1 YEAR
WARRANTY

OMEGA®

User's Guide

CDCN-91 DUAL CHANNEL
Conductivity/Resistivity Controller

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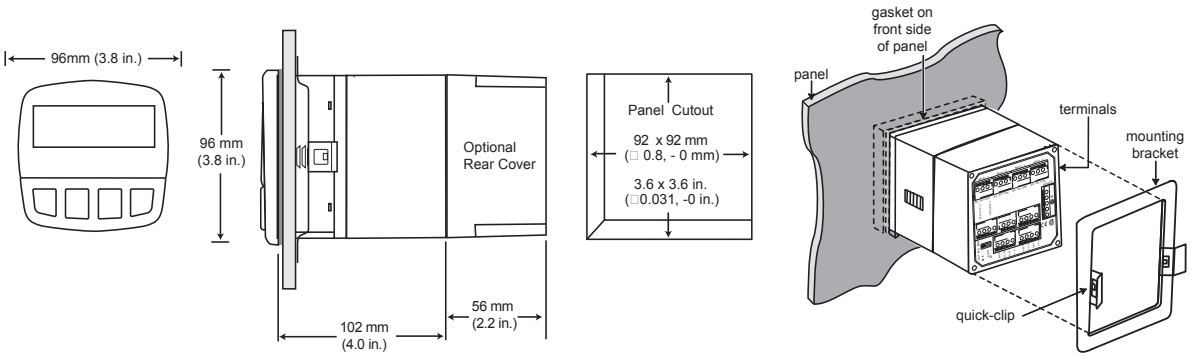
CDCN-91/CDCN-91AC
Dual Channel Conductivity/Resistivity Controller

CAUTION!
- Remove power to unit before wiring input and output connections.
- Follow instructions carefully to avoid personal injury.
- This product should only be used for the purposes and in the manner described in this manual.

Installation

1. Punch out panel and de-burr edges. Recommended clearance on all sides between instruments is 1 inch.
2. Place gasket on instrument, and install in panel.
3. Slide mounting bracket over back of instrument until quick-clips snap into latches on side of instrument.
4. Connect wires to terminals.
5. To remove, secure instrument temporarily with tape from front or grip from rear of instrument. DO NOT RELEASE. Press quick-clips outward and remove.
6. If cleaning is necessary, wipe the front of the unit with a damp cloth.
7. The live contacts on the back of this unit must be covered to avoid accidental shock hazard.



Specifications

General

Compatible electrodes: Omega CDCN-91 Series Standard and Certified Series Conductivity/Resistivity Electrodes

Enclosure:
- Rating: NEMA 4X/IP65 front (NEMA 4X Rear cover available)
- Case: PBT
- Panel case gasket: Neoprene
- Window: Polyurethane-coated polycarbonate
- Keypad: Sealed 4-key silicone rubber
- Weight: CDCN-91AC: 1.28 lb/0.58 kg; CDCN-91: 1.2 lb/0.55 kg

Display: Alphanumeric 2 x 16 LCD
- Contrast: User selected, 5 levels
- Update rate: 1.5 seconds

Sensor input range:
- Conductance: 0.055 µS/cm to 400.00 mS/cm
- Resistivity: 10 KΩ/cm to 18.26 MΩ/cm
- TDS: 0.0 to 999999 ppm
- Temperature: 25 to 120 °C (-13 to 248 °F) PT 1000; 25 ºC = 1096 Ω

Accuracy:
- Conductivity/Resistivity: ± 2% of reading
- Temperature: ± 0.5 ºC (0 to 100 ºC)

Electrical

Power requirements:
CDCN-91AC: 100 to 240 VAC ± 10% , 50-60 Hz, 20VA or 11 to 24 VDC ±10%, regulated, 0.5 A max
CDCN-91: 11 to 24 VDC ±10%, regulated, 0.5 A max

Current outputs (3 available):
- 4 to 20 mA, isolated, fully adjustable and reversible
- Max loop impedance: 150 Ω @ 12 V, 450 Ω @ 18 V, 750 Ω @ 24 V
- Update rate: ≈ 100 mS
- Accuracy: ±0.03 mA @ 25°C, 24 VDC

Open-collector outputs (2 available, optically isolated):
- 50 mA sink or source, 30 VDC max. pull-up voltage
- Programmable for:
- High or Low setpoint with adjustable hysteresis
- Pulse operation (max. rate: 400 pulses/min)
- USP standards
- Time delay: 0 to 6400 s.

Relay outputs (up to 4 SPDT relays available)
- Maximum resistive load: 5 A @ 250 VAC, 5 A @ 30 VDC
- Isolation: 500 V minimum
- Programmable for:
  - High or Low setpoint with adjustable hysteresis
  - Pulse operation (max. rate: 400 pulses/min)
  - USP standards
  - Time delay: 0 to 6400 s.

Environmental
- Ambient operating temp: -10 to 55 °C (14 to 131 °F)
- Storage temperature: -15 to 80 °C (5 to 176 °F)
- Relative humidity: 0 to 95%, non-condensing
- Maximum altitude: 2000 m (6562 ft)
- Insulation category: II
- Pollution degree: 2

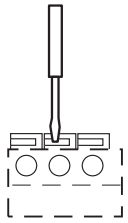
Standards and Approvals
- CE, UL listed
- Immunity: EN50082-2
- Emissions: EN55011
- Safety: EN61010
- Manufactured under ISO 9001, ISO 14001

Electrical Connections

CAUTION: Failure to fully open terminal jaws before removing wire may permanently damage instrument.
This product must be provided with a means to disconnect all current carrying conductors connected to the main AC line, or, as part of the building installation.

Wiring Procedure

1. Remove 0.35- 0.47 in. (9-12 mm) of insulation from wire end.
2. Press the orange terminal lever downward with a small screwdriver to open terminal jaws.
3. Insert exposed (non-insulated) wire end in terminal hole until it bottoms out.
4. Release orange terminal lever to secure wire in place. Gently pull on each wire to ensure a good connection.



Wiring Removal Procedure

1. Press the orange terminal lever downward with a small screwdriver to open terminal jaws.

Wiring Tips:

- Do not route sensor cable in conduit containing AC power wiring - electrical noise may interfere with sensor signal.
- Routing sensor cabling in grounded metal conduit may prevent moisture damage, electrical noise, and mechanical damage.
- Seal cable entry points to prevent moisture damage.
- Do not insert two wires into a single terminal. If necessary, splice the wires together before inserting into the terminal.

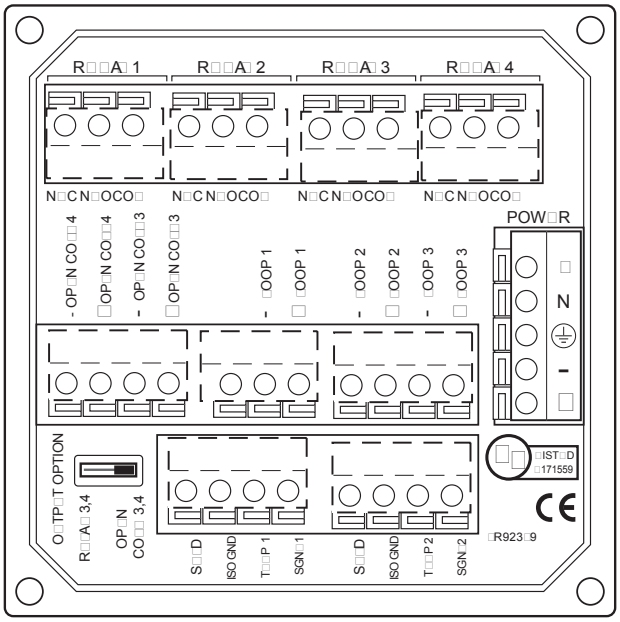
Caution:
Electrical shock hazard exists!

♦

Never connect live AC lines to the instrument.

♦

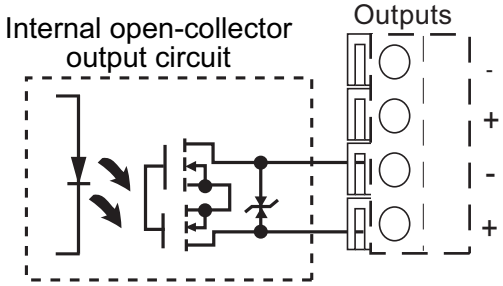
Always connect a ground wire to the ground terminal when using AC power.

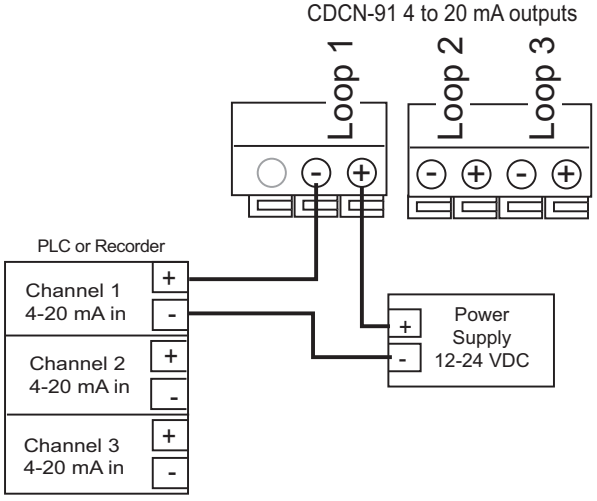


4 to 20 mA loop Outputs
The current loops in the CDCN-91 are passive circuits. 12-24 VDC must be provided from an external source. A single loop is illustrated for clarity.

Output Option Switch

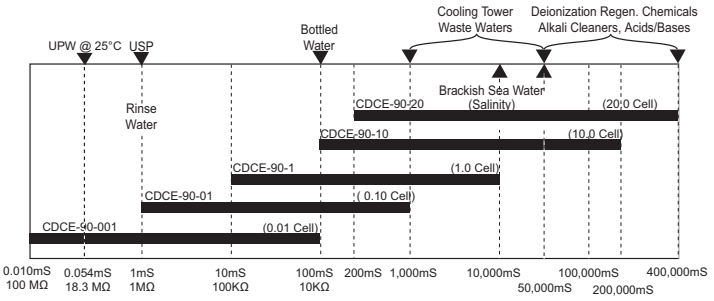
- In OPEN COLLECTOR position, relays 3 and 4 are open collector outputs as shown.
- In RELAY 3, 4 position, relays 3 and 4 are dry contact relays identical to relays 1 and 2.
- The menu references in the CDCN-91 display will not change. Outputs 3 and 4 will be identified as "Relay" regardless of switch setting.

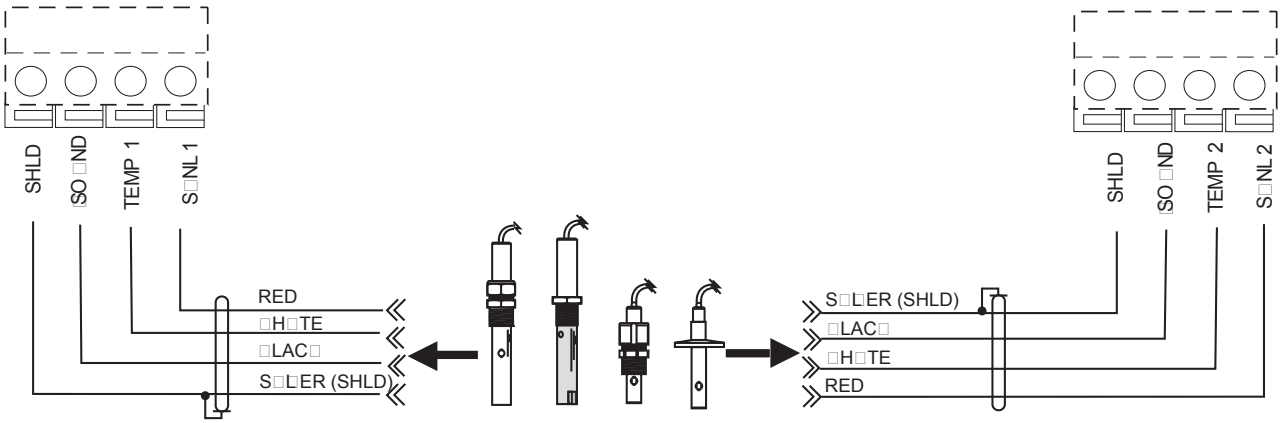




Sensor Input Connections

- The CDCN-91 will accept two independent sensor input signals. The two sensors may be of different cell constant values.
- Do not route sensor cable in any conduit containing AC power wiring - electrical noise may interfere with the signal.
- Use three conductor shielded cable for cable extensions up to 30 m (100 ft) max. for measurements below 10 MΩ (above 0.10 µS).
- Maximum cable length for resistivity measurements above 10 MΩ is 25 ft, and solution temperatures must be between 20 °C and 100 °C.





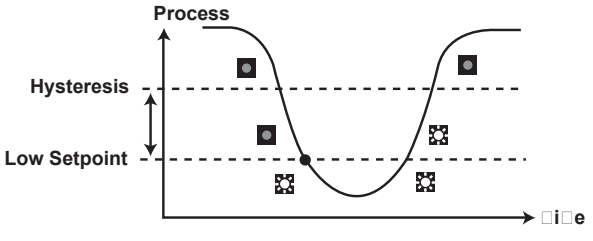
Relay and Open Collector Functions

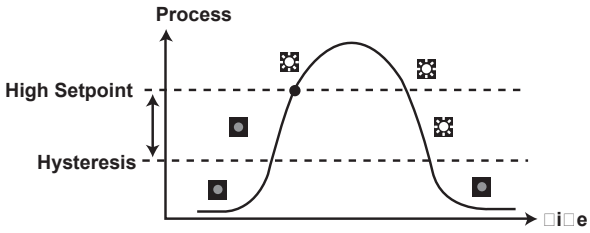
The CDCN-91 is equipped with four SPDT relays that can be configured for High alarm, Low alarm, Proportional Pulse or USP operation.

- **Low:** Output triggers when process variable is less than setpoint.

- **High:** Output triggers when process variable is higher than setpoint.

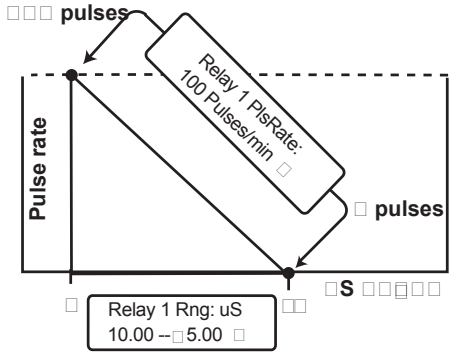
- **Off:** Disables output pulse.





- **Pulse Operation**
  The output emits a 100 mS pulse at a rate defined by the Source, Pulse Range and Max PlsRate settings, and by the process condition. The maximum pulse rate is 400 pulses per minute.

  Example: As the process falls below 10 µS the output will start pulsing in relation to the process value, the max pulse endpoint and the programmed pulses/min. The pulse rate will increase as the process approaches the programmed endpoint.



The Pulse Rate determines what the maximum rate will be. The CDCN-91 maximum capability is 400 pulses per minute.

The RANGE defines where the pulsing starts and where it reaches the maximum rate.

10 µS = 0 pulses/min.
7.5 µS = 50 pulses/min.
5 µS = 100 pulses/min.

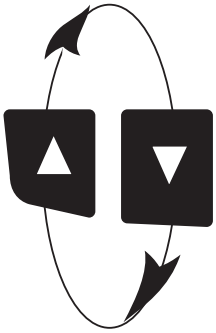
VIEW menu

- During normal operation, the CDCN-91 displays the VIEW menu.
- When using the CALIBRATE or OPTIONS menus, the CDCN-91 will return to the VIEW menu if no activity occurs for 10 minutes.
- To select the item you want displayed, press the UP or DOWN arrow keys. The items will scroll in a continuous loop. Changing the display selection does not interrupt system operations.
- No keycode is necessary to change display selection.
- Output settings cannot be edited from the VIEW menu.

View Menu

Display	Description
C1 1000.00 µS/cm C2 30.00 µS/cm	Monitor C1 Conductivity and C2 Conductivity simultaneously. This is the permanent display when Channel 2 is ON.

The VIEW displays below are temporary. The permanent display will return after 10 minutes.



C1 1000.00 µS/cm 25.0 °C	Monitor Channel 1 Conductivity and Channel 1 Temperature. This is the permanent display when Channel 2 is OFF.
C2 30.00 µS/cm 25.0 °C	Monitor Channel 2 Conductivity and Channel 2 Temperature. This view is available only when Channel 2 is ON.
Ratio C1: C2 97.00%	Monitor Percent Reject, Difference, or Ratio (Channel 1 to Channel 2 or Channel 2 to Channel 1)
Loop 1 12.03 mA Loop 2 5.69 mA	Monitor Loop 1 and Loop 2 current output simultaneously.
Loop 3 13.7 mA R3 ON R4 PLS	Monitor Loop 3 and status of Relays 3 and 4 (Open Collector 3 and 4).
Last CAL: 6-30-00 >	Display date for scheduled maintenance or date of last calibration.

CDCN-91 Editing Procedure:

Step 1. Press and hold ENTER key:
- 2 seconds to select the CALIBRATE menu.
- 5 seconds to select the OPTIONS menu.

Step 2. The Key Code is UP-UP-UP-DOWN keys in sequence.
- After entering the Key Code, the display will show the first item in the selected menu.

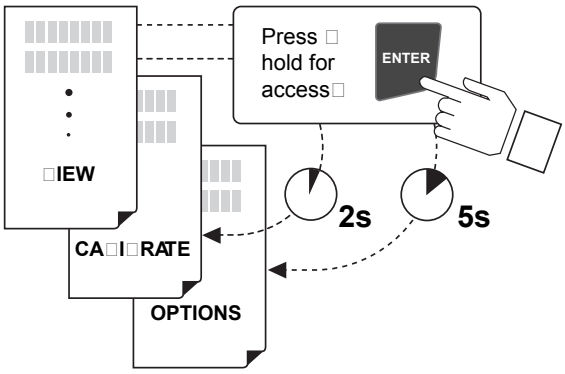
Step 3. Scroll menu with UP or DOWN arrow keys.

Step 4. Press RIGHT ARROW key to select menu item to be edited.
- The first display element will begin flashing.

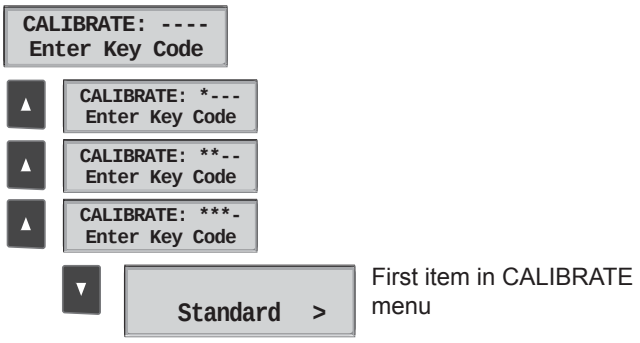
Step 5. Press UP or DOWN keys to edit the flashing element.
- RIGHT ARROW key advances the flashing element.

Step 6. Press ENTER key to save the new setting and return to Step 3.

Notes on Step 1:
- The View Menu is normally displayed.
- The CALIBRATE and OPTIONS menus require a KEY CODE.



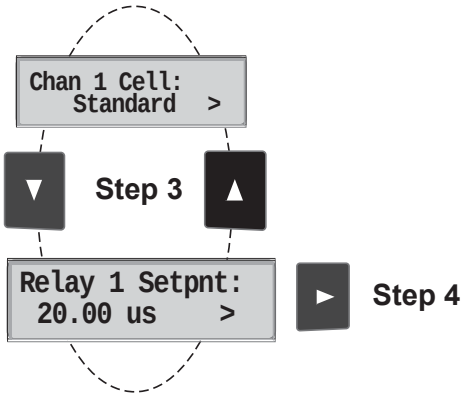
Notes on Step 2:
If no key is pressed for 5 minutes while display is showing "Enter Key Code", the display will return to the VIEW menu.



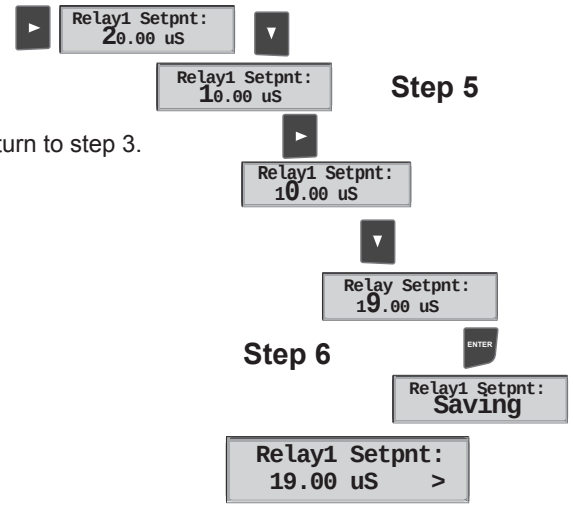
Notes on Steps 3 and 4:
- Refer to following pages for complete listing of menu items and their use.
- From the Step 3 display, pressing the UP and DOWN keys simultaneously will return the display to the VIEW menu.
- If no key is pressed for 10 minutes, display will also return to the VIEW menu.

Step 3: Finished Editing?

Press the UP and DOWN keys simultaneously after saving the last setting to return to normal operation.



Notes on Steps 5 and 6:
- All output functions remain active during editing.
- Only the flashing element can be edited.
- RIGHT ARROW key advances the flashing element in a continuous loop.
- Edited value is effective immediately after pressing ENTER key.
- If no key is pressed for 10 minutes unit will restore the last saved value and return to step 3.
- Step 6 (pressing ENTER key) always returns you to Step 3.
- Repeat steps 3-6 until all editing is completed.



Step 5: Made an Error?

Press the UP and DOWN keys simultaneously while any element is flashing. This will recall the last saved value of the item being edited and return you to Step 3.

Calibrate Menu

Display (Factory settings shown)	Description
Chan 1 Cell: Standard >	Select CUSTOM only if you are connecting a certified conductivity sensor. Select STANDARD for all non-certified sensors.
Chan 1 Cell: 1.0 >	For STANDARD sensors: Select the nominal cell constant: 0.01, 0.1, 1.0, 10.0 or 20.0.
Cell: Custom 1.0000 >	For CUSTOM sensors: Enter the precise cell constant from the certificate provided with your sensor, or from the information label on the sensor.
Chan 1 Set: Temperature >	Adjust the temperature of the system based on an accurate external reference.
Chan 1 Set: Conductivity >	This single-point wet calibration procedure requires a test solution of known value. Enter all zeroes here to restore TEMPERATURE and CONDUCTIVITY to factory calibration.
Chan 1 Units: uS/cm >	Select the units of measure: µS/cm, mS/cm, kΩ•cm, MΩ•cm, PPB, PPM
Chan 1 TDS: 2.0000 uS/PPM >	If the Units selection is PPM or PPB, set the ratio of µS to PPM of Total Dissolved Solids. The factory preset value is 2 µS per 1 PPM of TDS. (Always µS/PPM, even if units is PPB). See page 10 for additional information.
Function: Reject C1 → C2 >	Select a functional relationship between C1 and C 2: • Ratio is (C1:C2) or (C2:C1) • Percent Reject is 100%(1-C2/C1) or 100%(1-C1-C2) • Difference is (C1-C2) or (C2-C1)
Loop 1 Source: Chan 1 Cond >	Select the measured value or calculated FUNCTION you want Loop 1 to represent: Chan 1 Cond, Chan 2 Cond, Chan 1 Temp, Chan 2 Temp, or Function.
Loop 1 Range: uS 0.0000 → 100.000 >	Set the minimum (4 mA =) and maximum (20 mA =) range for Loop 1. Make sure that the values are consistent with the units of the source.
Relay 1 Mode: Low >	Select operating mode for Relay 1: OFF, LOW, HIGH, USP or PULSE. For USP mode: • Relay 1 SOURCE must be Cond 1 or Cond 2 • Temp Comp (Options menu) must be set to None
Relay 1 Source: Chan 1 Cond >	Select the INPUT SIGNAL (or FUNCTION) monitored by Relay 1: • Cond 1 • Cond 2 • Temp 1 • Temp 2 • Function
Relay 1 Setpnt: 10.0000 uS >	Set Relay 1 activation point. The maximum value acceptable is 999999. USP setpoints are high alarms, where the setpoint is a percentage below the USP limit.
Relay 1 Hys: 0.5000 uS >	Relay 1 will be deactivated at setpoint ± Hysteresis (depending on High or Low selection). When the relay Mode is USP (defined as a HIGH alarm), Hysteresis is displayed in µS.
Relay 1 Delay: 10.0 secs >	Set up to 6400 seconds delay time for relay response. Relay 1 will be activated only if the source value exceeds the setpoint for this time period.
Relay 1 Rng: uS 10.0000 → 40.0000 >	If Relay 1 is PULSE mode, set the start and end point of the conductivity range and also set the maximum pulse rate. (The maximum PULSE rate setting is 400 pulses per minute.)
Relay 1 PlsRate: 120 Pulses/Min >	The combined Relay 1 Range and Pulse rate settings shown here indicate: "Start pulsing when the conductivity value is 10 µS and increase the pulse rate up to the maximum of 120 pulses per minute when the conductivity value reaches 40 µS."
Last CAL: 6-30-00 >	Use this “note pad” to record important dates, such as annual recertification or scheduled maintenance.

- All changes in this menu become effective when saved, except the "Set Cond" and "Set Temp" settings.
- All outputs affected by a change in the "Set Cond" and "Set Temp" settings are frozen until you exit the Calibrate menu.

USP Limits

USP (United States Pharmacopoeia) has defined a set of conductivity values (limits) to be used for pharmaceutical water monitoring. This standard requires non-temperature compensated conductivity measurement be used to warn if the conductance approaches the USP limit. The limits vary according the temperature of the sample.

The CDCN-91 has the USP limits stored in memory. It will automatically determine the proper USP limit based on the measured temperature.

Temperature range is: (ºC)	USP limit is: (µS)
0 to < 5	0.6
5 to < 10	0.8
10 to < 15	0.9
15 to < 20	1
20 to < 25	1.1
25 to < 30	1.3
30 to < 35	1.4
35 to < 40	1.5
40 to < 45	1.7
50 to < 55	1.8
55 to < 60	2.1
60 to < 65	2.2
65 to < 70	2.4
70 to < 75	2.5
75 to < 80	2.7
80 to < 85	2.7
85 to < 90	2.7
90 to < 95	2.7
95 to < 100	2.9
100 to < 105	3.1

Using the USP function

In the CDCN-91, USP setpoints are defined as a percentage below the USP limit, so a USP alarm is always a HIGH alarm. The CDCN-91 can be set to warn you if the conductivity approaches within a set percentage of the USP limit.

The following settings and conditions are required for a USP relay function:

1. In the CALIBRATE menu:
- RELAY MODE must be set to **USP**.
- RELAY SOURCE must be **Chan 1 or Chan 2 Cond**.
- SOURCE UNITS must be set to **µS**.

2. In the OPTIONS menu:
- The TC Mode of the USP channel must be set to **None**.

(Service tip: If a relay is constantly on, check these settings.)

Example:
- The USP setpoint is 40%.
- The water temperature is 19 ºC, so the USP limit is 1.0 µS.
- The relay will be activated when the conductivity value reaches 0.6 µS, or 40% below the 1.0 USP limit.
- If the water temperature drifts to more than 20 ºC, the CDCN-91 will automatically adjust the USP limit to 1.1.
- The relay will now be activated when the conductivity value reaches 40% below 1.1µS, or 0.66 µS.

Options Menu

Display (Factory settings shown)	Description
Contrast: 3 >	Adjust the LCD contrast for best viewing. A setting of 1 is lower contrast, 5 is higher. In general, select lower contrast if the display is in warmer ambient surroundings.
Temp Display: °C >	Select ºC or ºF.
Channel 2: On >	Turn CH 2 OFF if not in use. This will remove all menu functions related to CH 2.
Power: 60 Hz >	Select 50 Hz or 60 Hz electrical noise suppression, according to the AC power used in your area. Select the proper setting for all applications, whether AC or DC powered.
Chan 1 TC Mode: Linear >	Set the method for temperature compensation to NONE, LINEAR or PURE WATER. You must select NONE for USP systems. Select LINEAR for applications where the water is less than 5 MΩ (or greater than 0.2 µS). Select PURE WATER for applications where the water is greater than than 5 MΩ (or less than 0.2 µS).
Chan 1 TC Slope: 0.00 % >	For LINEAR or PURE WATER temperature compensation, select a % per ºC slope. Maximum slope setting is 9.99 % per ºC. If Temp Comp setting is NONE, this item will not be displayed.
Averaging: Off >	OFF provides the most instantaneous response to process changes. Select LOW (4 sec) or HIGH (8 sec) averaging if your process experiences frequent or extreme fluctuations.
Chan 1 Decimal: *.**** >	Set the decimal to the best resolution for your application. The display will automatically scale up to this restriction. Select *****., ****.*, ***.** **.*** or *.****
Loop 1 Adjust: 4.00 mA >	Adjust the minimum and maximum current output. The display value represents the precise current output. Adjustment limits: • 3.80 mA < 4.00 mA > 5.00 mA • 19.00 mA < 20.00 mA > 21.00 mA Use this setting to match the system output to any external device. These settings repeat for Loop 2 and Loop 3.
Loop 1 Adjust: 20.00 mA >	
Relay 3 Active: High >	Select active HIGH or active LOW operation for relay 3. Recommended: Use active LOW if relay 3 is set for OPEN COLLECTOR operation. Active HIGH: Power is applied to relay coil when process value reaches SETPOINT. Active LOW: Power is removed from relay coil when process value reaches SETPOINT.
Test Loop 1: >	Press UP and DOWN keys to manually change Loop 1output current. Limits are 3.6 mA to 21.00 mA. Hold UP or DOWN keys to scroll the output value.
Test Relay 1: >	Press UP and DOWN keys to manually toggle the relay state.

Notes:
Channel settings will repeat when Channel 2 is enabled.
Loop settings will repeat for Loop 2 and Loop 3.
Check setting for related values when making changes (for example, if temp is set for ºC with a temp alarm at 25 ºC, and you change the temp display to ºF, be sure to change the alarm setpoint to 77 ºF.)
Relay settings will repeat for Relays 2, 3 and 4 (except "Relay Active" selection; applies to Relay 3 and 4 only.)

Calibration Procedure

The CDCN-91 has been electronically calibrated at the factory.

- Procedure A verifies the accuracy and linearity of the CDCN-91 by simulating temperature and conductivity values with precision (±0.1%) fixed resistors.
- Procedure B is a wet calibration. This procedure uses the sensor input and NIST traceable test solutions. When done correctly, this procedure offers the most accurate system calibration.

A) Accuracy Verification with Precision Resistors (Electronic Calibration):

1. Simulate the Temperature

The temperature input to the CDCN-91 is a PT-1000 thermistor, where 1000 Ohms (Ω) is equal to 0 ºC and a change of 3.84 Ω equals a 1 ºC change. (1000 Ω = 0 ºC, 1003.84 Ω = 1.0 ºC, 1007.68 Ω = 2.0 ºC ⋯ 1096 Ω = 25 ºC)

- Connect a resistor (1000 Ω to 1096 Ω) between "Temp" and "Iso. Gnd" terminals.
- Set Temp; Adjust the temperature to exact value based on the measured resistance. (See Editing Procedure, Calibrate menu.)
- To verify the CDCN-91 temperature linearity, connect a second resistor value to the terminals.
- If the CDCN-91 does not display the correct value (± 0.5 ºC), service is required.

2. Simulate the Conductivity

You may calculate the exact Resistance needed to simulate a specific conductivity value , or you may calculate the exact Conductivity based on a resistor value:

$$\text{Resistance} = \frac{\text{Cell constant}}{\text{conductivity (Siemens*)}} \quad \textbf{e.g.} \quad \frac{\text{0.1 cell constant}}{\text{0.000020 (Siemens*)}} = 5{,}000\ \Omega \text{ or } 5\ \text{K}\Omega$$

$$\text{Conductivity} = \frac{\text{Cell constant}}{\text{conductivity (Siemens*)}} \quad \textbf{e.g.} \quad \frac{\text{0.1 cell constant}}{\text{100,000 } (\Omega)} = 0.000001 \text{ Siemens* or } 1\mu\text{S/cm}$$

(*1 µS = 1 X 10^{-6} Siemens or 0.000001 Siemens)

- Connect the conductivity resistor between the "Sgnl 1 " and "Iso Gnd" (or Sgnl 2 and Iso Gnd) terminals.
- Set Cond: Adjust the conductivity value based on the resistor value. (See Editing Procedure and Calibrate menu.)
- Verify the linearity of the CDCN-91 by connecting a second Conductivity resistor of a different value.
- If the CDCN-91 does not display the correct value (±2% of reading), service is required.

B) Wet Calibration with NIST Traceable Solutions:

When using NIST traceable standards, review the temperature information provided with the test solution. Prevent contamination of the test solution. The sensor must be at the temperature specified on the test solution label.

- Remove the sensor from the system. Rinse the sensor in a small amount of test solution.
- Place the sensor into the test solution.
- Place a reference thermometer into the same solution.
- Allow sufficient time for the temperature to stabilize.
- Set Temp: Adjust the temperature value based on the reference thermometer. (See Editing Procedure.)
- Set Cond: Adjust the conductivity value based on the test solution value. (See Editing Procedure.)
- Verify the linearity of the CDCN-91 by placing the sensor into a second test solution of a different value.
- If the CDCN-91 does not display the correct value (Temperature ±0.5 ºC, Conductivity ±2% of reading), service is required.

Temperature Effects

Conductivity measurement is highly dependent on temperature. The basic rule is that higher temperatures result in greater conductance (less resistance). Temperature effects are expressed as the percentage of conductivity change (in µS) per °C. The conductivity value is generally referenced to 25 ºC.

The CDCN-91 has three temperature compensation options:

None
USP standards for pharmaceutical waters require that the measurement be made without temperature compensation. USP limits are are discussed on page 7.

Pure Water (Standard Compensation)
This selection is used for measurements of very clean water, less than 0.2 µS. Temperature effects are not linear in this range, so the temperature coefficient is not easily determined. This selection is recommended for all Resistivity applications measuring from 5 MΩ to 18MΩ. This selection conforms to ASTM standard D1125 and D5391.

Linear
This selection allows you to calculate a custom temperature compensation value for Conductivity measurements in the range of 0.2 µS and greater (Resistivity applications measuring less than 5 MΩ). The procedure is outlined in the following section.

Calculating a Linear Temperature Coefficient

1. Set TC Mode to NONE (see OPTIONS menu, page 7).
2. Heat a sample solution close to the maximum process temperature. Place sensor in the sample solution and allow several minutes for stabilization. Record the CDCN-91 temperature and conductivity values in the spaces provided:

   Displayed temperature: T1 = _____ °C

   Displayed conductivity: C1 = _____ °C

3. Cool the sample solution close to the minimum process temperature. Place sensor in the sample solution allowing several minutes for stabilization. Record displayed temperature and conductivity values in the spaces provided:

   Displayed temperature: T2 = _____ °C

   Displayed conductivity: C2 = _____ °C

   (A 10% change in conductivity between steps 2 and 3 is recommended.)

4. Substitute recorded readings (steps 2 and 3) into the following formula:

$$\text{TC Slope} = \frac{100 \times (C1 - C2)}{(C2 \times (T1 - 25)) - (C1 \times (T2 - 25))}$$

Example: A sample solution has a conductivity of 205 µS @ 48 °C. After cooling the solution, the conductivity was measured at 150 µS @ 23 °C (C1 = 205, T1 = 48, C2 = 150, T2 = 23).

The TC is calculated as follows:

$$\text{TC Slope} = \frac{100 \times (205 - 150)}{(150 \times (48 - 25)) - (205 \times (23 - 25))} = \frac{5500}{3860} = \frac{1.42\%}{°C}$$

TDS Factor

Some industries need to display a conductivity value as Total Dissolved Solids (TDS), measured in units of parts per million (PPM) or parts per billion (PPB).

- 1 PPM is equivalent to 1 mg per liter.
- 1 PPB is equivalent to 1 µg per liter.
- The CDCN-91 calculates PPM or PPB by dividing the µS value by a TDS Factor that you define. The CDCN-91 will accept a TDS factor from 0.01 to 99999.9 µS per PPM (factory preset = 2.00 µS per PPM).
- TDS factors can vary widely, ranging from 1.50 to 2.50 µS per PPM. Methods for establishing a TDS factor are beyond the scope of this manual.

NOTE: The TDS factor is always set in PPM.

TDS Factor = Conductivity (µS) ÷Total dissolved solids (PPM)
PPM = Solution conductivity (µS) ÷ TDS Factor

Example:

- Solution conductivity = 150 µS
- TDS = 80 PPM
- TDS Factor = 150 µS ÷ 80 PPM = **1.88 µS per PPM.**

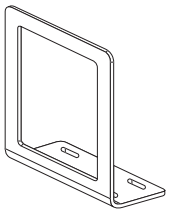
Troubleshooting

Display Condition	Possible Causes	Suggested Solutions
- - - -	Display is over range. This may be a normal condition if your process operates at/near the limits of the sensor range.	Check sensor for correct range. Check Decimal setting in OPTIONS menu. Check Calibrate menu settings for incompatible SOURCE and RANGE values.
Value must be 100 or less	The menu item being set is a percentage value and must be less than 100.	Select a value from 0 to 100.
Value must be more than 0	The menu item being set cannot be zero or a negative value.	Select a value greater than zero.
Value must be 400 or less	The Pulse Rate for Relay and Open Collector outputs cannot be greater than 400 pulses per minute.	Select a pulse rate less than 400
Reset to Factory Calibration	A value of "0" is being set into "Set: Conductivity" menu item.	This will remove any user calibration from the "Set Conductivity" and "Set Temperature" items in the Calibrate menu.
Too Much Error CHECK SENSOR	The calibration offset entered is beyond the allowable tolerances of the instrument.	Check calibration procedure for accuracy. Check sensor for proper operation. Check any cable extensions for poor splices or termination.

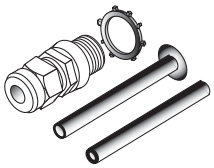
Technical Note
If a Current Loop is locked at 3.6 mA, the problem is related to the PT-1000 temperature circuit:
This occurs only if the CDCN-91 detects a resistance from the temperature sensor that is less than 250 Ω or greater than 2800 Ω.

- Check the sensor wiring for open/short or poor connections on white (TEMP IN) and black (ISO GND) wires.
- The temperature device in the sensor is defective.
- The transmitter is defective.

Accessories



Surface Mount Bracket
FPM-5000-MB



Liquid Tight Connector Kit
CDCN-91LTK

RC Filter Kit (for relay use)
FP90RC (no picture available)

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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- Wire: Thermocouple, RTD & Thermistor
- Calibrators & Ice Point References
- Recorders, Controllers & Process Monitors
- Infrared Pyrometers

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- Load Cells & Pressure Gages
- Displacement Transducers
- Instrumentation & Accessories

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- Air Velocity Indicators
- Turbine/Paddlewheel Systems
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- Immersion & Band Heaters
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- Laboratory Heaters

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- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments

M3670/0916