DULCOMETER®
Measurement and control systems

An Introduction to Process Measurement and Control

Process control in water treatment involves measurement of a variable related to water quality, combined with automation of chemical feed equipment or other physical/chemical processes to keep the measured value as close as possible to the desired setpoint or between high and low control limits.

ProMinent's approach combines the functions of an analyzer and a controller into one instrument, dedicated to a specific water quality parameter to simplify calibration and operation.

Each ProMinent DULCOTEST® sensor measures a specific water quality parameter and sends an electronic signal back to a DULCOMETER® controller. The operator calibrates that sensor to a known standard. It then displays any changes that are measured in that parameter within the sensor's range.

Measured Value Outputs

Up to two outputs are available. DULCOMETER® controllers offer the ability to continuously record measured values to document water quality or to send to another control device. Analog 4-20 mA or 0-20 mA measured value outputs are proportional to the measuring range of the sensor or spannable to provide greater detail within a smaller range, for connection to a chart recorder, datalogger or distributed control system [D1C/D2C controllers and DULCOMETER® transmitters (monitor only)]

Control Outputs

Different control outputs are available to control virtually any type of actuating device.

Setpoint relays change state (open or close contact) when the measured value drops below or exceeds the setpoint to start a process control device or alarm, and shut it off when the setpoint is reached (D1C or D2C).

Analog control outputs (4-20 or 0-20 mA) can drive a variable speed analog control device, such as a DC SCR drive or AC inverter, according to the control action used (D1C or D2C).

Pulse outputs are brief contact closures to pace pulse-input metering pumps corresponding to the control action used (D1C).

Modulating relay outputs cause a relay to open and close according to the control action used. These are used with solenoid valves or constant-speed motor-driven metering pumps. Minimum on-times may be set to prevent overheating of motors (D1C or D2C).

3P relays provide two relay outputs to control a bi-directional actuator (such as a stroke length controller on a metering pump) with provision for feedback potentiometer from the actuator to display the position according to the control action used (D1C or D2C).

Control Actions

A variety of control actions are available to suit the application and budget. Any variable control output listed above may be used with any of the control actions listed below.

Setpoint Control
Setpoint control uses a setpoint relay to start a constant output pump or open a solenoid valve when the measured value drops below (or exceeds) the setpoint. Once the measured value reaches setpoint again, the pump stops or the valve closes. This always results in overshooting the setpoint because of the lag time between the point of chemical addition and the point of measurement. This can waste chemicals and cause excessive variation on either side of the setpoint. It is suited only for closed systems or batch applications where tight control is not required (D1C or D2C).
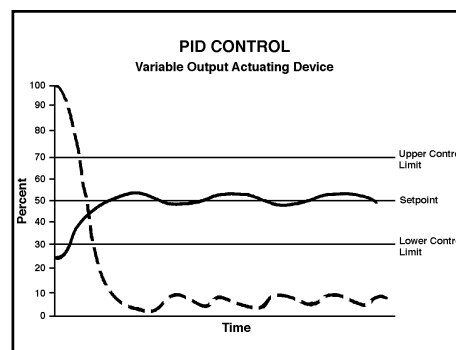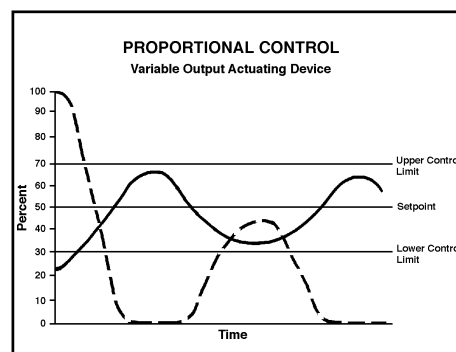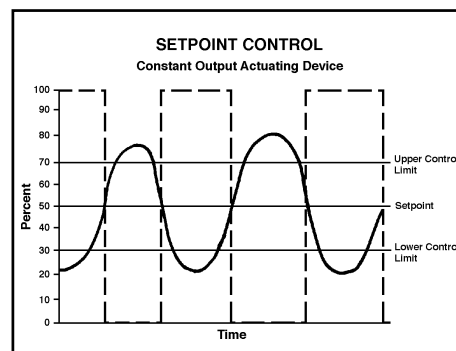
Proportional Control
Proportional control gives an output that is directly proportional to the measured value's deviation from the setpoint. The farther from setpoint, the greater the output of the actuating device, and the closer to setpoint, the lesser the

CONTROL ACTION RESPONSE IN ONCE-THROUGH SYSTEMS

Note: Actuating device output increases measured value in example (e.g. chlorine feed)

——— Measured value (as percent of measurement range)

– – – Actuating device output (as percent)

SETPOINT CONTROL
Constant Output Actuating Device

PROPORTIONAL CONTROL
Variable Output Actuating Device

PID CONTROL
Variable Output Actuating Device

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Measurement and control systems

output. Proportional control is suitable for closed systems or batch applications where more precise control is required. The proportional bandwidth may be spanned to set the distance from setpoint at which the actuating device is operating at maximum output. A small bandwidth results in maximum output at a measured value close to setpoint, and may cause overshooting. A large bandwidth may result in long time periods required until the setpoint is reached (D1C or D2C).

PID Control

PID control combines proportional, integral and derivative control actions, or any combination thereof.

Integral control considers the time interval of deviation and increases output when the deviation exceeds a programmed time interval. Derivative control considers the rate of change of deviation and increases the output when the rate of deviation exceeds a programmed rate. PID control ensures the least deviation from setpoint possible (D1C, D2C).

Control Techniques

The control technique used depends on the location of the sensor in relation to the actuating device, the presence of other inputs which may effect the measured value, or the requirement for secondary actuating devices to handle large swings. Some common control techniques are described below.

Closed loop control is where the sensor is located downstream of the actuating device and measures changes caused by the device. The controller varies the device's output to maintain the desired setpoint. This is usually used in recirculating or batch applications, or once-through systems with constant flow rate. The sensor must be located far enough downstream to ensure that any physical/chemical changes are complete, whether measuring pH, oxidant residuals or other variables (D1C or D2C).
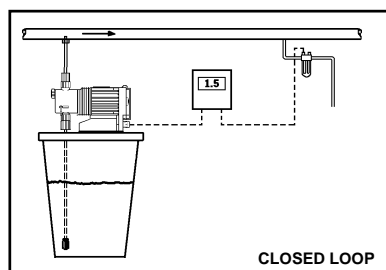

CLOSED LOOP

Compound loop control combines the closed loop signal from the sensor with a second (disturbance) input, normally water flow rate, and changes the actuating device's output in response to both variables. This is typically used in once-through applications with varying flow rates (D1C).
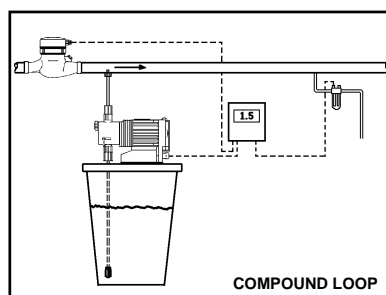

COMPOUND LOOP

With *open loop control*, the sensor is upstream of the actuating device and a control signal changes the actuating device's output. Usually, this is only used when the resulting measured value would be outside of the sensor's measuring range (D1C or D2C).
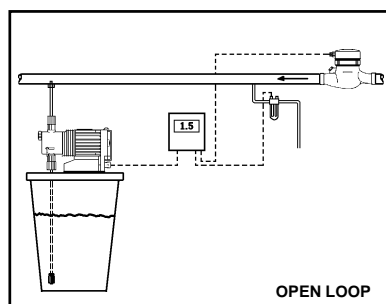
OPEN LOOP

Base and trim control uses two actuating devices to bring large fluctuations into control very quickly, yet provide tight control under normal operation. A variable output actuating device is normally used with proportional or PID control for the trim or fine tuning. A constant output device would be started by a setpoint relay for the base load to make fast changes in the event of large fluctuations that the trim device cannot handle (D1C or D2C).
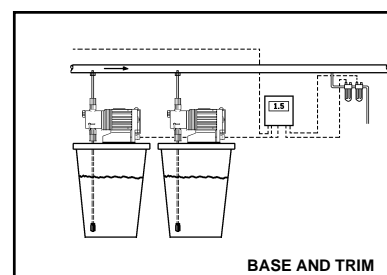
BASE AND TRIM

Bi-directional control of two opposing actuating devices, such as pumps for acid and base in a pH control application, is possible with one controller (D1C or D2C). To prevent repeated corrections caused by overshooting on both sides, a deadband may be programmed (between two setpoints) in which both actuating devices are stopped (D1C or D2C).
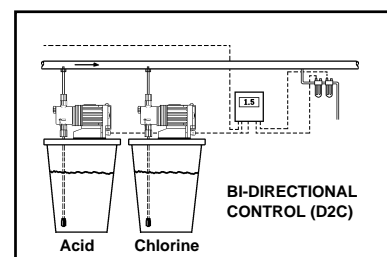
BI-DIRECTIONAL CONTROL (D2C)

Acid **Chlorine**

PROPORTIONAL CONTROL ONLY (BATCH LINE)

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Measurement and control systems

System Components

The ProMinent catalog lists a variety of components that <u>must be</u> combined to create a functional control system. *Please ensure that you select all required components, as follows:*

<u>Minimum Requirements</u>

✓ Controller
✓ Sensor(s)
✓ Sensor holder(s) (to mount sensor in process)
✓ Sensor cable(s) (to connect sensor to controller)
✓ Standardizing solution(s) (for pH or ORP, others use the sample water analyzed on site for calibration)
✓ Metering pump(s) with control input matched to controller's output

<u>Optional Equipment</u>

1. Impedance converter (millivolt) to minimize interference and maximize sensor life when distances between pH, ORP or temperature sensors and the controller are between 30 and 300 feet. Provides low impedance mV output.

2. 4-20 mA Signal Converters for pH, ORP or temperature sensors when distances between the sensor and controller is up to 300 feet, or where required by the controller (e.g. pH correction for chlorine). Provides 4-20 mA output.

3. Chart recorder

4. Spare membrane caps and electrolyte for membrane style sensors.

5. 2-wire shielded cable for transmission of 4-20 mA signals.

DGMa in-line sensor housings, DULCOTEST® instrumentation and DULCOMETER® D1C panel/wall mount controllers

What do I need to order with a D1C?

Chlorine	**pH**	**ORP**
D1C Controller	D1C controller	D1C controller
Power cord	Power cord	Power cord
Chlorine sensor	pH sensor	ORP sensor
25 mm DGMA	13.5 mm DGMA	13.5 mm DGMA
2-wire cable	pH buffers	ORP standard
Mounting set for sensor	2xSN6 cable or	2xSN6 cable or
	pH transducer/ 2-wire cable	pH transducer/ 2-wire cable

<u>Optional (free Chlorine)</u>	<u>Opt. (temperature comp.)</u>	<u>Opt. (temperature comp.)</u>
pH sensor for comp. (free)	temp. sensor for comp.	temp. sensor for comp.
pH transducer/2-wire cable	SN6 cable w/ extension wire	SN6 cable w/ extension wire
13.5 mm DGMA	Temp. transducer if long cable	Temp. transducer if long cable
pH buffers	2-wire cable for transducer	2-wire cable for transducer
extra 2-wire cable	extra 2-wire cable	extra 2-wire cable
	13.5 mm DGMA	13.5 mm DGMA

What do I need to order with a D2C?

pH/ Chlorine	**pH/ ORP**	**pH/ pH**
D2C Controller	D2C controller	D2C controller
Power cord	Power cord	Power cord
pH sensor	pH sensor	2xpH sensors
Chlorine sensor	ORP sensor	pH transducer
2-wire cable	ORP transducer	2xSN6 connector or
2xSN6 connector or	2-wire cable	pH transducer/ 2-wire cable
pH transducer/ 2-wire cable	2xSN6 connector or	pH buffers
pH buffers	pH transducer/ 2-wire cable	2x13.5 mm DGMAs
25 mm DGMA	pH buffers	2-wire cable
Mounting set for sensor	ORP standard	
13.5 mm DGMA	2x13.5 mm DGMAs	

<u>Optional</u>	<u>Optional</u>	<u>Optional</u>
extra 2-wire cable	extra 2-wire cable	extra 2-wire cable
Temp. sensor for pH temp. comp.	Temp. sensor for pH temp. comp.	Temp. sensor for pH temp. comp.
13.5 mm DGMA	13.5 mm DGMA	13.5 mm DGMA
SN6 cable w/ extension wire	SN6 cable w/ extension wire	SN6 cable w/ extension wire
Temp. transducer if long cable	Temp. transducer if long cable	Temp. transducer if long cable
2-wire cable for transducer	2-wire cable for transducer	2-wire cable for transducer

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DULCOMETER®
D1C and D2C Series Process Controller

Description	Part no.

Single Variable Controllers (D1C) and Dual Variable Controllers (D2C) for Water and Wastewater Treatment or Industrial Process Control

The D1C/D2C integrates process monitoring and control into a single, easy-to-use device, replacing separate and multiple monitors and controllers: ProMinent DULCOTEST® sensors measure the process; and the controller displays the value on a large LCD screen; control outputs can operate various control devices (e.g. metering pumps) to keep the process within control limits using proportional or PID control action; alarm relays are available for fault annunciation and analog outputs are available for recording the measured value. Features/ options are selectable by identity code.

Features:

- Microprocessor based technology

- Large, clear, backlit display of measured and correcting values, status, error annunciation

- Menu-driven calibration, limit and control settings

- Control opposing functions with one unit (e.g. both acid and base to set pH) with or without deadband

- Sensor diagnostics monitor alarms upon sensor failure

- Five available voltages, including DC capability

- Limit values may be exceeded for adjustable time periods before relays change state (hysteresis)

- Programmable access code prevents unauthorized setting changes, yet allows calibration by operators

- Non-volatile memory retains all settings, including calibration, when power is lost; with automatic restart when power is restored

- Retains last measured value in memory during calibration to allow time for sample analysis so that the exact concentration in the sample becomes the standard

- Fault text on the LCD describes the nature of the fault, allowing fast diagnostics and correction

- Electrically isolated signal outputs

- Two current analog signal outputs (optional)

- Spannable outputs offer greater detail for recording and optimization of control

- Controller can revert to pre-set basic load output during calibration or in the event of a fault

Wall Mount

Mounting

- *Wall mount:* Nonmetallic enclosure with protective gland-style strain relief cable sockets

  Dimensions: 7.87"H x 7.87"W x 3.00"D (200 mm x 200 mm x 76 mm)

  Cable glands: Five Pg11, Five Pg7

  Weight: Approx. 2.6 lbs. (1.2 kg) Shipping Weight: 4.4 lbs. (2.0 kg)

  Mounting: Detachable wall mount bracket

  Protection class: NEMA 4X (IP 65)

  Control panel assembly kit for installation   792908

Panel Mount

- *Panel mount:*

  Dimensions: 3.78"H x 3.78"W x 5.50"D (96 mm x 96mm x 140 mm)

  Weight: Approximately 1.87 lbs. (850 g); 2.6 lbs. (1200 g) shipping weight

  Protection class: NEMA 3 (IP 54) when mounted in panel

DULCOMETER® D1C/D2C Series (cont.)

**Measured Value Ranges Available
(from ProMinent DULCOTEST® sensors or other devices)**

- pH value: 0 to 14 pH

- Oxidation Reduction Potential (ORP): -1000 to 1000 mV

- Free Chlorine Concentration: 0 to 50 mg/L (D1C) (sensor dependent); 0 to 20 mg/L (D2C) (sensor dependent)

- Total Chlorine Concentration: 0 to 10 mg/L (sensor dependent)

- Bromine Concentration: 0 -10 mg/L (sensor dependant)

- Conductivity (from conductometric sensors): 0 to 20,000 µS/cm

- Dissolved Ozone Concentration: 0 to 2 mg/L

- Dissolved Oxygen Concentration: 0 to 20 mg/L

- Chlorine Dioxide Concentration: 0 to 10 mg/L (sensor dependent)

- Temperature: 32° to 212°F (0° to 100°C)

- Standard analog (mA) signal inputs from other devices: 0/4 to 20 mA

- Hydrogen Peroxide: 1 to 20, 10 to 200, 100 to 2000 mg/L

- Peracetic Acid: 10 to 200, 100 to 2000 mg/L (selectable on transducer)

Other Inputs

- Feed Forward (disturbance variable) from flow meter for compound loop control (D1C only)

- Pause contact to stop control output based on external event

- Correcting variables: temperature for pH and conductivity; pH for free chlorine

- Solution ground for pH

Control Capabilities

- Monitoring only

- Setpoint (on/off) control based on high and low limit relays

- Proportional control for batch processes

- PID (Proportional-Integral-Derivative) control for once-through processes

- Compound loop PID for once-through processes with varying flow (D1C only)

Outputs

- Analog (mA) control output or measured value output to recorder

- Pulse control outputs for metering pumps (adjustable from 1 to 500 pulses/minute)

- Relay control outputs for solenoid valves or constant speed pumps with adjustable minimum on-time

- Actuator relay control output with feedback for stroke positioners or control valves

- General fault annunciation relay changes state on internal faults, loss of sensor signal, exceeding either high or low limit

- High and low limit relays

DULCOMETER® D1C/D2C Series (cont.)

Typical Applications

pH - Control acid and/or base feed via metering pumps or valves to adjust pH

ORP - Control hypochlorite metering pump to maintain oxidant residual; or control sulfonator or bisulfite metering pump for dechlorination

Free Chlorine - Control chlorination or hypochlorite metering pump to maintain residual

Total Chlorine - Control chlorination or hypochlorite metering pump to maintain residual; or control sulfonator or bisulfite metering pump for dechlorination

Bromine - Control tablet brominator via solenoid valve; or bromine solution metering pump to maintain residual

Conductivity - Control conductivity through valve on blowdown/makeup for rinse bath, boiler or cooling tower

Dissolved Ozone - Control ozone generator output to maintain residual

Dissolved Oxygen - Control aeration units to limit energy usage or for nitrification/dentrification

Chlorine Dioxide Concentration - Control chlorine dioxide generator output to maintain residual

Temperature - Control heater or heat exchanger to maintain bath temperature or process cooling

Analog Signal Inputs - Control virtually any measureable and adjustable process where the measuring device has an analog output and the adjusting device may be controlled by one of the D1C's available control outputs

Peracetic Acid - Monitor or control concentration to ensure disinfection

Hydrogen Peroxide - Control peroxide metering pump for oxidation or advanced oxidation (AOX) systems

User Interface
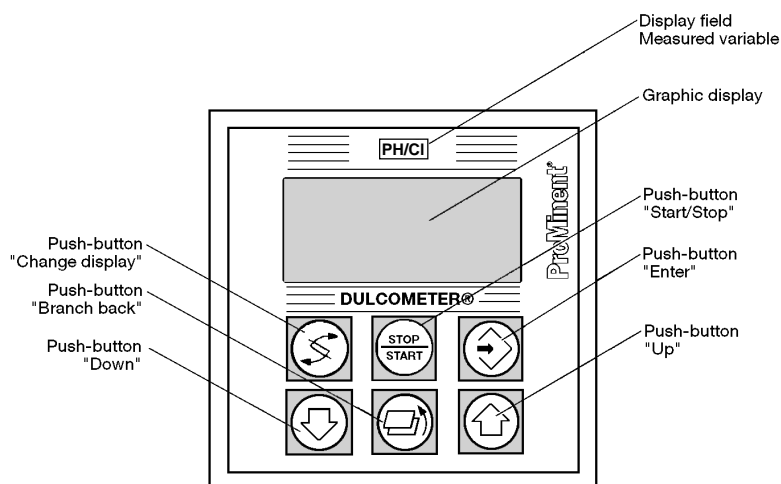
	CHANGE DISPLAY menu button To change over within a menu level and to change from one variable to another within a menu point.			UP menu button To increase a displayed numerical value and to change variables (flashing display).
	START/STOP menu button Start/stop of control function.			BRANCH BACK menu button To exit operating menu (back to start of relevant setting).
	ENTER menu button To accept, confirm or save a displayed value or status. For alarm acknowledgement.			DOWN menu button To decrease a displayed numerical value and to change variables (flashing display).

Identity Code: DULCOMETER® D1C Controller

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D1C															

Series:
D1C DULCOMETER one-variable

Series version:
A Standard

Type of mounting:
W Wall mounting
D Panel mounting

Operating voltage:
0 230 VAC, 50/60 Hz, 1 ph.
1 115 VAC, 50/60 Hz, 1 ph.
4 24 V AC/DC   *Note:* Power cord not included with unit. For 115 V US & Canada power cord, see PN. 741203

Measured variables:
P pH
R Redox/ORP
C Chlorine
B Bromine
L Conductivity
Z Ozone
X Dissolved oxygen
D Chlorine dioxide
T Temperature
S Standard process signal (0/4-20 mA)
A Peracetic acid
H Hydrogen peroxide

Connection for sensor input:
1 Standard signal 0/4-20 mA
2 SN6 plug (From pH or ORP sensor cable)
3 Terminal for standard conductivity cell (L)
4 Terminal for PT 100 temperature sensor (T)
5 Terminal for mV signal (From pH or ORP sensor cable)

Correcting value: (** Not available for measured variables A & H)
0 None**
1 pH for free chlorine via 4-20 mA signal
2 Temperature correction terminal for P or L (Temperature monitoring only for other variables)
3 Temperature correction terminal for 4-20 mA signal for P or L (Temperature monitoring only for other variables)
4 Manual temperature setting for P or L

Feed forward control:
0 None
1 0/4-20 mA signal
2 0-500 Hz signal
3 0-10 Hz signal

Pause contact:
0 None
1 Pause contact

Analog signal output (0/4-20 mA): (** Not available for measured variables A & H)
0 None
1 Measured value (For recording)
2 Control action
3 Measured correcting value
4 Two current outputs **

Relay outputs:
G Alarm + 2 limit relays
M Alarm + 2 control relays
R Alarm + positioner relays w/ position feedback potentiometer

Pump pacing:
0 None
2 Two pulse control outputs

Control action:
0 None
1 Proportional control
2 PID control

Interface:
0 None

Language: (Other Languages available)
D German
E English
F French
S Spanish
I Italian

D1C	A	W	1	P	2	2	1	1	1	G	2	2	0	E

Identity Code: DULCOMETER® D2C Controller

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Series:		
D2C	DULCOMETER® two-variable	

	Series version:
A	Standard

	Type of mounting:
W	Wall mounting
D	Panel mounting

	Operating voltage:
0	230 VAC, 50/60 Hz, 1 ph.
1	115 VAC, 50/60 Hz, 1 ph.
4	24 V AC/DC
	Note: Power cord not included with unit. For 115 V US & Canada power cord, see PN. 741203

	Measured variables:	
PC	pH/Chlorine	* Requires Signal Converter
PR	pH/Redox*	ORP 809127 (for PR option)
PP	pH/pH* (variable 1 can be controlled, variable 2 is for monitoring)	PH 809126 (for PP option)

	Measurement variable 1 connection (Variable 2 connection: 4-20 mA):
1	Standard signal 0/4-20 mA
2	SN6 plug (From pH or ORP sensor cable)
5	Terminal for mV signal (From pH or ORP sensor cable)

	Correcting value:
0	None
2	Temperature correction terminal
4	Manual temperature setting

	Pause contact:
0	Standard, with pause contact

	Analog signal output (0/4-20 mA):
0	None
4	Two current outputs

	Relay outputs:
G	Alarm + 2 limit relays
M	Alarm + 2 control relays

	Control action:
1	Proportional control
2	PID control

	Interface:
0	None

	Language: (Other Languages available)
D	German
E	English
F	French
S	Spanish

D2C	A	W	1	PR	1	0	0	4	G	1	0	E

Identity Code Options for D1C / D2C Controllers

NOTE: OPTIONS ARE NOT IDENTICAL FOR THE D1C / D2C CONTROLLERS. REFER TO THE IDENTITY CODE.

SERIES:

D1C = Single variable controller

D2C = Dual variable controller

SERIES VERSION:

A = Standard

MOUNTING:

W = Wall mount enclosed in NEMA 4X non-metallic housing. Includes detachable mounting plate in back to allow easy removal from wall. Features five Pg11 and five Pg7 glands for wiring power cord, relays, SN6 connectors, etc.

D = Panel mount (no enclosure). Fits 3.78" x 3.78" (9.6 cm x 9.6 cm) opening, 5.51" (14 cm) depth. The unit must be mounted in an enclosure suitable for the environment. The controllers's membrane switch face and gasketed frame provide NEMA 3 (IP 54) protection; mounting hardware included. For optional wall mount enclosure for the panel mount controller, see PN 790235.

OPERATING VOLTAGE:

0 = 230 VAC, 50/60 Hz, 1 phase
1 = 115 VAC, 50/60 Hz, 1 phase
4 = 24 V AC/DC

Note: Power cord not included with unit. For 115 V US power cord, see PN 741203.

D1C MEASURED VARIABLES:

P = pH: For wall mount, use connection 2 (SN6) for push-and-twist connectors with pH sensors. For panel mount, use terminal connection 5 for same sensors. For distances between 30 and 300 feet from sensor to controller, add impedance converter, PN 305350. For distances > 300 feet from sensor to controller or with stray currents, use connection 1 with signal converter pH-V1 (PN 809126) giving 4-20 mA output.

R = Oxidation Reduction Potential: For wall mount, use connection 2 (SN6) for push-and-twist connectors with ORP sensors. For panel mount, use terminal connection 5 for same sensors. For distances between 30 and 300 feet from sensor to D1C, add impedance converter, PN 305350. For distances > 300 feet from sensor to D1C or with stray currents, use connection 1 with signal converter RH-V1 (PN 809127) giving 4-20 mA output.

C = Chlorine; use connection 1. For free chlorine (hypochlorous acid) measurement, use CLE-3-mA sensors. See "correcting value" for optional pH correction on free chlorine. For total chlorine, use CTE-mA sensors.

B = Bromine; use connection 1 and bromine BRE 1-mA-10 ppm sensor.

L = Conductivity; use connection 1 for conductivity cells with transducer giving 4-20 mA output. Use connection 3 for standard conductivity cells.

Z = Ozone; use connection 1 and OZE 3-mA-2 ppm sensor.

X = Dissolved Oxygen; Use connection 1 and DO1-mA-20 ppm sensor.

D = Chlorine Dioxide; use connection 1 and CDE 2-mA - 0.5 ppm, 2 ppm or 10 ppm sensors, or the CDP with PT 100.

T = Temperature; use connection 4, terminal, with PT100 sensor. For distances > 30 feet from sensor to D1C, use connection 1 with signal converter PT-100-V1 (PN 809128) giving 4-20 mA output.

S = Standard signal 0/4-20 mA. Use connection 1 with any measuring device that outputs a 0-20 or 4-20 mA signal corresponding to the measured value. Display is as a percent of input current.

A = Peracetic Acid; use connection 1 with PAA transducer (PN 741128).

H = Hydrogen Peroxide; use connection 1 with Perox transducer (PN 741129).

D2C MEASURED VARIABLES:

PC = pH/chlorine: See above descriptions for each variable.

PR = pH/Oxidation Reduction Potential: See above descriptions for each variable. (Requires Signal Converter PN 809127)

PP = pH/pH: See above descriptions for each variable. (Requires Signal Converter PN 809126) Variable 1 can be controlled, Variable 2 is for monitoring.

CONNECTION FOR SENSOR INPUT (FOR VARIABLE 1 CONNECTION ON D2C CONTROLLERS):

1 = Standard signal 0/4-20 mA

2 = SN6 plug connector for pH (P) or ORP (R). Usually, this is only used with the wall mount since SN6 plugs cannot pass through cable glands on a panel mount enclosure.

3 = Terminal for standard conductivity cell (L)

4 = Terminal for PT 100 temperature sensor (T)

5 = Terminal for mV input on standard pH (P) or ORP (R) sensors

CORRECTING VALUE:

0 = None

1 = pH for free chlorine (total chlorine does not require pH correction); corrects CLE sensor's hypochlorous acid (HOCl) measurement by chlorine dissociation curve to display free chlorine (HOCl + OCl⁻). The correcting pH input must be a 4-20 mA signal, requiring signal converter PH-V1 (PN 809126).

2 = Temperature for P or L via terminal for PT-100 sensor. Required for accurate pH measurement when operating at extreme pH values and high temperatures. Required for accurate conductivity measurement at varied temperatures. (Temperature monitoring only for other variables)

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3 = Temperature for P or L via 0/4-20 mA signal; used with signal converter PT-100-V1 (PN 809128) and PT-100 sensor. Feed Forward control is not possible with this option. (Temperature monitoring only for other variables)

4 = Manual temperature entry for P or L (no sensor); used where temperature is constant.

FEED FORWARD CONTROL - The D1C's control output is based on measured value; however, with feed forward control, a signal from a flow meter proportions the control output considering both the measured value and process flow rate. This eliminates the need for both variable speed drives and stroke positioners on compound loop control metering pumps. Several types of signals may be accepted proportional to process flow:

0 = None

1 = 0/4-20 mA signal (such as from a magmeter or open channel flow meter) Note: cannot be used for chlorine measurement with pH compensation (D1C)

2 = 0-500 Hz signal (such as from a paddlewheel sensor)

3 = 0-10 Hz (0-600 pulses/min.) signal (such as from a pulse-type water meter)

PAUSE CONTACT - The pause contact allows the controller to continue monitoring measured value, but stops control outputs when the NC contact is opened. This may be used to stop metering when a main water pump is stopped, or when water flow in the sample line to the sensor is blocked as signaled by the DGMa rotameter:

0 = None (D1C); Pause contact (D2C)

1 = Pause contact (D1C)

ANALOG OUTPUTS (0/4-20 mA) - Analog outputs can be programmed as a control output or a measured value output for recording. Up to 2 analog outputs are possible except for Hydrogen Peroxide and Peracetic Acid controllers.

0 = None

1 = Measured value; normally used for chart recorder, datalogger or DCS.

2 = Control action; normally used to control a variable speed drive or actuator.

3 = Measured correcting value; normally used for recording or as input to a second D1C.

4 = Two current outputs (Not for measured variables A and H)

RELAY OUTPUTS:

G = Alarm + 2 limit relays: limits may be on either side of setpoint, or both limits may alarm on one side, such as low limit and low, low limit. May be used to start a constant rate feeder for simple setpoint control, or a baseline feeder to handle large swings with trim pump on the control output.

M = Alarm + 2 control relays: used to start and stop constant speed pumps or to open and close solenoid valves for opposing functions. Modulating output corresponds to the control action selected (proportional or PID). The minimum "on-time" period may be adjusted from 1 to 9,999 seconds.

R = Alarm + 2 positioner relays with positioner feedback from 1 kOhm feedback potentiometer. Positioner status displayed on LCD. Used for ProMinent 3P stroke positioning motors or valve positioners. Output corresponds to the control action selected (proportional or PID).

PUMP PACING - gives pulse outputs for controlling 1 or 2 metering pumps:

0 = None

2 = Outputs for one or two pulse-control metering pumps (spannable from 0-500 pulses per minute); for opposing functions. Pulse (dry contact) output corresponds to the control action selected (proportional or PID).

CONTROL ACTION:

0 = None; for use as monitor or setpoint relay controller only.

1 = Proportional control; used for batch processes, where output signal is proportional to the measured variable such that the farther from setpoint the greater the output; the closer to setpoint the lesser the output.

2 = PID control; used for once-through or difficult to control processes, providing proportional, integral and derivative control actions, or a combination thereof.

INTERFACE:

0 = None (Future versions will have RS interface available)

LANGUAGE - Note that it is possible to change among other languages in the field, as indicated in parentheses:

†E = English (D, F, N)   †D = German (E, F, N)

†F = French (D, E, N)   H = German (F, I, S)

S = Spanish (D, I, F)   I = Italian (D, F, S)

Call for other available languages.

†Languages available for measured variables A and H

NOTE: Power cord not included.

Power cord, 6 ft. (2 m) 115 VAC   741203

Power cord, 6 ft. (2 m) 230 VAC   7724015

Specifications for Wall and Panel Mount D1C/D2C

ProMinent®

Temperature data (Panel Mount)
Permissible ambient temperature
Basic version: Control panel installation: 32° to 122°F (0° to 50°C)
Installation in wall-mounted housing: 23° to 113°F (-5° to 45°C)

Extended version (with status feed-back or with correction value via mA or with disturbance variable via mA: Control panel installation: 32° to 113°F (0° to 45°C)
Installation in wall-mounted housing: 23° to 104°F (-5° to 40°C)
Permissible storage temperature: Control panel installation: 14° to 158°F (-10° to 70°C)

Material data/chemical resistance:

Part	Material
Housing and frame	PPO GF 10
Rear panel	PPE GF 20
Membrane keypad	Polyester film PET
Seal, outside	Cellular rubber CR
Seal, inside	Silicon-based sealing compound
Retaining clip and screws	Galvanized steel

Temperature data (Wall Mount)
Permissible ambient temperature
Basic version: 23° to 122°F (-5° to 50°C)
Installation in wall-mounted housing: 23° to 113°F (-5° to 45°C)

Extended version (with status feed-back or with correction value via mA or with disturbance variable via mA: 23° to 104°F (-5° to 40°C)
Permissible storage temperature: 14° to 158°F (-10° to 70°C)

Material data/chemical resistance:

Part	Material
Housing	Luranyl PPE GF 10
Membrane keypad	Polyester film PET
Housing seal	Cellular rubber CR
Outer seal	Cellular rubber CR
Retaining bracket	Galvanized steel
M5 screws	A2

Standards: Supply voltage in accordance with DIN IEC 38
Electrical safety in accordance with EN 61010-1
Electromagnetic emitted interference in accordance with EN 55011 Gr.1/C1.A
CSA special inspection

Electrical data:	**Panel Mount**	**Wall Mount**
Rated voltage:	115/230 VAC, 50/60 Hz	115/230 VAC, 50/60 Hz
Max. power input:	140 mA at 115 V	120 mA at 115 V
	70 mA at 230 V	60 mA at 230 V
Internal fuse protection:	Fine-wire fuse 5 x 20 mm	Fine-wire fuse 5 x 20 mm
	250 V slow-blow	250 V slow-blow
	100-115 V = 315 mA	100-115 V = 315 mA
	200-230 V = 160 mA	200-230 V = 160 mA

Rated voltage:	100/200 VAC, 50/60 Hz
Max. power input:	150 mA at 100 V
	75 mA at 200 V
Internal fuse protection:	Fine-wire fuse 5 x 20 mm
	250V slow-blow
	100-115 V = 315 mA
	200-230 V = 160 mA

Electrical data for both wall mount and panel mount D1C's

Rated voltage: 24 VDC or 24 VAC, 50/60 Hz (low voltage operation only)
Internal fuse protection: Fine-wire fuse 5 x 20 mm
250 V slow-blow, 100-115 V = 315 mA, 200-230 V = 160 mA

Specifications (cont.)

Sensor input via SN6 socket:	Input impedance > 10^{12} Ω
	Input impedance with reference electrode with respect to:
	Device ground: <1 kΩ
	Input range: ±1 V
	Accuracy: ±0.5% of input range
	Resolution: 0.0625% of input range
	Connection facility for one potential equalization electrode (solution ground). As an alternative, two connection terminals can be connected with a wire jumper.
Sensor input via terminals:	Input impedance: >5 x 10^{11} Ω
	Input impedance with reference electrode with respect to:
	Device ground: <1 kΩ
	Input range: ±1 V
	Accuracy: ±0.5% of input range
	Resolution: 0.0625% of input range
	Connection facility for one potential equalization electrode (solution ground). As an alternative, two connection terminals can be connected with a wire jumper.
Standard signal input for measured variable:	Input range: 0/4...20 mA (programmable)
	Input impedance: 50 Ω **(Panel Mount)**; -50 Ω **(Wall Mount)**
	Accuracy: 0.5% of input range
	Resolution: 0.014/0.012 mA
	Supply voltage and current for external electronics: 20 V ±0.5 V, 20 mA
Standard signal input for correction measured value or disturbance variable mA:	Galvanically isolated from remaining inputs and outputs
	Insulation voltage: 500 V
	Input range: 0/4...20 mA (programmable)
	Input resistance: 50 Ω
	Accuracy: 0.5% of input range
	Resolution: 0.014/0.012 mA
	Supply voltage and current for external electronics: 23 V ±1 V, 20 mA **(Panel)** 19 V ±1.5 V, 20 mA **(Wall)**
Pt100 input:	Input range: 32° to 212°F (0° to 100°C)
	Accuracy: ±0.5°C
	Resolution: 0.1°C
Digital inputs:	Common reference potential with respect to each other and with the RS 232 interface, but galvanically isolated from remaining inputs and outputs
	Insulation voltage: 500 V **(Wall Mount only)**
	Disturbance variable: Up to 10 Hz or up to 500 Hz (as per identity code/ programmable)
Status signaling input:	Galvanically isolated from remaining inputs and outputs
	Insulation voltage: 500 V
	Potentiometer to be connected: 800 Ω ...10 kΩ
	Accuracy (without potentiometer error): 1% of input range
	Resolution: 0.5% of input range
Current output:	Galvanically isolated from remaining inputs and outputs
	Insulation voltage: 500 V **(Wall Mount only)**
	Output range: 0/4...20 mA (programmable)
	Maximum load: 600 Ω
	Accuracy: 0.5% of output range with respect to displayed value
Frequency outputs (Reed relay)	Type of contact: n/o contact, interference suppressed with varistors
	Load capacity: 100 V peak, 0.5 A switching current **(Panel Mount)** 25 V peak, 0.5 A switching current **(Wall Mount)**
for pump control:	Contact service life: >50 x 10^6 switching operations at contact load 10 V, 10 mA
	Max. frequency: 8.33 Hz (500 strokes/min)
	Closing time: 100 ms
Power relay output for alarm signaling:	Type of contact: Changeover contact, interference supressed with varistors
	Load capacity: 250 VAC, 3 A, 700 VA
	Contact service life: >50 x 10^6 switching operations **(Panel Mount)** >20 x 10^6 switching operations **(Wall Mount)**

Specifications (cont.)

Power relay output for	Type of contact:	n/o contact, interference supressed with varistors
for control variable output	Load capacity:	250 VAC, 3 A, 700 VA
or limit value signaling:	Contact service life:	>20 x 10^6 switching operations

Electrotechnical Safety/Radio Interference Protection:

EC low voltage directive (73/23/EEC) subsequently 93/44/EEC

EC EMC directive (89/336/EEC) subsequently 92/31/EEC

Supply voltage in accordance with DIN IEC 38

Electrical safety in accordance with EN 61010-1

Electromagnetic emitted interference in accordance with EN 55011 Gr. 1/Cl B

Noise immunity in accordance with IEC 801-2, -3, -4 or DIN VDE 0843, Part 2,
  Part 3, Part 4 or EN 50082-2

| *EN 60335-1:*	Safety of electrical devices for domestic use
EN 50081-1:	EMC, emitted interference, residential
EN 50082-2:	EMC, noise immunity, industrial
EN 60555-2:	EMC, reactions in power supply networks, harmonics
EN 60555-3:	EMC, reactions in power supply networks, voltage fluctuations

ProMinent®

DULCOMETER®
D1C Cooling Tower Controller

The **DULCOMETER® D1C Cool-Control** is a compact system for cooling tower control. It can carry out all necessary functions, i.e. blowdown, biocide and inhibitor control. The Cool-Control controls blowdown on the basis of the conductivity measured in the recirculating water.

The Cool-Control activates the inhibitor pump based on the signal of a make-up water meter. The controller displays concentration in ppm. The Cool-Control can control two biocide pumps independently via a daily/ weekly timer. Up to 10 processes can be programmed.

The Cool-Control processes the conductive conductivity input signal, displays the measured value and transmits it via a 4-20 mA output.
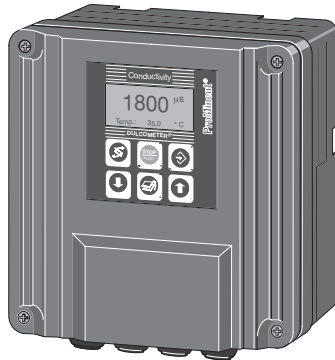
Features

- Blowdown control

- Inhibitor feed control

- Metering of up to four biocides

- Daily and four week timer

- Blowdown enabling/disabling

- Calibration function for metering pumps

- Water meter input with adjustable pulse interval

- Pause input

- Signal output for conductivity, 0/4 - 20 mA, electrically isolated

- Alarm relay output

- Adjustable alarm limit values for measured conductivity

- Wall and panel mounted housing

Applications: Cooling towers, air scrubbers

pk_5_006_1

pk_5_011

Cool-Control

DULCOMETER® D1C Cooling Tower Controller

ProMinent®
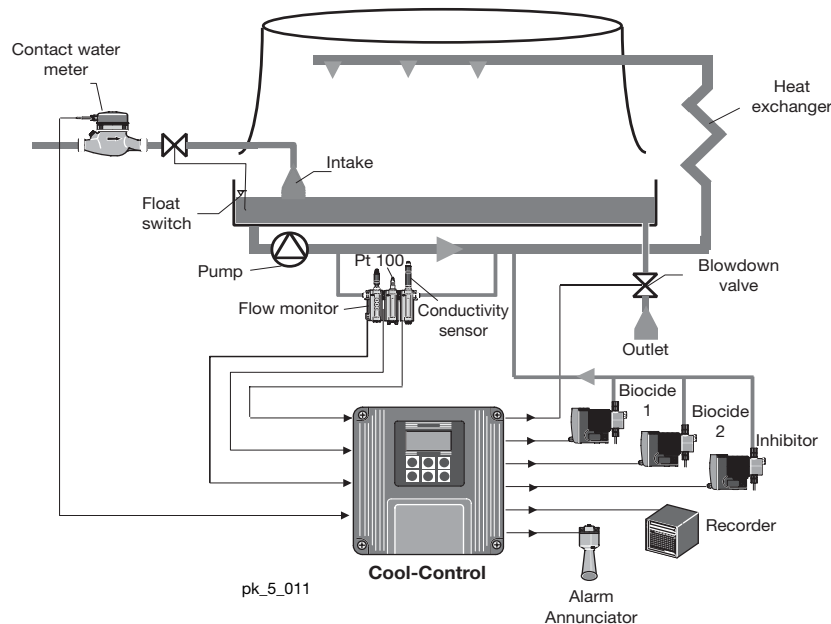
Technical Data:

Conductivity measurement range:	500/2000/5000 μS/cm, 20 mS/cm
Cell constant:	0.006 - 12.0 (depends on measurement range)
Resolution:	0.0625% of input range
Repeatibility:	0/.5% from measurement range
Conductivity Measurement freq.:	56 Hz - 2.7 kHz
Measurement input:	terminal (conductive 2- and 4-electrode sensors)
Correction variable:	temperature
Blowdown control means:	2-point control with hysteresis
Signal current output:	1 x 0/4-20 mA electrically isolated, max. load 600 Ω, adjustable measured variable range
Control outputs:	2 reed contacts for control of inhibitor and biocide pump 1 2 relays for control of biocide pump 2 and blowdown valve
Alarm relay:	250 V ~ 3 A, 700 VA contact type N.O./N.C.
Power supply:	24 V approx. 115 V~/230 V~ ±10%
Ambient temperature:	panel mounted: 32 to 122ºF (0 to 50ºC) wall mounted: 23 to 122ºF (-5 to 50ºC)
Enclosure rating:	panel mounted: NEMA 3 (IP 54) wall mounted: NEMA 4X (IP 65)

5) *Dimensions*:	panel mounted: 3.8 x 3.8 x 5.5 in. (WxHxD)
	        (96 x 96 x 140 mm)
	wall mounted: 7.4 x 7.9 x 3 in. (WxHxD)
	        (189 x 200 x 76 mm)

Accessories:	
Conductive conductivity sensors:	see DULCOTEST section
Inline probe housings, signal leads:	see DULCOTEST section

	Order No.
Control panel assembly kit for installation (wall mount version)	792908

Cool Control System Requirements

DULCOMETER D1Ca Cool Controller (see Ident Code)

DULCOTEST Conductivity Sensor with temperature compensation or Conductivity Sensor and PT 100 Temperature Sensor

DGMa Inline Sensor Holder(s) (to mount sensor in process)

Sensor Cable

Identity Code: DULCOMETER® D1C Cool-Control

ProMinent®

D1C	**Series:** DULCOMETER Cool Control, Type D1C		

A	**Series version:** Standard	

W	**Type of mounting:** Wall mounting	
D	Panel mounting	

Operating voltage:
0   230 VAC, 50/60 Hz, 1 ph.
1   115 VAC, 50/60 Hz, 1 ph.
4   24 V AC/DC   *Note:* Power cord not included with unit. For 115 V US & Canada power cord, see PN. 741203

Measured variables:
K   Conductivity for cooling tower control

Measured variable connection:
3   Conductive conductivity sensor terminal

Correcting value:
0   None
2   Temperature via terminal (Pt 100)
4   Manual temperature input

Make-up water meter input:
0   None
2   0-500 Hz (Signal)

Pause contact:
0   None
1   Pause contact

Analog signal output (0/4-20 mA):
0   None
1   Measured value (Conductivity)

Relay output:
G   Alarm + 2 output relays (blowdown valve and biocide 2)
S   Alarm + servomotor (blowdown valve only)

Pump pacing:
2   Two pumps (inhibitor and biocide 2)

Control action:
0   2-point control with hysteresis/blowdown

Interface:
0   None

Language: (Other Languages available)
D   German
E   English
F   French
S   Spanish

This identcode describes a D1C A series controller for wall mounting and 115 V operating voltage.

The measured variable is conductive conductivity.

A temperature sensor for correcting the conductivity is connected via a terminal.

D1C	A	W	1	K	3	2	0	0	0	G	2	0	0	E

Fluoride Monitoring System

Fluoride Monitoring System

The D1C fluoride monitoring system incorporates the first buffer or reagent-free, ion specific sensor with a DULCOMETER® D1C fluoride monitor. The monitor features upper and lower limit relays with alarm, and analog output for recording.

Note: The fluoride D1C is for analysis only.

Measuring Principle & Application

The D1C fluoride monitoring system is based on the principles of potentiometric measuring using a reagent-free, ion specific sensor & reference electrode. The fluoride sensor features a continuous electrode activation function, ensuring long-term stability of the measurement without the need for frequent recalibration or conditioning chemicals. The fluoride sensor automatically compensates temperature, but a temperature sensor is also used to compensate for fluctuation during application.

The fluoride sensor is recommended for use in water treatment only (patent pending). We recommend installation at atmospheric pressure.

### Measuring Ranges & Operating Conditions of Fluoride Sensor

Measurement Range:	0.05 to 10 ppm fluoride
pH Operating Range:	5.5 to 8.5
Temperature Range:	34 to 95°F (1 to 35°C)
Max. Operating Pressure:	101.5 psi (7 bar) **Note:** the maximum admissible operating pressure for the monitoring system is 14.5 psi (1 bar) determined by the in-line sensor housing.
Sensor Response Rate T_{90}:	approx. 30 seconds
Reproducible Measuring Accuracy:	0.1 ppm
Measurement Water Flow Rate:	16 gph (60 L/h)

Fluoride Monitoring System

Part No.
7744836
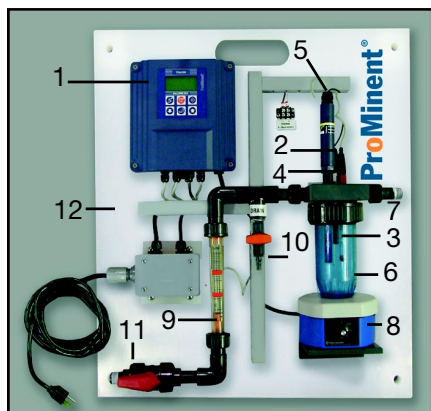
- D1C Fluoride Monitor (1)
- Fluoride sensor (2): FLE 010 SE with PG 13.5 male threaded connector & SN6 plug
- Reference electrode (3): REFP-SE with PG 13.5 male connector & SN6 plug
- Temperature sensor (4): PT 100 SE with PG 13.5 connector & SN6 plug
- 4-20 mA Measurement transducer (5): FV1 for connection to fluoride monitor & reference electrode
- DLG IV In-line sensor housing (6): with PG 13.5 threaded connector
- Sample outlet (7)
- Magnetic stirrer and magnet (8)
- PVC piping with ball stop/adjusting valve, rotameter with limit contact (9), sampling tap (10)
- Sample inlet (11)
- 115V Power cord, connectors from monitor to sensors
- PP Backpanel (12)
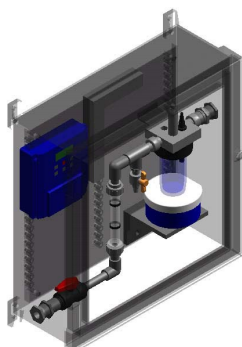
Options

Stand Base	7744837
NEMA 4X enclosed	7744711
Heater	7744722
Sun shield	7744723

Fluoride Monitoring System
Accessories

Description	Part No.

Accessories

Replacement Sensors

FLE 010 SE Fluoride Sensor
  with PG 13.5 male threaded connector and SN6 plug   1010311

REFP-SE Reference Electrode
  with PG 13.5 male connector and SN6 plug   1018458

PT 100 SE Temperature Sensor
  with PG 13.5 male connector and SN6 plug   305063

FV1 4-20 mA Measurement Transducer
  for connection to fluoride monitor and reference
  electrode   1009962
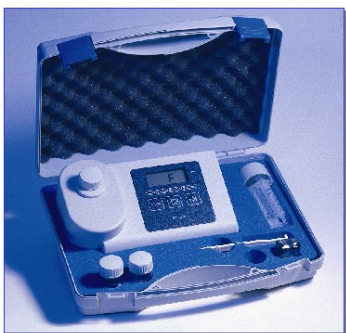
Fluoride Photometer

The D2TA or D2TB Photometer (see DULCOMETER section, pp. 34-35) can be used to calibrate the fluoride monitor.

Measurement Range:	**DT2A**	0.05 to 2 mg/L fluoride
	DT2B	0.05 to 2 mg/L fluoride
		0.05 to 6 mg/L free or total chlorine
		0.01 to 11 mg/L chlorine dioxide

D2TA kit with carry case   1010383
D2TB kit with carry case   1010394

DULCOMARIN®
Swimming pool controllers

2591/3

DULCOMARIN® swimming pool controller

The DULCOMARIN® swimming pool controller is a measurement and control system designed exclusively for the special require-ments in swimming pools. The self-adjusting control behavior, adaptive control, ensures optimum measuring results. Pre-selected set values and alarm values enable the device to be operated easily.

The basic version of the DULCOMARIN® swimming pool controller has two measuring inputs for the variables pH and chlorine con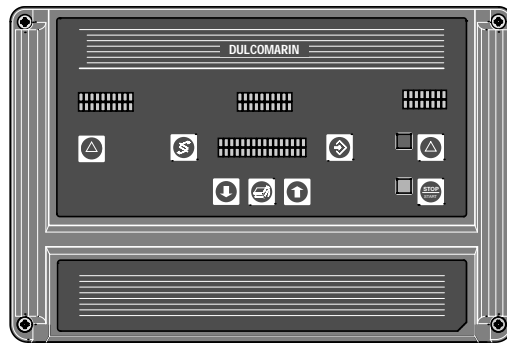centration, or pH and redox potential. A remote control input enables the control to be stopped; for example, during backwash of the filter. Another contact input enables the alarm annunciation, if there is no measuring fluid or for other external faults. A distur-bance signal input ensures that the control of whirlpools can also take place optimally.

Two pulsed contact outputs for controlling beta, gamma, or Vario metering pumps, as well as a relay output for the collective fault indication, are available. Selectable via an identity code, the device can be equipped with 0/4-20 mA outputs for the recording of the measured values and can additionally be equipped with a RS 232 interface for data collection.

Measured values appear on a large, brightly illuminated, seven-segment digit display; a two-line, 16 digit alpha-numeric display shows helpful text screens to aid in calibrating and settings. Alarm messages are also displayed when fault relays are indicated.

An additional feature is the point-of-use signal converter which converts the sensor signals into disturbance-free 4 - 20 mA standard signals. The connection between the sensors and the DULCOMARIN® swimming pool controller can therefore take place with normal twisted pair (therefore eliminating the need for special coaxial cable between the signal converter and the DULCOMARIN®).

DULCOMARIN® add-on model

The DULCOMARIN® add-on model can be equipped with up to four measurement inputs. In addition to the pH value, the redox potential and the chlorine concentration, the temperature of the pool can also be recorded. The fourth measurement variable, temperature or redox potential can selectively be signalized on the additional seven-segment display or on the LCD display. The swimming pool controller designed for public pools has, optionally, an input for the position feedback of chlorine gas control valves. On the output side there are two additional relays for controlling a chlorine gas control valve. Optionally, all four measured values can be recorded via 0/4 - 20 mA outputs.

Presetting

All operating values of the device can be freely set using the keys. In most cases however, the preset values lead to optimal metering.

The following tables provide an overview of the presettings which can be chosen using the identity code. Presettings are selectable for public swimming pools (in accordance with DIN 19643), private pools, whirlpools and pools with higher chlorine concentrations.

DULCOMARIN®
Swimming pool controllers

Preset Target and Alarm Values

"O" private pools:

	Lower limit*	Target value	Upper limit*	Range analog output
pH	pH 6.5	pH 7.2	pH 7.5	pH 2-12
Chlorine	0.2 mg/L	0.3 mg/L	0.5 mg/L	0-1 mg/L
Redox	600 mV	650 mV	700 mV	0-1000 mV

"1" public pools (in accordance with DIN 19643):

	Lower limit*	Target value	Upper limit*	Range analog output
pH	pH 6.5	pH 7.2	pH 7.5	pH 2-12
Chlorine	0.3 mg/L	0.45 mg/L	0.6 mg/L	0-1 mg/L
Redox	750 mV	—	800 mV	0-1000 mV

"2" whirlpools:

	Lower limit*	Target value	Upper limit*	Range analog output
pH	pH 6.5	pH 7.2	pH 7.5	pH 2-12
Chlorine	0.7 mg/L	0.85 mg/L	1 mg/L	0-1 mg/L
Redox	750 mV	—	800 mV	0-1000 mV

"3" pools with high chlorine concentration:

	Lower limit*	Target value	Upper limit*	Range analog output
pH	pH 6.8	pH 7.2	pH 7.8	pH 2-12
Chlorine	1 mg/L	1.5 mg/L	2.5 mg/L	0-5 mg/L
Redox	600 mV	700 mV	800 mV	0-1000 mV

*Activates alarm relay

Technical data:

Dimensions:	Wall mounted: 13.46" x 8.94" x 3.07" (342 x 227 x 78 mm) (w x h x d)
	Panel mounted: 13.46" x 8.94" x 1.57" (342 x 227 x 40 mm) (w x h x d)
Enclosure rating:	NEMA 4 wall mounted
	NEMA 3 panel mounted
Power supply:	115V / 230V (+10 / -15%) 50/60 Hz
Contact inputs:	Input impedance 1 kΩ
	contact load 7 mA closed, 24 V = open
	5 voltage free (sample water, pause, 2 pump failure, disturbance signal)
Analog inputs:	4 - 20 mA
Analog outputs:	0/4 - 20 mA; max. burden 600 Ω
Frequency outputs:	Reed contacts 24 V / 50 mA resistive load only
	closing time 100 ms; rating 0 - 120 pulses per min.
Relay outputs:	Change-over contact for alarm relay: NO for other relays.
	load: 250 V / 3 A / 700 VA; for inductive loads surge protection must be used.

Identity code ordering system for ProMinent®
DULCOMARIN® swimming pool controllers

DCM	**Series:** DULCOMARIN											
	b	**Series version:** Standard										
		0 1	**Version:** Basic version Add-on version									
			W S	**Type of assembly:** Wall mounting Panel mounting								
				0 1	**Operating voltage:** 220 V 115 V							
					0 1 2* 3* 4* 5*	**Measurement variables: **** pH, chlorine (Version 0) pH, Redox (Version 0) from version 1 pH, Redox, chlorine pH, temp., chlorine pH, Redox, temp., chlorine (4th measurement variable on LCD) pH, temp., chlorine, Redox (4th measurement variable on LCD)						
						0 1* 2 3* 4 5	**Other control outputs:** None Control 3P stroke positioning motor Solenoid valve, pH Solenoid valve, pH + stroke positioning motor chlorine Solenoid valve, pH + solenoid valve, chlorine Solenoid valve, chlorine					
							0 1	**Analog event outputs:** None For all measurement variables				
								0 1	**Interface:** No interface RS 232 interface			
									D E F I N S	**Language presetting:** German English French Italian Dutch Spanish		
										0 1 2 3	**Presetting target and alarm values:** Private pool Public pool Spa Higher chlorine values	
											0 1	**Presetting uniform for all analog outputs (If present):** 0-20 mA 4-20 mA

* Only possible in add-on version.

** Frequency (pulse) control outputs for metering pump control are included with each measured variable selected (except temperature), unless other outputs are selected. Each measured variable selected has high and low alarm setpoints with a common alarm relay for that variable.

DCM	b	1	W	1	2	0	1	0	E	1	1

ProMinent®

DULCOMETER® DSR
Swimming Pool Controller

Description	Part No.

DSR Swimming Pool Controller

ProMinent® DULCOMETER® DSR Swimming Pool Controller is a dual controller for measuring pH and Redox (ORP) values. A large illuminated LCD displays parameters in pH / mV and/or ppm (for measuring oxidizing disinfectants such as chlorine and bromine). Dulcotest® sensors are directly connected via terminals; two powered relay outputs are available to control pumps. These can be programmed for either proportional control or On/Off control.

DSR Features:

- Dual readout (pH/mV and/or ppm)
- Proportional controller
- NEMA 4X housing
- Compact design
- Available as pre-assembled package including pumps, sensors, and sensor housing
- Simple calibration
- Pause input, adjustable
- Sample flow input, adjustable
- Control 2 pumps

DSR pH / Redox Controller

pH / mV display, 115V	7781216
pH / ppm display, 115V	7781204

Specifications for DSRa Controller

Measuring range:	ph 2...12 and ORP 100...1000 mV
Control outputs:	Powered 120 VAC, 3 amp. resistive only Pulse length control relays with proportional control function, switchable to On/Off function
Control inputs:	2 inputs; pause and loss of sample flow
Sensor connections:	Terminals
Operating voltage:	115 VAC, 50/60 Hz
Display:	Illuminated LCD graphic display 100 x 32 dots
Display resolution:	0.01 pH, 1mV/0.01 ppm
Housing:	PPE fiberglass reinforced for wall mounting
	7.8" x 7.8" x 3" (198 x 200 x 76 mm) (L x H x D) - Grey color
Ambient temperature:	23 to 122°F (-5 to 50°C) in operation; 14 to 158°F (-10 to 70°C) in storage/transport
Degree of protection:	NEMA 4X (IP 65)
Language:	English
Recommended pH sensor:	PHE 112 SE	305054
Recommended ORP sensor:	RHE-Pt-SE	305001
Recommended pumps:	ProMinent® alpha, Dulcoflex series

DULCOMETER®
DMTa Transmitters

Description **Part No.**

DMTa Transmitter

ProMinent® DULCOMETER® DMT transmitters are compact, intelligent two-wire technology devices for measured variables pH, redox, chlorine, temperature and conductivity.

Conductivity
ProMinent®
CAL

Summary of advantages:

- Reliable measurement
- High level of operating safety
- Simple, flexible installation
- Full text user guidance
- Automatic buffer recognition (pH)
- Autoranging (conductivity)
- Compact design
- Switch between pH, redox and temperature.
- Field bus capabilities

Applications (Process control in):

- Food and beverage industry
- Chemical industry
- Pharmaceutical industry
- Water treatment
- Wastewater treatment

Specifications for DMTa Transmitters

Measurement range:	-1.00 to 15.00 pH -1200 to 1200 mV Redox voltage 0.01 to 50.0 mg/L chlorine 4 to 302°F (-20 to 150°C) 0.00 to 200 mS/cm (autoranging)
Cell constant:	0.006 to 12.0/cm for conductivity
Resolution:	pH: 0.01 Redox: 1 mV Chlorine: 0.1% from measurement range for chlorine Temperature: 32.18°F (0.1°C) Conductivity: Conductivity 1/1000 of display value (min. 0.001 µS/cm)
Repeatability:	0.5% of measurement range
Measurement input:	mV terminal (pH, redox); input resistance > 5 x 10^{11} W Chlorine terminal (DMT chlorine sensors) Pt 100/1000 terminal Conductivity terminals 2 or 4 wire
Correction variable:	Temperature via Pt 100/1000 (conductivity, pH, chlorine)
Correction range:	Chlorine: 41 to 113°F (5 to 45°C), pH: 32 to 212°F (0 to 100°C), Conductivity: 32 to 212°F (0 to 100°C)
Signal output:	4-20 mA
Power supply:	16 - 30 VDC, Loop powered
Communication interface:	Profibus DP (wall mounted version only)
Ambient temperature:	23 to 131°F (-5 to 55°C)
Climatic conditions:	up to 95% relative humidity (above dewpoint)
Enclosure rating:	NEMA 4X (IP 65) for wall mounted unit NEMA 3 (IP 54) for control cabinet installation
Display:	graphical display
Housing:	PPE
Dimensions:	4.9" W x 5.3" H x 3.0" D (125mm W x 135mm H x 75mm D)
Weight:	approximately 0.9 lb. (450 grams)

AC adapter, 24VDC, 500 mA Wall Pack	7500039

DMTa System Requirements

DULCOMETER DMTa Transmitter (see Ident Code)

DULCOTEST Sensor(s) (dependent on measured variable)

DGMa Inline Sensor Holder(s) (to mount sensor in process)

Sensor Cable

Identity code: DULCOMETER® DMTa Transmitters

ProMinent®

	Series:
DMTA	DULCOMETER TRANSMITTERS version A

	Installation:
W	Wall mounted (also column mounted)
S	Control panel installation

	Labeling:
0	Standard with logo

	Electrical Connection:
9	Terminals for 4-20 output, 16-30 VDC loop power supply required
5	Terminals for 4-20 output, 16-30 VDC loop power supply required (for Profibus DP)

	Communication Interface:
0	None
4	Profibus DP (wall-mounted version only)

	Measured Variable 1:	See sensor section for cables.
L	Conductivity	
P	pH	
R	Redox	
T	Temperature	
C	Chlorine	

	Measured Variable 2 (Connection Variable):
1	Temperature Pt 1000/Pt 100
0	None (for measured variable T)

	Enclosure Rating:
0	Standard

	Language:
E	English
D	German
F	French
S	Spanish
I	Italian

The final 4 digits in the identity code give the software presettings, e.g. cell constant at conductivity.

0 = Standard settings

Presettings options available on request.

DMTA	W	0	9	0	L	1	0	E	0	0	0	0

DULCOMETER® Explosion Proof
Transmitters, pH

ProMinent®

Description	Part no.

Measured Variables: pH, Conductivity, Inductive Conductivity

ProMinent® DULCOMETER® two-wire explosion-proof transmitters for measured variables pH and inductive or conductive conductivity.

Summary of advantages:

- Continuous sensor monitoring
- Automatic device self-test
- Easy installation
- Wall, pipe or panel mounted
- Simple to operate (pictograms)
- Large easy-to-read measured variables display
- Explosion-proof

Applications:

- Chemical industry
- Power stations
- Food and beverage industry
- Pharmaceutical industry
- Water and wastewater technology

Transmitter 2201 X pH

pk_5_096

Measurement range:	pH:	0 to +14
	Redox potential:	-1500 to +1500 mV
	Temperature:	-4 to 266ºF (-20 to +130ºC)
Measurement error:	pH:	< 0.02 $\pm$1 digit
	Redox potential:	< 1 mV $\pm$1 digit
	Temperature:	0.9ºF (0.5ºC)
Measurement input:	Terminal	
Sensor monitoring:	Monitoring of glass and reference electrodes (optionally ON/OFF)	
Temperature input:	Pt 100 / Pt 1000 / NTC 30 kΩ	
Current output:	4 to 20 mA, fault current 22 mA	
Supply voltage:	12 to 30 V DC	
Ambient temperature:	-4 to 131ºF (-20 to +55ºC)	
Enclosure rating:	NEMA 4X (IP 65)	
Explosion protection:	II 2 (1) G EEx ib [ia]IIC T6 TUV 01 ATEX 1689; FM and CSA approvals pending	
Display:	LCD	
Dimensions:	5.6" x 4.1" x 5.6" (144 x 105 x 144 mm) (W x H x D)	
Weight:	Approximately 2.2 lbs. (1 kg)	

Transmitter 2201 X pH	1008672

Note: The intrinsically safe repeater power supply is absolutely essential for use in explosion threatened areas.

ProMinent®

DULCOMETER® Explosion-Proof Transmitters, Conductivity

Description	Part no.

Transmitter 2201 X Cond

pk_5_091

Conductivity measurement range:	0.2 µS*c to 1000mS*c (c = cell constant)	
Measurement error:	< 1% of Measured range + 0.4 µS*c	
Measurement range:	Conductivity:	0.000 - 9.999 µS/cm
		00.00 - 99.99 S/cm
		000.0 - 999.9 S/cm
		0.000 - 9.999 mS/cm
		00.00 - 99.99 mS/cm
		000.0 - 999.9 mS/cm
	Specific resistance:	0.000 - 9.999 MΩcm
		00.00 - 99.99 MΩcm
		000.0 - 999.9 MΩcm
	Salinity:	0 to 45%; 32 to 95ºF (0 to 35ºC)
Measurement input:	Terminal	
Sensor monitoring:	Monitoring of polarization and cable influences	
Temperature input:	Pt 100 / Pt 1000 / NTC 30 kΩ/ NTC 100 kΩ	
Temperature measurement range:	NTC -4 to 266ºF (-20 to +130ºC)	
	Pt 100/Pt 1000 -4 to 302ºF (-20 to +150ºC)	
Temperature measurement error:	±0.9ºF (±0.5ºC)	
Current output:	4 to 20 mA, fault current 22 mA	
Supply voltage:	14 to 30 V DC	
Ambient temperature:	-4 to 131ºF (-20 to +55ºC)	
Enclosure rating:	NEMA 4X (IP 65)	
Explosion protection:	ll 2(1) G EEx ib [ia]llC T6; FM and CSA approvals pending	
Display:	LCD	
Dimensions:	5.6" x 4.1" x 5.6" (144 x 105 x 144 mm) (W x H x D)	
Weight:	Approximately 2.2 lbs. (1 kg)	

Transmitter 2201 X Cond	1008704

Note: The intrinsically safe repeater power supply is absolutely essential for use in explosion threatened areas.

DULCOMETER® Explosion-Proof Transmitters, Inductive Conductivity

Description   **Part no.**

Transmitter 2201 X Cond I

pk_5_091

Conductivity measurement range:	0 to 2000 mS/cm	
Measurement error:	< 1% of Measurement range ±1 digit	
Measurement range:	Conductivity:	00.00 - 99.99 mS/cm 000.0 - 999.9 mS/cm 0000 - 9999 mS/cm
	Concentration:	0.0 - 100%/weight
	Salinity:	0.0 to 45%; 32 to 95°F (0 to 35°C)

Conductivity input for connection of inductive sensor LF 654 X

Measurement input:	Terminal
Temperature input:	Pt 100 / Pt 1000 / NTC 30 kΩ/ NTC 100 kΩ
Temperature measurement range:	NTC -4 to 266°F (-20 to +130°C) Pt 100/Pt 1000 -4 to 302°F (-20 to +150°C)
Temperature measurement error:	±0.9°F (±0.5°C)
Current output:	4 to 20 mA, fault current 22 mA
Supply voltage:	14 to 30 V DC
Ambient temperature:	-4 to 131°F (-20 to +55°C)
Enclosure rating:	NEMA 4X (IP 65)
Explosion protection:	II 2(1) G EEx ib [ia]IIC T6; FM and CSA approvals pending
Display:	LCD
Dimensions:	5.6" x 4.1" x 5.6" (144 x 105 x 144 mm) (W x H x D)
Weight:	Approximately 2.2 lbs. (1 kg)

Transmitter 2201 X Cond I   1008705

DULCOMETER®
Transmitters, Inductive Conductivity

ProMinent®

Description	Part no.

Measured Variable: Inductive Conductivity

pk_5_091_2

Summary of advantages:

- Reliable measurement
- High level of operating safety
- Simple, flexible installation
- Full text user guidance
- Automatic buffer recognition (pH)
- Autoranging (conductivity)
- Compact design
- Switch between conductivity and temperature or pH, redox and temperature

Applications: **Process control in:**

- Food and beverage industry
- Chemical industry
- Pharmaceutical industry
- Water treatment
- Wastewater treatment

Transmitter 2401 Cond I

Conductivity measurement range:	0 - 2000 mS/cm
Measurement error:	< 1% of Measurement range ±1 digit
Measurement range:	Conductivity: 00.00 - 99.99 mS/cm 000.0 - 999.9 mS/cm 0000 - 9999 mS/cm Concentration: 0.0 - 100%/weight Salinity: 0.0 to 45%; 32 to 95°F (0 to 35°C)

Conductivity input for connection of inductive sensor LF 654 X

Measurement input:	Terminal
Temperature input:	Pt 100 / Pt 1000 / NTC 30 kΩ/ NTC 100 kΩ
Temperature measurement range:	NTC -4 to 266°F (-20 to +130°C) Pt 100/Pt 1000 -4 to 302°F (-20 to +150°C)
Temperature measurement error:	±0.9°F (±0.5°C)
Current output:	(0)4 - 20 mA, 22 mA in the case of alarm
Auxiliary power:	20 - 253 V AC/DC, approximately 2 VA
Ambient temperature:	-4 to 131°F (-20 to +55°C)
Enclosure rating:	NEMA 4X (IP 65)
Relay outputs:	2 limit relays (no adjustable hysteresis) 1 alarm relay 1 wash contact Load capacity: 250 VAC, 3A 30 VDC, 3A
Display:	LCD
Dimensions:	5.6" x 4.1" x 5.6" (144 x 105 x 144 mm) (W x H x D)
Weight:	Approximately 2.2 lbs. (1 kg)

Transmitter 2401 Cond I	1008706

DULCOMETER®
Transmitter Sensors

Electrodeless sensor LF 654 X for 2201 X Cond I and 2401 Cond I

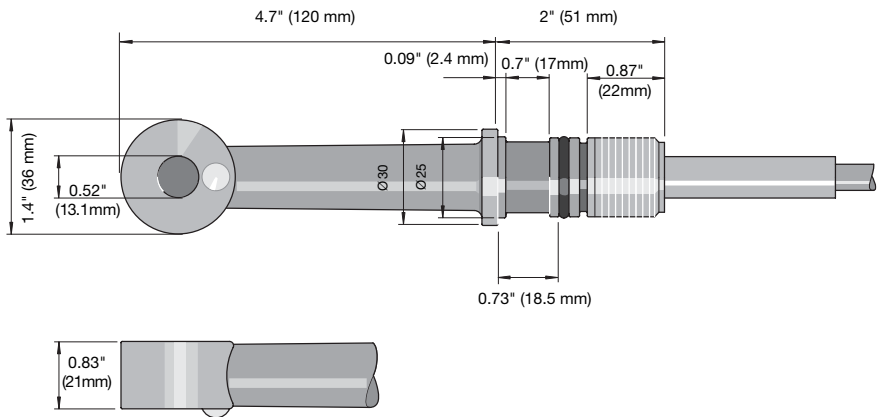|	
Cell factor:	Nominal value 2.25 cm $^{-1}$
Measurement range:	0.001 mS/cm to 2000 mS/cm
Material:	Cell: PEEK, Seal: EPR
Temperature probe:	NTC 100 kΩ
Temperature:	23 to 248°F (-5 to +120°C)
Pressure:	0 to 254 psi (0 to 17.5 bar)
Cable length:	20 Ft. (6 m)
Mounting:	3/4" NPT thread

pk_5_097

Sensor LF 654 X   1008720

DULCOMETER®
Transmitter Accessories

ProMinent®

Description	Part no.

**Repeater power supply for DULCOMETER® 2-Wire Transmitters
(2201 X pH, 2201 X Cond, 2201 X Cond I, 2401 Cond I)**

The Repeater Power Supply supplies intrinsically safe 2-wire transmitters. It powers the transmitter and delivers the measured signal galvanically isolated and at high accuracy to the output.

- Universal power input, 90-250 VAC, EEx Rated
- Extended-range supply
- Protective separation to VDE 0100 Part 410
- High transmission accuracy

Repeater power supply for auxiliary power 90 to 253 V AC	1008721
Optional: auxiliary 24 V AC/DC power supply	1008722

Technical Data:

Supply measurement circuit

Output:	4 to 20 mA
Load:	$\leq$ 13 V
Residual ripple at output:	< 10 mV
Adjustment time:	< 10 ms
Explosion protection:	[EEx ia] IIC PTB No. Ex-96.D.2090; FM and CSA approvals pending. Supply measurement circuit internally safe
Test voltage:	4 kV~ (supply measurement circuit against output and auxiliary power) 3 kV~ (auxiliary power against output)
Protection against dangerous physical currents:	Amplified insulation in accordance with DIN EN 61010-1 and safe isolation in accordance with VDE 0100 Part 410 in the terms of VDE 0106 Part 101
Ambient temperature:	Operation 14 to 140°F (-10 to +60°C) Transport and storage -22 to 176°F (-30 to +80°C)
Construction:	Serial connection housing with snap fastening for 1.37" (35 mm) busbar in accordance with DIN EN 50022, width 0.88" (22.5 mm)
Enclosure rating:	Housing IP 40 Terminals IP 20
Power supply:	90 to 253 V AC, 48 to 62 Hz, approximately 3 VA Optional: 24 V AC/DC
Weight:	Approximately 8.8 oz. or 0.55 lbs. (250 grams)

DULCOMETER®
Transmitter Accessories

Description	Part no.

**DULCOMETER® 2-Wire Transmitters
(2201 X pH, 2201 X Cond, 2201 X Cond I, 2401 Cond I)**

pk_5_094

Pipe mounting set

For mounting onto upright or horizontal pipes or pillars   1008707

pk_5_095

Protective hood

Additional protection against direct weather influences and mechanical
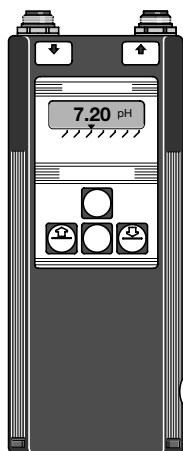strain   1008709

pk_5_104

Panel mounting

For mounting into standard panel 5.66" x 5.66" (144 x 144 mm)
cut-out (DIN 43 700)   1008708

DULCOMETER®
Measuring and Test Instruments

ProMinent®

Description	Part No.

Measurement simulator for pH/mV/Temperature

Microprocessor-based combined measuring instrument and simulator for pH value, redox potential, and temperature.

Functional portable housing with table stand and carrying strap. Sensor input and simulator output through SN 6 connector. Display of measured or simulated values on 3-1/2 digit LCD readout, which also displays arrows to indicate the operating mode.

Measuring ranges: pH 0-14.00, redox -1300 to +1300 mV,
      Temperature: -4 to 248°F (-20 to 120°C)
Simulating ranges: pH 0-14.00, in steps of 0.01 pH
      redox -1300 to +1300 mV in steps of 1 mV
      Temperature: -4 to 248°F (-20 to 120°C) in steps of 32°F
(0.1°C)

This unit is powered by AA batteries.

The following versions are available:

1. DULCOMETER® type pH/mV Test with sensor receptacle, with plastic carrying case, 2 AA batteries and shoulder strap.

pH/mV/T Test, complete,	**Version 1**	1010984

2143/4

2. As Version 1, but additionally provided with type PHE-112-SE pH combination sensor, 2.62 ft. (0.8 m) of sensor cable with SN 6 connectors both ends, with 50 mL each of standardizing solutions pH 7 and pH 4, and 3-M KCl solution.

pH/mV/T Test, complete,	**Version 2**	1010985

3. As Version 2, but additionally provided with type RHE-Pt-SE redox combination sensor and 475 mV standardizing solution.

pH/mV/T Test, complete,	**Version 3**	1010986

Consumable material

Buffer solution, pH 7.0, 50 mL	506253
Buffer solution, pH 4.0, 50 mL	506251
Buffer solution, 465 mV, 50 mL	506240
3-M KCl solution, 50 mL	505533
Type PHE-112-SE pH combination sensor	305054
Type RHE-Pt-SE redox combination sensor	305001
Type PT 1000 temperature sensor	1002856

DULCOMETER®
Measuring and Test Instruments

Simulator for pH/mV/mA/Pt 100/Pt 1000

Combined measuring instrument and simulator for pH value, Redox potential, temperature and mA signal   1004042

Applications:
Testing DULCOMETER® devices, service and laboratory
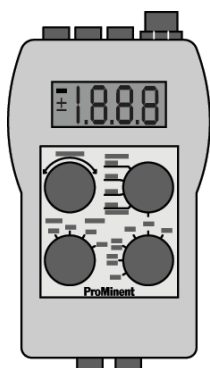
Measurement range:		5 to 30 V DC (measures the supply voltage for external passive 4 to 20 mA transmitters)
Simulation:	pH:	2.00 to 12.00
	Redox:	$\pm$ 2000 mV
	Analog:	0 to 20 mA
	Temperature:	(Pt 100, Pt 1000), 77 to 176°F (25 to 80°C)
Simulation output:		SN6 / banana socket
Battery:		9 V battery
Operating life:		Approximately 150 hours
Weight:		Approximately 9.34 oz. or 0.58 lbs. (265 grams) with battery
Enclosure rating:		IP 20
Ambient temperature:		32 to 104°F (0 to 40°C)

pk_5_108

ProMinent®

DULCOMETER®
Measuring and Test Instruments

Description	Part no.

Photometers

ProMinent® DULCOMETER® Photometers are compact units for simple and reliable measurement of chlorine (free & total), pH, chlorine dioxide, ozone, bromine, cyanuric acid or fluoride.

Photometer

• Portable compact photometer

• Simple to operate with support text

• Self-diagnostic

Applications:
Swimming pool, drinking water, process water

Technical Data

Measurement range DT1:	0.05 to 6.0 mg/L free chlorine (DPD1) or total chlorine (DPD 1+3) 0.1 to 13.0 mg/L bromine (DPD1) 0.1 to 11 mg/L chlorine dioxide (DPD1) 0.03 to 4.0 mg/L ozone (DPD 1+3) 6.5 to 8.4 pH (phenol red tablets) 1 to 80 mg/L cyanuric acid
Measurement range DT2A:	0.05 to 2.0 mg/L fluoride
Measurement range DT2B:	0.05 to 2.0 mg/L fluoride 0.05 to 6.0 mg/L free chlorine and total chlorine 0.01 to 11.0 mg/L chlorine dioxide
Measuring tolerance:	Dependant upon measured variable and measuring method
Battery:	9 V battery (approximately 600 x 4-minute measurement cycles)
Ambient temperature:	0 to 104°F (5 to 40°C)
Relative humidity:	30 to 90% non-condensing
Housing material:	ABS
Keypad:	Polycarbonate
Dimensions:	7.5" x 4.3" x 2.17" (190 x 110 x 55 mm) (L x W x H)
Weight:	Approximately 0.8 lb. (0.4 kg)

DT1

Photometer DT1 kit with carrying case	1003473
Photometer DT2A kit with carring case	1010383
Photometer DT2B kit with carrying case	1010394

DULCOMETER®
Measuring and Test Instruments (cont.)

Description	Part no.

Photometers

DT2A

Consumbable items:

DPD 1 buffer, 15 mL	1002857
DPD 1 reagent, 15 mL	1002858
DPD 3 solution, 15 mL	1002859
Phenol red tablets R 175 (100 in each)	305532
Cyanuric acid tablets R 263 (100 in each)	305531
SPADNS reagent, 250 mL for fluoride detection	1010381
Calibration standard fluoride 1 mg/L for calibration of photometer (fluoride detection)	1010382
3 replacement vials for round sachets with cover for phenol red and cyanuric acid detection (DT1 and DT2B)	1007566
3 replacement vials for fluoride detection (DT2A and B)	1010396
DPD reagent kit, 15 mL each; 3x DPD 1 buffer, 1x DPD 1 reagent kit, 2x DPD 3 solution	1007567

DULCOMETER®
Measuring and Test Instruments

ProMinent®

Description	Part No.

Portamess® Portable Meters
Measured Variable pH

Features:

• Connection for pH combination sensor PHEKT 013 F

• Smooth membrane keypad

• Large easy-to-read LCD

• Integrated sensor quivers

• Robust housing NEMA 4X (enclosure rating IP 66)

• Robust, watertight gold plated connector sockets

Applications:
Industrial, environmental protection, food and beverage production and in water and wastewater investigation

Technical Data for Portamess® 911 pH

pk_5_099

Measurement range:	pH: 0 to 14
	mV: -1300 to +1300
	Temperature: -4 to 248°F (-20 to +120°C)
Measurement error:	pH: < 0.01
	mV: < 0.1% of Measured range $\pm$0.3
	Temperature: < 0.54°F (< 0.3°C)
Measured variable buffer memory:	100 storage spaces: pH/mV, temperature, time and date
Sensor adjustment:	8 buffer record options
Temperature compensation:	Pt 1000/NTC 30 kΩ (automatic recognition at switch on or manual)
Enclosure rating:	NEMA 4X (IP 66)
Operating life:	2000 hours with 3 AA batteries
Dimensions:	5.2 x 6.3 x 1.2 in. (133 x 160 x 30 mm) (W x H x D)
Weight:	Approximately 1.23 lbs. (560 grams) with batteries
Standards:	FM and CSA approvals pending

Portamess® 911 pH	1008710
PHEKT 013 F pH sensor	1007774
Buffer solutions can be found on page DULCOTEST- 52	

DULCOMETER®
Measuring and Test Instruments

Portamess® Portable Meters
Measured Variable pH

Unit equipped as 911 pH, plus:

- Integrated time and date
- Data memory (100 measured values including temperature, time and date)
- Calibration (automatic or manual)
- Datalogger
- Serial interface for printer or PC
- Software for transfer of measured variables to the PC

Applications:
Industry, environmental protection, food and beverage production and in water and wastewater investigation

Technical Data for Portamess® 913 pH

pk_5_102

Measurement range:	pH: 0 to 14
	mV: -1300 to +1300
	Temperature: -4 to 248°F (-20 to +120°C)
Measurement error:	pH: < 0.01
	mV: < 0.1 % of Measured range $\pm$0.3
	Temperature: < 0.54°F (< 0.3°C)
Data memory:	100 storage spaces: pH/mV, temperature, time and date
Electrode standardization:	8 buffer record options
Temperature compensation:	Pt 1000/NTC 30 kW
Time function:	Integrated real-time clock with date
Datalogger:	100 data records, manual input, interval or event controlled
Interface:	Serial, bi-directional, asynchronous, 600 - 9600 Baud, configurable as printer or computer interfaces
Interface cable:	Length 6 Ft. (2m), universal plug, optional PC or printer connection
Transfer software SW 105:	Recording of measurement data, memory contents and device logs in table form, optional entry of notes for each measured variable (e.g. sample station no.) transfer of data into other Windows applications (e.g. Excel)
Enclosure rating:	NEMA 4X (IP 66)
Operation time:	2000 hours with 3 AA batteries
Dimensions:	5.2 x 6.3 x 1.2 in. (133 x 160 x 30 mm) (W x H x D)
Weight:	Approximately 1.23 lbs. (560 grams) with batteries
Standards:	FM and CSA approvals pending

Portamess® 913 pH	1008711
PHEKT 013 F pH sensor	1007774

Buffer solutions can be found on page DULCOTEST- 52

ProMinent®

DULCOMETER®
Measuring and Test Instruments

Description	Part No.

Portamess® Portable Meters
Measured Variable Conductivity

Features:

• Connection for 4-electrode sensor LF 204

• Smooth durable membrane keypad

• Large easy-to-read LCD

• Integrated sensor quivers

• Robust housing NEMA 4X (enclosure rate IP 66)

• Robust, watertight gold plated connector sockets

Applications:
Industrial, environmental protection, food and beverage production and in water and wastewater investigation

Technical Data for Portamess® 911 Cond

pk_5_098

Measurement range:	Conductivity: 0.01μS/cm to 1000mS/cm
Temperature:	-4 to 248°F (-20 to +120°C)
Salinity:	0.0 to 45.0 g/kg; 32 to 86°F (0 to 30°C)
TDS:	0 to 1999 mg/L; 50 to 104°F (10 to 40°C)
Measurement error: (±1 digit)	Conductivity: < 0.5% of Measured range (at conductivity levels > 500 mS/cm < 1% of Measured range)
	Temperature: < 0.54°F (< 0.3°C)
Sensor adjustment:	Direct input of cell constants, automatic detection of cell constants with KCl solution 0.01 or 0.1 mol/L, cell adjustment with any known solution
Cell constant:	0.010 to 199.9 cm-1 (adjustable)
Temperature compensation:	Configurable
Enclosure rating:	NEMA 4X (IP 66)
Operating life:	Approximately 1000 hours with 3 AA batteries
Dimensions:	5.2" x 6.3" x 1.2" (133 x 160 x 30 mm) (W x H x D)
Weight:	Approximately 1.23 lbs. (560 grams) with batteries
Standards:	FM and CSA approvals pending

Portamess® 911Cond	1008713
PHEKT 013 F pH sensor	1007774
Buffer solutions can be found on page DULCOTEST- 52	

DULCOMETER®
Measuring and Test Instruments

Description	Part No.

Portamess® Portable Meters
Measured Variable Conductivity

Unit equipped as 911 Cond, plus:

• Integrated time and date

• Data memory (100 measured values including temperature, time and date)

• Datalogger

• Serial interface for printer or PC

• Software for transfer of measured variables to the PC

Applications:
Industry, environmental protection, food and beverage production and in water and wastewater investigation

Technical Data for Portamess® 913 Cond

pk_5_103

Measurement range:	Conductivity: 0.01μS/cm to 1000mS/cm
Temperature:	-4 to 248°F (-20 to +120°C)
Salinity:	0.0 to 45.0 g/kg; 32 to 86°F (0 to 30°C)
TDS:	0 to 1999 mg/L; 50 to 104°F (10 to 40°C)
Measurement error: (±1 digit):	Conductivity: < 0.5% of Measured range (at conductivity levels > 500 mS/cm < 1% of Measured range) Temperature: < 0.54°F (< 0.3°C)
Measured variable buffer memory:	100 storage spaces: conductivity, salinity or TDS with temperature, time and date
Sensor adjustment:	Direct input of cell constants, automatic detection of cell constants with KCl solution 0.01 or 0.1 mol/L, cell adjustment with any known solution
Cell constant:	0.010 to 199.9 cm-1 (adjustable)
Temperature compensation:	Configurable
Time function:	Integrated real-time clock with date
Datalogger:	100 data records, manual input, interval or event controlled
Interface:	RS 232 C, serial, bi-directional, asynchronous, 600 - 9600 Baud
Interface cable:	Length 6 Ft. (2m), universal plug, optional PC or printer connection
SW105 transfer software:	Recording of measurement data, memory contents and device logs in table form, optional entry of notes for each measured variable (e.g. sample station no.) transfer of data into other Windows applications (e.g. Excel)

DULCOMETER®
Measuring and Test Instruments

Description	Part No.

Portamess® Portable Meters
Measured Variable Conductivity

Enclosure rating:	NEMA 4X (IP 66)
Operating life:	Approximately 1000 hours with 3 AA batteries
Dimensions:	5.2"x 6.3" x 1.2" (133 x 160 x 30 mm) (W x H x D)
Weight:	Approximately 1.23 lbs. (560 g) with batteries
Standards:	FM and CSA approvals pending

Portamess® 913 Cond	1008714

DULCOMETER® Accessories for Measurement and Control Devices

Description	Part no.

## Accessories for Portamess® Portable Meters

pk_5_093

Conductivity sensor for Portamess® 911 Cond

4-electrode sensor LF 204   1008723

Number of electrodes:	4
Electrode shaft material:	Black epoxy
Electrode material:	Graphite
Shaft length:	4.7" (120 mm)
Shaft diameter:	0.6" (15.3 mm)
Cable length:	5 ft. (1.5 m)
Temperature sensor:	NTC (30 kΩ); 23 to 212°F (-5 to +100°C)
Immersion depth:	Minimum 1.4" (36 mm)
	Maximum total length 49 Ft. (1.5m); sensor and cable
Pressure resistance:	29 psi (2 bar)
Temperature range:	32° to 194°F (0° to 90°C)
Cell constant:	0.475 cm^{-1} ±1.5%
Measurement range:	1 μS/cm to 500 mS/cm

pH Combination sensor for Portamess® 911 pH and 913 pH

PHEKT 013 F   1007774
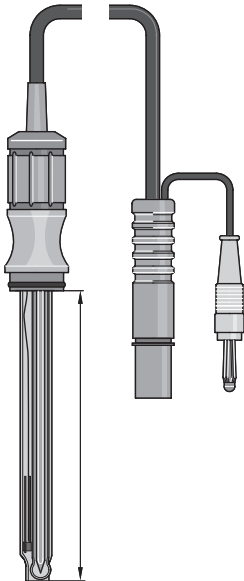
pH range:	0 to 13
Temperature:	32 to 176°F (0 to 80°C)
Maximum pressure:	Operates at atmospheric pressure
Minimum conductivity:	> 150 μS/cm
Diaphragm:	Fiberglass
Length:	4.3" ±0.1" (110 mm ±3 mm)
Cable length:	3 Ft. (1 m)
Plug:	Banana plug/DIN plug

Sensor quivers   1008716

5 pieces for leak-proof storage of sensor

pk_6_008

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PROMINENT FLUID CONTROLS, INC.
DULCOMETER®- D1C CHLORINE MEASUREMENT AND CONTROL SYSTEM

SECTION_____ - INSTRUMENTATION

1.1 APPLICATION
    A. Quantity:_____
    B. Measured Variable: ((CHOOSE ONE: <u>Free Chlorine</u> or <u>Total Chlorine</u>))
    C. Tag Nos.: _____
    D. Location:_____

1.2 GENERAL
    A. The vendor shall supply all components necessary for a functional system, including sensor(s); sensor holder with flow meter, flow control valve and mounting brackets; chlorine monitor and all required cables and spare parts. The sensor, holder and monitor shall all be made by the same manufacturer to assure compatibility and provide sole source responsibility.
    B. The manufacturer shall provide a one-year warranty on all system components. All components shall be fully tested prior to shipment.
    C. The power supply shall be ((CHOOSE ONE: <u>115 </u>or <u>230</u>)) VAC, 50/60 Hz, single phase.

1.3 SENSOR
    A. The chlorine sensor shall be an amperometric-type, providing continuous measurement of residual chlorine concentration without use of any reagents in the sample stream.   A membrane shall protect the electrodes from flow, pressure and conductivity-based interferences.
    B. The residual chlorine measuring range shall be: ((CHOOSE ONE: <u>0.01 to 0.50 ppm</u> OR <u>0.02 to 2.00 ppm</u> OR <u>0.01 to 5.00 ppm</u> OR <u>0.05 to 5.00 ppm </u>OR <u>0.10 to 10.0 ppm</u> OR <u>0.20 to 20.0 ppm</u>)). Measurement accuracy shall be better than +/- 3% of the sensor signal. Response time to 90% of measured value shall be better than two minutes. Drift shall be less than 2% per month.
    C. The sensor shall include automatic temperature compensation. The signal to the monitor shall be 4-20 mA via 2-wire technology. The sensor shall feature a terminal block with watertight cable gland for field connection of any length cable to the monitor.
    D. ((OPTIONAL)) Automatic pH compensation shall be provided by means of a double junction pH sensor with signal converter to provide a 4-20 mA signal to the monitor via 2-wire technology. The signal converter shall feature a terminal block with watertight cable gland for field connection of any length cable to the monitor.
    E. ((OPTIONAL, NOT POSSIBLE WITH pH COMPENSATION)) Display of water temperature shall be provided by means of a resistance thermometer with signal converter to provide a 4-20 mA signal to the monitor via 2-wire technology. The signal converter shall feature a terminal block with watertight cable gland for field connection of any length cable to the monitor.

1.4 SENSOR HOLDER
    A. The sensor holder shall be transparent PVC material with integral flow control valve and rotameter for setting the sample flow rate at 8 gph. The flow shall be directed at the sensor membrane to provide continuos cleaning action. Mounting brackets for wall mounting shall be included. The sample line connections shall be ((CHOOSE ONE: <u>1/4" MNPT unions</u> OR <u>1/2" x 3/8" tube fittings</u>)).

B. ((OPTIONAL)) A flow switch shall be provided with the rotameter to pause chemical feed or alarm upon loss of sample flow.

1.5 MONITOR / CONTROLLER

A. The monitor shall be microprocessor-based, with illuminated LCD display of measured value, status and error annunciation. Unit shall feature non-volatile memory to retain settings in the event of power failure; menu-driven calibration, limit and control settings; sensor monitoring to alarm upon sensor failure or loss of sensitivity; programmable access code allowing calibration but not unauthorized adjustment of limits and outputs.

B. Mounting shall be ((CHOOSE ONE: <u>in a NEMA 4X plastic enclosure with removable wall mount bracket</u> OR <u>in a NEMA 3 panel mount configuration, 96 mm H x 96 mm W x 140 mm D</u>)).

C. ((OPTIONAL ANALOG OUTPUT)) Electronically isolated active analog (0/4...20 mA) output, with 600 Ohm maximum load, shall be ((CHOOSE ONE: <u>proportional to the measured chlorine value and spannable within the measuring range</u> OR <u>proportional to the measured compensating variable and spannable within the measuring range</u> OR <u>chemical feed control output with PID control algorithm, selectable as chlorination or dechlorination</u> OR <u>two current outputs.</u>))

D. ((OPTIONAL PULSE CONTROL OUTPUT)) Pulse output for control of sodium hypochlorite metering pump shall provide PID control algorithm, and shall be spannable from 1 to 500 maximum pulses/minute. Pulse shall be by reed relay with rated life greater than 50×10^6 switching operations.

E. Loop control shall be provided with a single control output by factoring a water flow input times the calculated PID control output. Flow signal input shall be by means of ((CHOOSE ONE: <u>active analog 0/4...20 mA signal</u> / OR <u>0...10 Hz signal</u> OR <u>0...500 Hz signal</u>)).

F. Relay outputs, rated 250 VAC, 3A, shall include CHOOSE ONE:

- one general fault alarm relay to change state upon exceeding limits, loss of input signals or sensor failure /
- two limit relays with adjustable hysteresis periods, plus one general fault alarm relay to change state upon exceeding limits, loss of input signals or sensor failure /
- two control relays with PID algorithm and adjustable minimum on-times plus one general fault alarm relay to change state upon exceeding limits, loss of input signals or sensor failure/
- stroke positioner relays for use with 3P metering pump stroke length positioners, including LCD display of stroke length, plus one general fault alarm relay to change state upon exceeding limits, loss of input signals or sensor failure.

END OF SECTION

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PROMINENT FLUID CONTROLS, INC. - DMTa TRANSMITTER FOR CHLORINE MEASUREMENT

SECTION_____ - INSTRUMENTATION

1.1 APPLICATION

   A. Quantity:_____
   B. Measured Variable: ((CHOOSE ONE: Free Chlorine or Total Chlorine))
   C. Tag Nos.: _____
   D. Location:_____

GENERAL
   A. The vendor shall supply all components necessary for a functional system, including sensor(s); sensor holder with flow meter, flow control valve and mounting brackets; chlorine monitor and all required cables and spare parts. The sensor, holder and monitor shall all be made by the same manufacturer to assure compatibility and provide sole source responsibility.
   B. The manufacturer shall provide a one-year warranty on all system components. All components shall be fully tested prior to shipment.
   C. The power supply shall be 12-40VDC, loop powered.
   D. All components shall be pre-mounted on a polypropylene back panel for ease of installation.

SENSOR
   A. The chlorine sensor shall be an amperometric-type, providing continuous measurement of residual chlorine concentration without use of any reagents in the sample stream.   A membrane shall protect the electrodes from flow, pressure and conductivity-based interferences.
   B. The residual chlorine measuring range shall be: ((CHOOSE ONE: 0.01 to 5.00 ppm OR 0.05 to 50.00 ppm for free chlorine OR 0.01 to 10.00 ppm for total chlorine). Measurement accuracy shall be better than +/- 3% of the sensor signal. Response time to 90% of measured value shall be better than two minutes. Drift shall be less than 2% per month.
   C. The DMTa shall include automatic temperature compensation. The signal to the monitor shall be powered through a mV via 2-wire technology and converted to a 4-20mA signal. The sensor shall feature a terminal block with watertight cable gland for field connection of any length cable to the monitor.

SENSOR HOLDER
   A. The sensor holder shall be transparent PVC material with integral flow control valve and rotameter for setting the sample flow rate at 8 gph.
   B. The flow shall be directed at the sensor membrane to provide continuous cleaning action.
   C. Mounting brackets for wall mounting shall be included. The sample line connections shall be ((CHOOSE ONE: 1/4" MNPT unions OR 1/2" x 3/8" tube fittings)).

MONITOR

    A.   The monitor shall be microprocessor-based, with illuminated LCD display of measured value, status and error annunciation. Unit shall feature non-volatile memory to retain settings in the event of power failure; menu-driven calibration, limit settings; sensor monitoring to alarm upon sensor failure or loss of sensitivity; programmable access code allowing calibration but not unauthorized adjustment of limits and outputs.

    B.   Mounting shall be ((CHOOSE ONE: in a NEMA 4X plastic enclosure with removable wall mount bracket OR in a NEMA 3 panel mount configuration, 5.3"H x 4.9"W x 3.0"D)).

    C.   Electronically isolated active analog 4...20 mA output, with 600 Ohm maximum load, shall be proportional to the measured chlorine value and spannable within the measuring range.

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PROMINENT FLUID CONTROLS, INC.
DULCOMETER – D1C FLUORIDE MEASUREMENT AND MONITOR SYSTEM

PART 1 – GENERAL

1.1 GENERAL

A. This specification covers the fluoride measuring and monitoring system complete with all necessary components for a functional system, including sensors; sensor holder, flow control valve, flow meter, and mounting brackets, fluoride analyzer and all required cables and spare parts.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer shall have experience in manufacturing analytical equipment used to accurately measure residuals that are monitored in potable drinking water.

B. All equipment provided under this Section shall be obtained from a single supplier or manufacturer who shall assume full responsibility for the completeness and proper operation of the fluoride measurement system.

C. To insure quality and unit responsibility, the fluoride monitoring system must be assembled and tested by the manufacturer at its facility and be a standard and regularly marketed product of that manufacturer. The manufacturer must have a physical plant, technical and design staff, and fabricating personnel to complete the work specified.

1.3 SUBMITTALS

A. Shop Drawings
1. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
2. Detailed drawings and schematics showing the equipment dimensions, size, locations of connections.
3. Power and control wiring diagrams, including terminals and numbers.

1.4 SPARE PARTS

A. Furnish for each fluoride analyzer system;
1. One fluoride sensor.

1.5 WARRANTY

A. The manufacturer shall provide two year warranty on the fluoride analyzer and six months on the sensors. All components shall be fully tested prior to shipment.

PART 2 – PRODUCTS

2.1 GENERAL

A. Manufacturers:
1. ProMinent Fluid Controls, Inc.
2. Pre-approved equal

2.2 SENSORS

A. The fluoride sensor shall be potentiometric-type and ion-selective, providing continuous measurement of free fluoride residual concentration in potable drinking water. Measurement shall be accomplished without the use of any reagents or buffers added to the sample water stream. The ion selective layer of the fluoride sensor shall comprise a europium-doped lanthanum fluoride crystal, which forms a solid ion conductor for fluoride ions.

B. Signal generated by the fluoride sensor shall be converted to an analog signal and transmitted to the analyzer.

C. The maximum measuring range of the fluoride sensor shall be 0.05 to 10 ppm. Measuring range of lower value shall be field programmable. Measurement accuracy shall be better than +/- 3% of the sensor signal. Response time to 95% of measured value shall be better than one minute.

D. A temperature sensor shall be included to provide automatic temperature compensation.

2.3 SENSOR HOLDER

A. The sensor holder shall be transparent PVC material with integral flow control valve and variable area flow meter for setting sample water flow at 16 gph. The sensor holder shall be configured with stir plate and bar to assure constant water movement around the sensor.

B. The variable area flow meter shall be configured to sense loss of sample water flow and transmission of a fault signal to the fluoride analyzer.

2.4 ANALYZER/MONITOR

A. The analyzer shall be microprocessor-based, with illuminated LCD display of measured value, status, and error annunciation. Unit shall feature non-volatile memory to retain settings in the event of power failure; menu-driven calibration, limit settings; sensor monitoring to alarm upon sensor failure; programmable access code allowing calibration but not unauthorized adjustments of limits and outputs.

B. The analyzer and components shall be mounted as a self-contained unit on a wall-mounted back panel such that installation will only require piping to and from the sensor holder. The analyzer shall be in a NEMA 4X plastic enclosure.

C. Electronically isolated active analog (0/4…20mA) output, with 600 Ohm maximum load, shall be provided and shall be proportional to the measured fluoride value and spannable with the programmed measuring range.

D. Relay outputs, rated 250 VAC, 3A, shall include two limit relays with adjustable hysteresis periods, plus one general fault alarm relay to change state upon exceeding limits, loss of input signals, sensor failure, or loss of sample water flow.

E. The analyzer shall be powered by 120 VAC, 1 phase, 60 Hz.

PART 3 – EXECUTION

3.1 GENERAL

A. The fluoride analyzer and monitor shall be installed and operated in accordance to manufacturer's recommendations.

END OF SECTION