to 65.0 Hz, switching, 15 W

⧈ Equipment protected by double insulation

(1) Kynar is a registered trademark of Elf Atochem North America.

(2) Noryl is a registered trademark of General Electric.

(3) Viton is a registered trademark of E.I. duPont de Nemours & Co.

(4) Teflon is a registered trademark of E.I. duPont de Nemours & Co

RFI/EMI: EN-61326

LVD: EN-61010-1

Outputs: Two 4-20 mA or 0-20 mA isolated outputs. Continuously adjustable. Linear or logarithmic. Maximum load 550 Ω. Output dampening is user-adjustable.

Alarms: Four alarm relays. Any relay can be configured as a fault alarm instead of a process alarm. Each relay can be configured independently and each can be programmed with interval timer settings.

Relays: Form C, SPDT, epoxy sealed

Relay Contact ratings:

5 A at 28 VDC or 300 VAC (resistive)
1/8 HP at 120/240 VAC.

Terminal Connections Rating: Power connector (3-leads): 18-12 AWG wire size. Current output connectors (2-leads): 24-16 AWG wire size. Alarm relay terminal blocks: 18-16 AWG wire size

Hazardous Location Approvals: For more information refer to the Model 1056 product data sheet 71-1056. Approvals apply to the analyzer only. The FCL is not suitable for use in hazardous areas.

Specifications — Model 56 Analyzer

Case: Polycarbonate

Display: Full color LCD, 3.75 x 2.20 in. (95 x 56 mm); display can be customized by the user.

Languages: English, French, German, Italian, Spanish, Portuguese, Chinese, Russian, and Polish.

Ambient Temperature and Humidity: 14 to 140°F (-10 to 60°C); RH 5 to 95% (non-condensing). Between 23 and 131°F (-5 to 55°C) there is no visible degradation in display response or performance.

Storage temperature: -4 to 140°F (-20 to 60°C)

Power: 85 to 265 VAC, 47.5 to 65.0 Hz, 20 W

RFI/EMI: EN-61326

LVD: EN-6101-01

Outputs: Four 4-20 or 0-20 mA isolated current outputs; assignable to measurement or temperature; fully scalable; maximum load 550 Ω. HART digital signal is superimposed on output 1.

Alarms and Timers: Four relays, fully configurable as a setpoint alarm, interval timer, TPC, bleed and feed timer, delay timer, date and time timer, and fault alarm.

Relays: Form C, SPDT, epoxy sealed.

Relay Contact ratings:

5 A at 28 VDC or 300 VAC (resistive)
1/8 HP at 120/240 VAC

Control features: PID control (analog output) and time proportional control or TPC (relays) are standard.

Data logger: Data automatically stored every 30 seconds for 30 days; older data removed to make room for new data. The following data are automatically stored:

Chlorine: date and time, ppm, temperature, raw sensor current

pH: date and time, pH, temperature, mV, glass impedance, and reference impedance (if available)

Event logger: Stores up to 300 events with data and time stamp: faults, warnings, calibration data, calibration results (pass or fail), power on/off cycles, and hold on/off. Alarm relay activation and deactivation can also be stored. Older events are automatically removed to make room for new events.

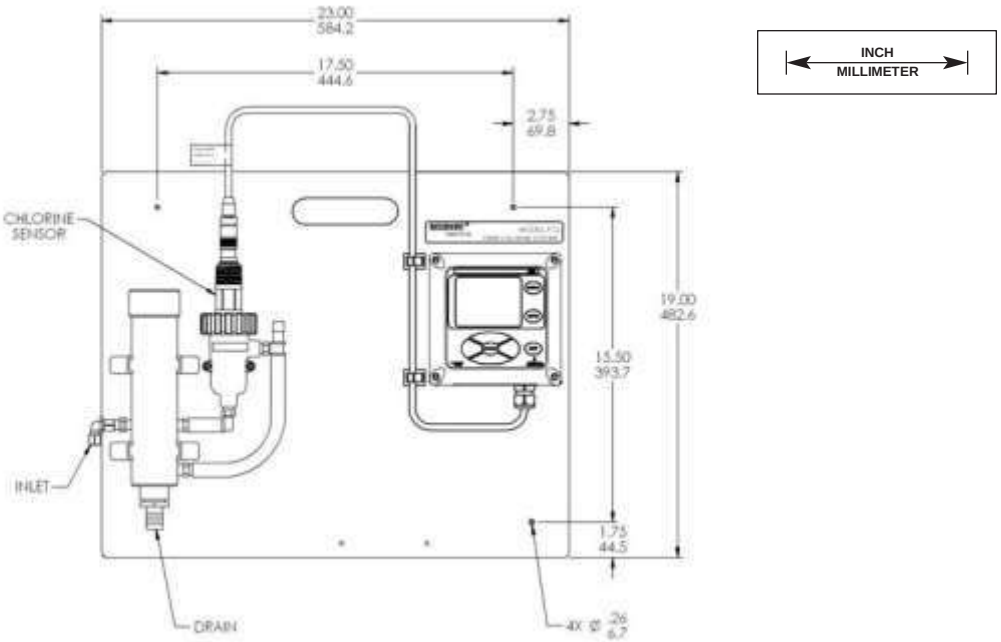
Data and event downloading: through USB port on front panel.

Graphical display: Dual graphical display shows measurement data on the y-axis and time on the x-axis. Y-axis is fully assignable and scalable. X-axis can be set to one hour, one day, seven days, or 30 days.

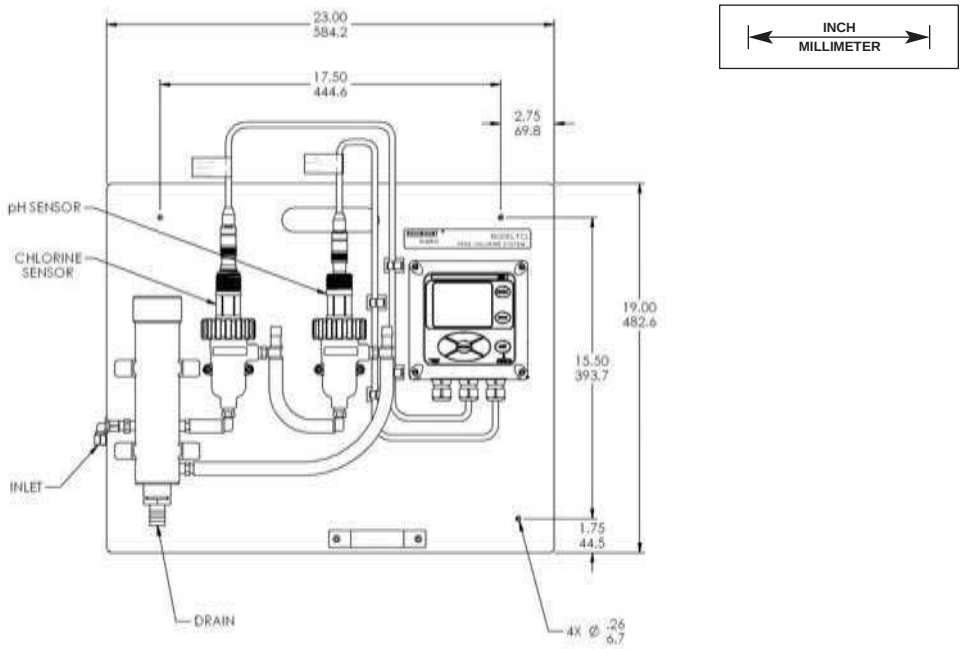
Digital communications: HART digital communications is standard.

Hazardous Location Approvals: For more information refer to the Model 56 product data sheet 71-56. Approvals apply to the analyzer only. The FCL is not suitable for use in hazardous areas.

Model FCL-01-220 shown. All versions of the FCL-01 have the same overall dimensions



Model FCL-02-221 shown. All versions of the FCL-02 have the same overall dimensions



Model FCL-1056 Engineering Specification

1. The system shall be suitable for the determination of free chlorine in water having conductivity greater than about 50 uS/cm at 25°C and pH between about 5.5 and 9.5 without the use of reagents.
2. The system shall consist of an analyzer, a free chlorine sensor, a pH sensor (if required), flow cells for each sensor, and a flow controller. The components shall be mounted on a back plate. Sensor cables shall be pre-wired to the analyzer. Sensors shall plug into the cables using Variopol quick dis- connect fittings. The sensor flow cells shall be clear plastic to allow the sensors to be easily inspected for fouling. The inlet shall be fitted with a check valve to ensure the sensors remain wet in the event sample flow is lost.
3. The system shall use no mechanical devices, such as pressure regulators, valves, or rotameters, to control flow. Instead, flow shall be regulated using a constant head flow controller. Minimum sample flow shall be no more than about 3 gallons per hour (11 liters per hour). Maximum flow can be as high as 80 gallons per hour (303 liters per hour). The flow controller shall be able to handle inlet pressure between 3 and 65 psig (122 to 549 kPa abs) and temperature between 32 and 122°F (0 and 50°C).
4. The free chlorine sensor shall be a two-electrode, membrane-covered amperometric sensor. The free chlorine sensor shall be fitted with an RTD to allow continuous correction for changes in membrane permeability caused by temperature. The linear range of the free chlorine sensor shall be at least between 0 and 10 ppm as Cl_2.
5. The pH sensor shall be a combination electrode having a glass sensing membrane and a double junction reference electrode.
6. The pH sensor shall be required if the pH of the sample varies more than about 0.2 units peak-to-peak. For pH variations less than 0.2, the pH sensor shall generally not be required.
7. The analyzer shall have dual input, one for the free chlorine sensor and the other for the pH sensor (if needed). The analyzer shall receive the raw signal from the free chlorine sensor and automatically correct it for temperature and pH effects. Results shall be displayed as ppm Cl_2.
8. The analyzer shall require single point calibration. A correction for the sensor zero current shall also be available.
9. The analyzer shall have automatic buffer recognition for pH sensor calibration.
10. The analyzer shall have a four line, back lit display. The display shall show ppm chlorine, pH (if required), and temperature on one screen. The display shall be programmable to show additional information such as raw sensor current.
11. The analyzer shall be capable of operating between 32 and 131°F (0 and 55°C) and between 5 and 95% relative humidity (non-condensing).
12. The analyzer shall have dual 0/4-20 mA isolated outputs. Outputs shall be fully scalable and assignable independently to chlorine, pH, or temperature.
13. The analyzer shall have four alarm relays fully programmable for logic (high or low operation), dead band, and setpoint. Relays shall also be configurable to energize when the analyzer detects a fault with the sensor or itself.
14. All analyzer programming shall be through a front panel membrane keypad. The language (English, Spanish, Italian, Portuguese, German, French, or Chinese) used in the menu screens shall be selectable by the user.
15. The analyzer shall have a security feature to prevent unauthorized tampering with calibration and configuration settings.
16. The analyzer shall be Rosemount Model FCL-01-220 (free chlorine only) or Model FCL-02-221 (free chlorine with continuous pH correction) or approved equal.

Model FCL-56 Engineering Specification

1. The system shall be suitable for the determination of free chlorine in water having conductivity greater than about 50 uS/cm at 25°C and pH between about 5.5 and 9.5 without the use of reagents.

2. The system shall consist of an analyzer, a free chlorine sensor, a pH sensor (if required), flow cells for each sensor, and a flow controller. The components shall be mounted on a back plate. Sensor cables shall be pre-wired to the analyzer. Sensors shall plug into the cables using Variopol quick disconnect fittings. The sensor flow cells shall be clear plastic to allow the sensors to be easily inspected for fouling. The inlet shall be fitted with a check valve to ensure the sensors remain wet in the event sample flow is lost.

3. The system shall use no mechanical devices, such as pressure regulators, valves, or rotameters, to control flow. In-stead, flow shall be regulated using a constant head flow controller. Minimum sample flow shall be no more than about 3 gallons per hour (11 liters per hour). Maximum flow can be as high as 80 gallons per hour (303 liters per hour). The flow controller shall be able to handle inlet pressure between 3 and 65 psig (122 to 549 kPa abs) and temperature between 32 and 122°F (0 and 50°C).

4. The free chlorine sensor shall be a two-electrode, membrane-covered amperometric sensor. The free chlorine sensor shall be fitted with an RTD to allow continuous correction for changes in membrane permeability caused by temperature. The linear range of the free chlorine sensor shall be at least between 0 and 10 ppm as Cl_2.

5. The pH sensor shall be a combination electrode having a glass sensing membrane and a double junction reference electrode.

6. The pH sensor shall be required if the pH of the sample varies more than about 0.2 units peak-to-peak. For pH variations less than 0.2, the pH sensor shall generally not be required.

7. The analyzer shall have dual input, one for the free chlorine sensor and the other for the pH sensor (if needed). The analyzer shall receive the raw signal from the free chlorine sensor and automatically correct it for temperature and pH effects. Results shall be displayed as ppm Cl_2.

8. The analyzer shall require single point calibration. A correction for the sensor zero current shall also be available.

9. The analyzer shall have automatic buffer recognition for pH sensor calibration.

10. The analyzer shall have a four line, full color display. The display shall show ppm chlorine, pH (if required), and temperature on one screen. The display shall be programmable to show additional information such as raw sensor current.

11. The analyzer shall be capable of operating between 14 and 140°F (-10 and 60°C) and between 5 and 95% relative humidity (non-condensing).

12. The analyzer shall have four 0/4-20 mA isolated outputs and HART digital communications. Outputs shall be fully scalable and assignable independently to chlorine, pH, or temperature. PID control shall be available as a standard feature.

13. The analyzer shall have four alarm relays fully programmable as a high/low alarm with adjustable deadband or as a timer. Timer functions shall include an interval timer, bleed and feed timer, delay timer, and date and time timer. Time- proportional control shall also be available. In addition relays shall be configurable to energize when the analyzer detects a fault with itself or the sensor.

14. All analyzer programming shall be through a front panel membrane keypad. The language (English, Spanish, Italian, Portuguese, German, French, Russian, Polish, or Chinese) shall be selectable by the user.

15. The analyzer shall have a data logger that automatically stores data every thirty seconds for thirty days with older data being discarded to make room for newer data. In addition to storing date and time, chlorine concentration, pH, and temperature, the analyzer will store raw sensor current (chlorine sensor) and mV reading and glass and reference impedance (pH sensor). Stored data shall be downloadable through a USB port.

16. The analyzer shall have a dual graphical display that allows stored data to be viewed over one hour, one day, seven days, and one month intervals.

17. The analyzer shall have a data logger that stores up to 300 events.

18. The analyzer shall have help screens, available at the touch of a button, that provide information about configuration, calibration, and troubleshooting.

19. The analyzer shall have a security feature to prevent unauthorized tampering with calibration and configuration settings.

20. The analyzer shall be Rosemount Model FCL-01- 240 (free chlorine only) or Model FCL-02-241 (free chlorine with continuous pH correction) or approved equal.

Ordering Information

Model FCL Free Chlorine Measuring System. The FCL is a complete system for the determination of free chlorine in water. It consists of the sensor(s), analyzer, and constant head overflow cup to control sample flow. All components are mounted on a backplate. Model option -02 includes a pH sensor for continuous, automatic pH correction. Three replacement membranes and a 4-oz. (120 ml) bottle of electrolyte solution are shipped with the chlorine sensor.

Model FCL Free Chlorine Measuring System	
CODE	**pH Correction (required selection)**
01	Without continuous pH correction
02	With continuous pH correction
CODE	**Analyzer (required selection)**
220	1056-03-24-38-AN, single input (chlorine) (option -01 only)
221	1056-03-24-32-AN, dual input (free chlorine) (option -02 only)
240	56-03-24-38-HT, (option -01 only)
241	56-03-24-32-HT, (option -02 only)
FCL-02-221	**EXAMPLE**

Component Parts

Analyzer Model	Description
1056-03-24-38-AN	1056 analyzer, single input (chlorine), alarm relays, analog output, 85-265VAC, 47.5-65.0 Hz
1056-03-24-32-AN	1056 analyzer, dual input (chlorine and pH), alarm relays, analog output, 85-265VAC, 47.5-65.0 Hz
56-03-24-38-HT	56 analyzer, single input (chlorine), alarm relays, analog / HART output, 85-265 VAC, 47.5-65.0 Hz
56-03-24-32-HT	56 analyzer, dual input (chlorine and pH), alarm relays, analog / HART output, 85-265 VAC, 47.5-65.0 Hz

Sensor Model	Description
499ACL-01-54-VP	Free chlorine sensor with Variopol connector
3900VP-02-10	pH sensor with Variopol connector

Sensor Cable	Description
23747-04	Interconnecting cable, Variopol for 499ACL sensor, 4 ft (1.2m)
23645-08	Interconnecting cable, Variopol for 3900VP sensor, (gray) 4 ft (1.2m)
24281-05	Interconnecting cable, Variopol for 3900VP sensor, (blue) 4 ft (1.2m)

Accessories and Spare Parts

Part Number	Description
9240048-00	Tag, stainless steel (specify marking)
23502-08	Membrane assembly with o-ring for free chlorine sensor, quantity 3
9210356	Fill solution for free chlorine sensor, 4 oz. (120 ml)

Global Headquarters

Emerson Automation Solutions
8200 Market Blvd.
Chanhassen, MN 55317, USA
+1 800 999 9307 or +1 952 906 8888
+1 952 949 7001
Liq.CSC@Emerson.com

Latin America Regional Office

Emerson Automation Solutions
1300 Concord Terrace, Suite 400
Sunrise, FL 33323, USA
+1 954 846 5030
+1 952846 5121
RFQ.RMD-RCC@Emerson.com

Europe Regional Office

Emerson Automation Solutions Europe GmbH
Neuhofstrasse 19a P.O. Box 1046
CH 6340 Baar
Switzerland
+1 954 846 5030
+1 952846 5121
RFQ.RMD-RCC@Emerson.com

Asia Pacific Regional Office

Emerson Automation Solutions Asia Pacific Pte LTD
1 Pandan Crescent
Singapore 128461
+65 6777 8211
+65 6777 0947
Enquiries@AP.Emerson.com

Middle East and Africa Regional Office

Emerson Automation Solutions
Emerson FZE P.O. Box 17033
Jebel Ali Free Zone - South 2
+971 4 8118100
+971 4 88665465
RFQ.RMTMEA@Emerson.com

Analyticexpert.com

Linkedin.com/company/Emerson-Automation-Solutions

Twitter.com/Rosemount_News

Facebook.com/Rosemount

Youtube.com/user/RosemountMeasurement

Google.com/+RosemountMeasurement